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Cover picture: A view of Lake Sompiojärvi towards southeast from the summit of the Pyhänattanen fell. - Photo: Mauri Hirvenoja.

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BIOLOGICAL STUDIES IN THE OLD SOMPIOJÄRVI AND THE LOKKA RESERVOIR

Editor
JUHA VIRAMO

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Preface 1

During the 1950 decade the Kemijoki Oy planned several hydroelectric power dams in northern Finland ("Forest Lapland"). Consequently, the Finnish League of Nature Protection organized several field studies, especially from the shrinking areas of the historical "Sompio Lapland". The largest impoundment in Finland, Lokka, was inundated in the 1970's.

The author did hydrobiological studies on the water bodies of the Lokka Reservoir watershed during the summers of 1959-61, continuing methodical comparable studies, which were made in southern Finland during 1953-57. Due to economic constraints the collected materials were never examined in complete detail. However, in preliminary studies on the macrobenthic fauna 22 species new to science were described from the Sompio area, highlighting our here-to-fore meagre knowledge of the aquatic fauna of the area.

Among the three shallow lakes of the water bodies studied, the peculiar nature of Sompiojärvi became apparent during these studies. This lake, famous from the time of the ancient Saami, was prior to that time, of an unknown typology. The late Professor Martti Salmi (Geological Survey of Finland) published in 1963 paleobotanical studies of some sites in northern Finland, including Sompiojärvi. The author obtained subsamples of Professor Salmi's cores to acquire greater familiarity with the area's prehistory.

Unfortunately, due to press of other duties, these subsamples were not completely sorted for larval midge head capsules (Chironomidae, Diptera) until the 1980's.

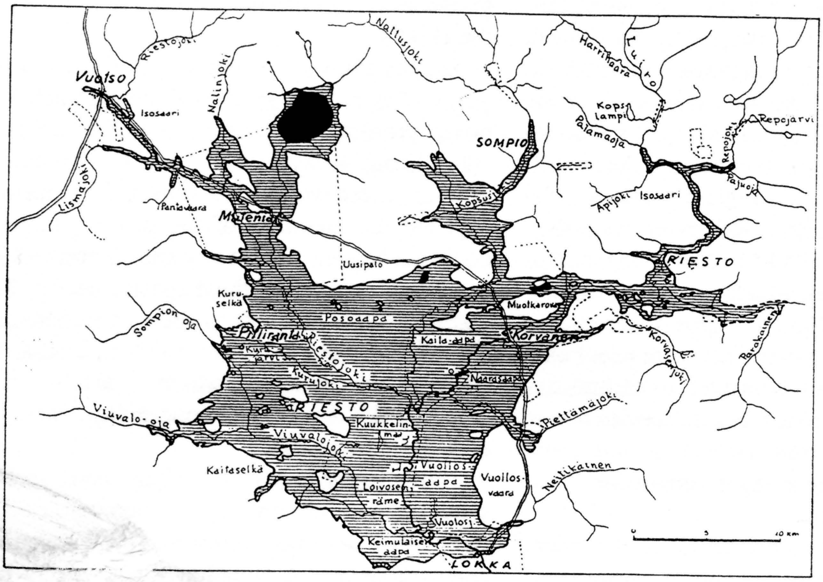
In June 1984 on a trip to Lokka Reservoir with a group of hydrobiology students an unforeseen taxonomic problem arose. Lokka is a *Chironomus*-type lake. About 40 species of adult Chironomidae in several genera were netted during the student field trip, but the members of the genus *Chironomus*, could not be identified to any known northern European species. Most of these species need still to be clarified. Later attempts to collect additional material of *Chironomus* found 1984 at Lokka, were, however, not productive which leads to the conclusion that the reservoir is undergoing gradually an ecological succession.

In the paper about the Lokka shore pools presented in in the present issue the taxonomic difficulties with the genus *Chironomus* were somewhat comparable to the situation found in the Lokka Reservoir proper.

It is necessary in paleolimnological studies, which deals, for the most part, with poorly preserved subfossils to work, in many instances to work at the generic level only. However, to understand significant changes in the overall biodiversity of the many aquatic biotopes, both in paleozoology and neozoology, emphasis must be placed on species-level taxonomy.

Vantaa, September 3, 1998

Mauri Hirvenoja



Lokka Reservoir at its maximum pool level (Castrén 1958). The pre-impoundment lakes Sompiojärvi, Posolampi and Seitajärvi which were studied are shown in black. The 1984-1995 study area is restricted mainly to the area which is south of the partly inundated village Mutenia in the northern part of the reservoir. The area has been dammed at the village Lokka, but since 1981 the waters have been diverted through the Vuotso Channel to Porttipahta, the next impoundment.

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Oulanka Reports 18: 7—35. 1998

The history of Sompiojärvi and Mustajärvi, *Corynocera ambigua* lakes in northern Finland, in light of the subfossils of Chironomidae (Diptera)

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Hirvenoja, M. 1998: The history of Sompiojärvi and Mustajärvi, *Corynocera ambigua* lakes in northern Finland, in light of the subfossils of Chironomidae (Diptera). — Oulanka Reports 18: 7—35. ISSN 0358-3651.

Changes in chironomid taxocoenoses were studied using cores from lakes Sompiojärvi and Mustajärvi, lakes in northern Finland, which during their history often were predominated by *Corynocera ambiqua* Zetterstedt. Pollen diagrams from Sompiojärvi have been presented by Salmi (1963). Undisputed direct ^{14}C datings are not available for these cores. The ages of the chironomid phases were also estimated from descriptions of earlier climates in the literature. The variations in taxocoenoses of the chironomids seem to correlate with climate, indicating that during cold periods the species living in oligotrophic and/or cool recent waters of different kinds predominated, whereas during the warm and dry periods the abundance of the species predominating in recent more-or-less eutrophic waters increased. The polyoxyphilous, mesothermous species *C. ambiqua* benefits from cool and/or rainy conditions. The results agree with some earlier views about deglaciation in northern Finland, but as far as past early phases they contradict recent opinions.

Key words: Paleolimnology, climatic changes, hydrobiology, Chironomidae (Diptera).

Introduction

Datings of the past periods belong to the most important, but also to the most difficult tasks in the paleobiological studies. Salmi (1963) presented pollen diagrams of the Lake Sompiojärvi (1959 water depth < 2 m, diameter about 4 km) in Sodankylä (68°05´N, 27°30'E) and of the bog Kalkkarovuoma, Kittilä (67°40´N, 25°15'E), northern Finland (Fig. 1). A piece of birch wood was found from the bottom of the Tanka-aapa bog, which lies about 20 km NW of Sompiojärvi. By ^{14}C dating, its age was determined to be 6340 ± 200 B.C. (Hyyppä et al. 1962). Comparing Hyyppä´s unpublished pollen diagram from the Tanka-aapa bog to that of Sompio-

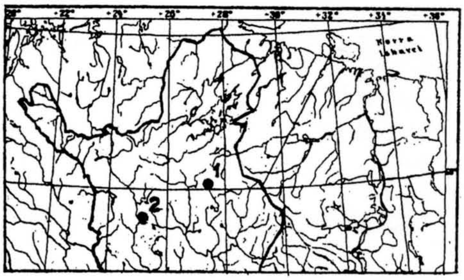

Fig. 1. Localities investigated by Salmi (1963). 1. Sompiojärvi, 2. Kittilä: Kalkkarovuoma and Mustajärvi.

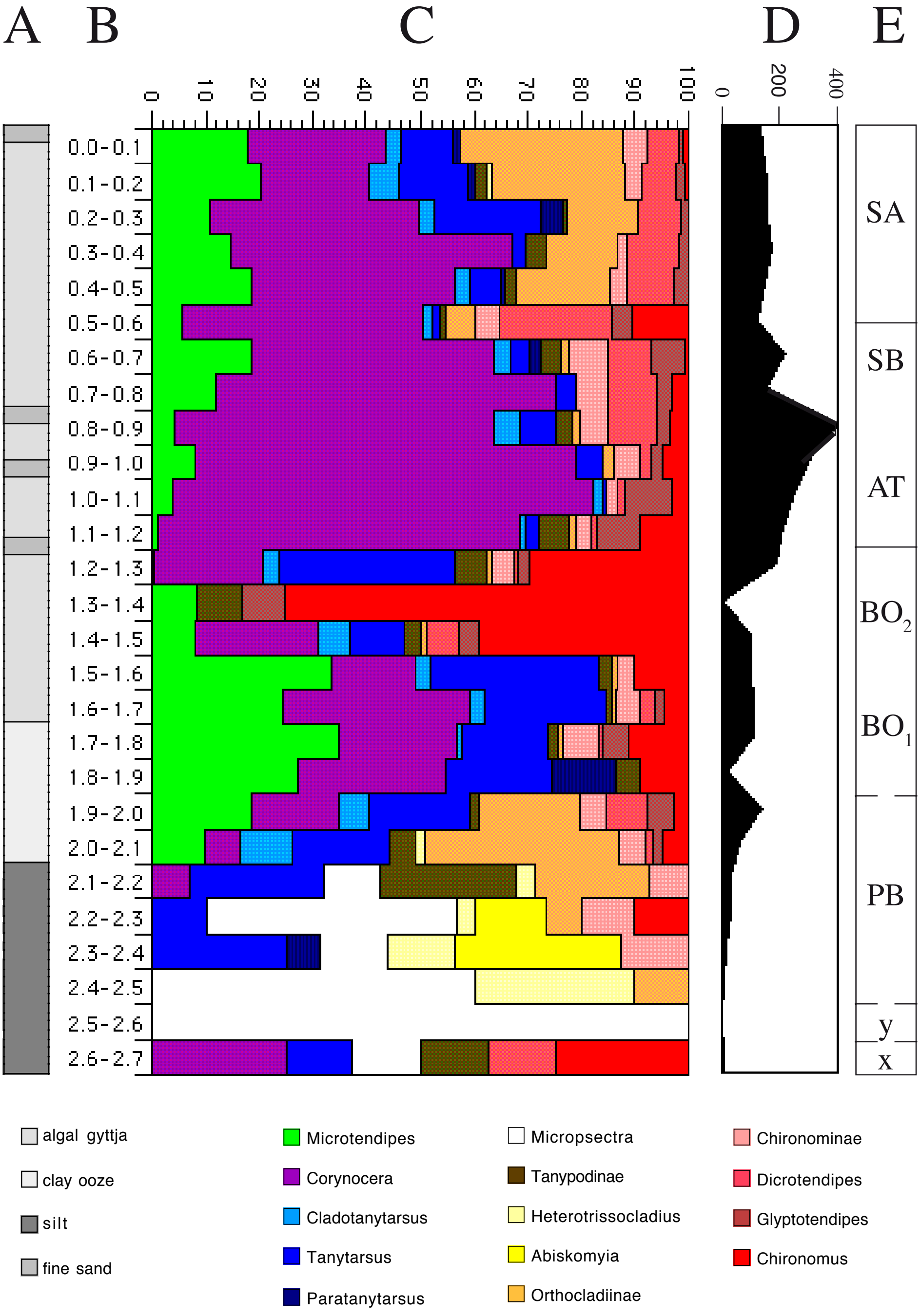

Fig. 2. Development of chironomid taxocoenoses in Sompiojärvi.
A. Sediments (redrawn from Salmi 1963); B. Depth in m; C. Relative abudance of the most abudant taxa; D. Number of head capsules found per about 20 ml dry sediment (exception: depth 0.8-0.9 m); E. Suggested chronozones (in this column x = first relatively warm period, y = includes obviously also the period of the extinction of all chironomids).

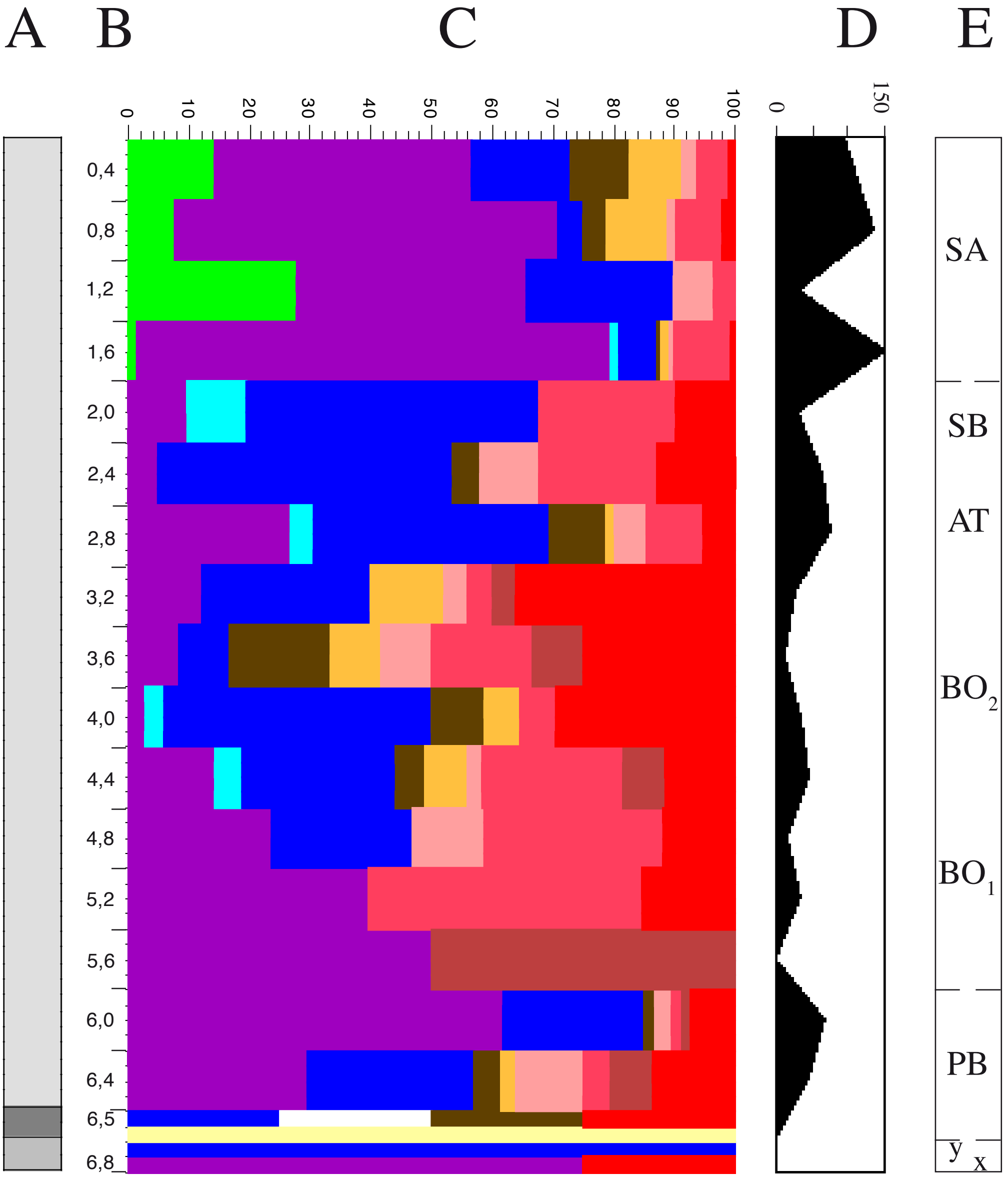

Fig. 3. Development of chironomid taxocoenoses in Mustajärvi.
A. Column of sediments according to Salmi (1965). Explanations otherwise as in Fig. 2.

järvi, Salmi (1963: 108) concluded that the niveau of the birch corresponds to the 1.2 m level of the Sompiojärvi profile.

According to Donner (1971: 290) the upper boundary of the Birch Regional P.A.Z. in Sodankylä is c. 8 400 B.P. The upper boundary of Birch Regional P.A.Z. in the sediment core of Sompiojärvi (Salmi 1963; see Appendix II) is at about 1.1 m. Thus the 1.1-1.2 m level of the core of Sompiojärvi based on this fact and on the age of the piece of birch should be roughly near the end of the Boreal period. Salmi (1963: 110) supposed that the lower part of the Sompiojärvi pollen diagram belongs to the end of the Younger Dryas stadial. Pieces from the same core collected by Salmi (1963) have been studied for the present paper to observe the changes in chironomid taxocoenose after deglaciation (for definition of taxocoenose, see Chodorowski 1960).

Later Salmi (1965) published ^{14}C-datings for the small (diameter <0.5 km) Lake Mustajärvi, lying 15 km eastwards from the church of Kittilä (järvi = lake; often called Mustalampi, lampi = tarn, for instance in Donner & Jungner 1974). The 14C dates given by Salmi for Mustajärvi are as follows:

4.4 m	8060 ± 140 B.C.	(T- 409)
5.2 m	8120 ± 150 B.C.	(T - 408)
6.4 m	10740 ± 190 B.C.	(T - 407)

Sorsa (1965: 353-354) compared and discussed among others the pollen diagram he prepared from Tankavaara (not far from the Tanka-aapa bog mentioned above) with that of Sompiojärvi presented by Salmi (1963). According to Sorsa (1965: 391) the lowermost layers of Sompiojärvi described by Salmi (1963; see Appendix I) corresponded to the Younger Dryas deposits of the localities in his study. He also gave several other pollen diagramms and datings from eastern Lapland, the oldest of them (I-1 140) 12 350 ± 400 B.P (10 400 B.C.) from a tarn Aapalampi, Salla. Very old radiocarbon datings were obtained also in the studies of Lappalainen (1970) from the bogs of the Kittilä, Sodankylä, and Pelkosenniemi areas south of Sompiojärvi.

The oldest ages mentioned from northern Finland were critically evaluated by Donner (1971), Donner et al. (1971) and Donner & Jungner (1974). The hard-water effect or redeposited organic matters were suggested to be especially important sources of errors.

Material and methods

Dried pieces, with depth intervals of 10 cm from a Sompiojärvi core sample were received from Professor Martti Salmi (The Geological Survey of Finland) as well as pieces from Mustajärvi at intervals of 40 cm; from the latter lake the 4 lowermost samples at intervals of 10 cm were available (cf. Figs. 2 and 3). The studied core of Mustajärvi is more difficult to date and compare than that of Sompiojärvi because of the long distances of the sites in the profile, but it has been used in the present paper, because it roughly shows that the changes seen in the profile of Sompiojärvi are not only local events.

The dried sediment pieces were boiled or held in a KOH solution some hours or even several days and dispersed with a magnet stirrer in at a temperature of about 60°C. Most pieces from Sompiojärvi were, however, possible to decompose slowly after addition of tri-sodium orthophosphate, too (Warwick 1980: 106). The dissolved material was washed in a sieve (<100 µm), and the head capsules were gathered with the aid of a binocular microscope and mounted in Euparal on microscope slides.

Between 2.7 m and 2.1 m the sediment of the Lake Sompiojärvi comprises silt, between 2.1 m and 1.7 m clay gyttja. The upper sediment (algae gyttja) of Sompiojärvi was called *Pediastrum* ooze by Salmi (1963: 107, cf. Fig. 4). This is intercalated in Sompiojärvi by obviously alluvial layers of fine sand. The pH value varies from 6.4 (bottom) to 5.8 (uppermost ooze).

In Mustajärvi (see Salmi 1965) the lowermost layer on the till surface is sand between 6.8 m and 6.6 m, silt between 6.6 m and 6.4 m and *Pediastrum* gyttja (with shells of molluscs) above 6.4 m. The organic sediment of Mustajärvi is thus about twice as thick as that of Sompiojärvi, but the inorganic sediment is relatively thin.

The potential chironomid fauna of the study area

Change in climate is obviously the most prominent factor in the development of the fauna of the lakes studied. The investigation of past climates with the aid of subfossil insects has a long tradition (cf. Coope et al. 1961), but recently the use of the chironomids has been criticized by Warner & Hann (1987) and also discussed by Walker & Mathewes

(1987,1989a, 1989b) or Warwick (1989). Much information exists in the literature, but some unpublished features known to the author are given here, as they are important to the interpretation of the results in the present paper.

The recent chironomid fauna of the Mustajärvi (Mustalampi) district (Kittilä) has not been sampled. Material from Sompiojärvi, and from several adjacent waters of the Sompio district (inundated under the present dam basin of Lokka), trapped by the author with funnel and cage traps from May to September 1959-61 is abundantly available but not completely studied. (The chironomid material has more or less completely been treated by P. Böhling, J. Tuiskunen, V. Myllys and the author.) From each of the 3 small littoral lakes of this area approximately hundred species of chironomids were captured. Less than 30 % of the taxa found in the recent assemblages of Sompiojärvi have been considered from the taxocoenoses in the core samples of this lake.

Tanypodinae

In the recent fauna adults of *Ablabesmyia* Johannsen (2), *Conchapelopia* Fittkau (1), *Macropelopia* Thienemann (1) and *Procladius* Skuse (6 species) were present in Sompiojärvi. Most of the subfossils of the Tanypodinae belonged probably to *Procladius*.

Orthocladiinae (s. l.)

Abiskomyia Edwards

Abiskomyia virgo Edwards is the only known species of this genus in Finland; *A. paravirgo* Goetghebuer is known only from the streams of north Sweden. Therefore the head capsules found in the sediment of Sompiojärvi between 2.2 m and 2.4 m belong with great probability to *A. virgo.* It was not found in the fauna of the 3 lakes studied in the Sompio district sampled 1959-1961. Lindeberg (1974: 157-161) found a bisexual recent population in Finland from Lake Inari, about 100 km north of Sompiojärvi. Inari belongs today to the (Birch -) Pine vegetational zone (see Kalliola 1973 Fig. 86, Hyvärinen 1987: Fig. 2, Eronen 1987 Fig. 2), and lies a little north of the northern forest limit of *Picea*, but south of the tree limit of *Picea* (cf. Tolonen 1983). Inari thaws in spring approximately 2-3 weeks later than Sompiojärvi.

All known records of *A. virgo* from Swedish Lappland are parthenogenetic (Säwedal 1978). Thienemann (1941) reported the occurrence of *Abiskomyia* in three lakes of northern Sweden, two of which were from the alpine region; according to him, this species is known only north of the polar circle. The highest temperature, which he mentions as for the littoral water of the alpine Lake Katterjaure, was 13.5° (7.7.1937). The littoral water temperature from Lake Abiskojaure (birch region) was according to him even 18.6° on 23.7.1937. In contrast 1959-60 in Sompiojärvi where *Abiskomyia* was not found, the highest water temperature 23.5°C was measured on 8.7.1959 by the present writer. *A. virgo* thus very probably can be considered as an oligothermous (? perhaps oligoeurythermous, cf. Illies 1971: 12-13) species.

The adults of *A.virgo* are epineustal swarmers, which do not leave the water surface (Lindeberg 1974). *Corynocera ambigua* Zetterstedt has a quite similar pattern of behaviour, whirling on the surface during the copulation in "tandem", 1-2 males with a female individual (cf. Hirvenoja 1960b: 161-162). *Abiskomyia* occurred abundantly in the core samples of Sompiojärvi during an early phase (2.4-2.2 m) of the lake history, when *Corynocera* was absent from the lake. Their occurrence in early Sompiojärvi seems to resemble vicariance which it is not. Both species can also coexist in the lakes of the birch region (Thienemann 1941, sub *Corynocera crassipes* Zetterstedt). Tuiskunen & Lindeberg (1986) also report both species from the lakes Inari (birch-pine) and Kilpisjärvi (boundary of the birch and alpine region) in Finland. The living habit of the larvae are different: the larvae of *Abiskomyia* have movable cases, whereas those of *Corynocera* are tube dwellers.

Heterotrissocladius Spärck

H. marcidus (Walker) is the only species found in the 1959-61 studied springs, brooks, rivers and lakes of the Sompio district. It occurs abundantly in krenal (c. 5-10°C) or in hypokrenal/epirhithral running waters (up to ca 18°C), often even on a pure mud (dy) bottom in northern as well as in southern Finland (unpublished data of the present author). It may occasionally be found also on the littoral of the lakes.

For instance 5 indiviuals emerged 1959 in Sompiojärvi near the inlet of a small spring brook on the silt bottom into a tent trap. (About 60 000 individuals of Chironomidae were capured with funnel and tent traps in May - September 1959 from different parts of this lake.) *H. marcidus* emerged also from a rivulet (Kuusioja) near the Lake Sompiojärvi in a place where the water temperature on the surface was as high as 21.5°C; near the bottom at this site, however, probably because of the mixed ground water, it was <11.2°C (at a depth of 1.5 m). Important for the temperature indicating value of *Heterotrissocladius* is its relative abundance in comparison to the other species of chironomidae. Thienemann (1941: 174) pointed out the absence of *Heterotrissocladius* in the lakes of northern Germany, but reported the occurrence of the genus in springs and brooks and also in the shores of mountain lakes. *H. marcidus* can obviously be considered as an oligo-eurythermous species.

The subfossil remnants of *Heterotrissocladius* from the lowermost sediments of Sompiojärvi or Mustajärvi can be determined only at the generic level because of the bad condition of the few head capsules found. Because they occur on the mineral sediment during the early phases, but the number decreases as the eurythermous taxa increase, even *H. subpilosus* might be the species in the lowermost layers.

Cricotopus van der Wulp

Quite a few subfossil remnants of this genus were identified in the core samples. From the samples of 1959-60, in contrarst, 13 species were more or less abundantly present (Hirvenoja 1973), often each on its specific littoral areas of Sompiojärvi proper.

Orthocladius van der Wulp

O. (Pogonocladius) consobrinus (Holmgren) was emerging abundantly (up to about 650 ind./m^2) in recent (1959-60) Sompiojärvi from the centre of the lake quite soon after *Corynocera ambigua* (about 10 000-12 000 ind./m^2), at the beginning of June. In the uppermost core sample it comprised 0.9 % of the head capsules found, but in one Late Preboreal core sample (1.9-2.0 m) 3.9 % of the head capsules. Few adults of other species of *Orthocladius* were emerged in 1959-60. The genus was usually rare in the core samples.

Psectrocladius Kieffer

Remnants of *Psectrocladius* were often present throughout the sediments of Mustajärvi. In Sompiojärvi there are two periods with more remarkable abundances of head capsules belonging to this genus. The first occurrence was during the suggested Preboreal period, where the most important species was *P. septentrionalis* Chernovski (1949), a species originally described from northern Russia and known obviously still only as a larva (Pankratova 1970). (The larvae should be reared as adults to combine the possible known adult with immature stages.) This species has probably been distributed over Fennoscandia and has been reported among others from Norway (Raddum & Saether 1981). Only a few head capsules of *P. septentrionalis* were found in the Subatlantic Orthocladinae assemblage, where other species of *Psectrocladius* were important. In the Sompiojärvi area, *P. barbimanus* (Edwards) occurred in 1959 near the outlet of the hypokrenal rivulet Kotaoja. Other fauna recently known from Lake Sompiojärvi proper (adult specimens) consisted of 3 common species of *P. calcaratus* (Edwards), *P, fennicus* Storå, *P. limbatellus* (Holmgren) and of the very rare *C. psilopterus* Kieffer. Brodin (1986) also reports *P. septentrionalis* from the Late Preboreal sediments in Lake Flarken, southern Sweden, but Olander (1992) found it quite abundant from the uppermost layers of Lake Orajärvi, southern Finland.

Zalutschia Lipina

Z. tornetraeskensis Edwards was caught in Sompiojärvi 1959-60 especially on the side of the fells of Nattastunturit. It was found in a preboreal core sample.

Chironominae, Chironomini

Chironomus Meigen

In the core samples of Sompiojärvi at least 3 different types of hypochilum (Gouin 1957) occur in the head capsules, which are often (if not worn down) distinguishable from each other. They may, however, belong to many species. Some speculations as to the possibilities are given below.

Chironomus sp. type 1. - In the hypochilum the apex of the median tooth reaches to the level as the apices of the second laterals (counted from the median tooth). Such type has been illustrated in Pinder & Reiss (1983: 357, Fig. 10.6, A). This larval type occurs especially in the lower sediment layers, but is not clearly present for instance in the layer between 1.4 m and 1.3 m of Sompiojärvi, during the highest relative dominance of the genus *Chironomus* at the culmination of the suggested very warm end of the Boreal period.

Chironomus sp. type 2. - The hypochilum of type 2 is similar to that of the type 1, but the median tooth is shorter. It is possible that the sp. type 2 is *C.entis* Shobanov (cf. Shobanov 1989), but the existence of several similar species is probable.

Chironomus sp. type 3. - This type of hypochilum is often mentioned in the literature as belonging to the *anthracinus* larval type. The hypochilum of the species belonging to the *aberratus* larval group or *salinarius* larval type (cf. Andersen 1937, Wülker 1973, 1991, Michailova 1992) may easily be confused to that of *C. anthracinus*. The relative abundance of this type increases during the Late Boreal period.

Cladopelma Kieffer

C. viridula Linnaeus was quite abundant 1959 in Sompiojärvi and might well be the species which appeared occasionally in the core samples beginning from the early Boreal times.

Cryptochironomus Kieffer

C. redekei (Kruseman) and *C. supplicans* (Meigen) occurred in 1959-60 samples from Sompiojärvi. The genus appears in the core samples contemporaneously with *Corynocera ambigua* at 2.1-2.2 m at the beginning of the Late Preboreal period.

Dicrotendipes Kieffer

D. pulsus (Walker) and *D. lobiger* (Kieffer) occurred 1959-60 in Sompiojärvi. Some few individuals of *D. pulsus* emerged during the first days of June 1959, when the water temperature was about 10°C, but most (with the first individuals of *D. lobiger*) around 10.6.1959 when the surface water temperature had for several days been about 15°C. Most individuals of *Corynocera ambigua* had already emerged, in contrast, at the same stations in surface water temperatures of (5-)8-10°C. The genus belongs among the first inhabitants of Sompiojärvi. The majority of the remnants of the subfossil head capsules belonged obviously to *D.pulsus.*

Endochironomus Kieffer

E. albipennis (Meigen) and *E. tendens* (Fabricius) belonged to the recent fauna of Sompiojärvi. The genus was very rare in the core, but appeared first at the beginning of the Boreal period.

Glyptotendipes Kieffer

G. paripes (Edwards) and *G. gripekoveni* Kieffer occurred in recent samples from Sompiojärvi and in adjacent lakes; the genus is in the cores beginning from the Late Preboreal.

Microtendipes Kieffer

M. nigellus Hirvenoja (1963) was the predominant species ("mass occurrence") in the profundal (dy, <2.5 m) of Lake Seitajärvi, not far from Sompiojärvi, and existed in all of the lakes studied in 1959-61 in the Sompio area as well as in the littoral of the Lokka reservoir of our era. In one running water station with a very slow flow of current on the sand bottom also *M. chloris* (Meigen) and in two other on the mud bottom *M. lugubris* Kieffer were found and thus the both latter species are not excluded from the possible species of the core samples. The relative abundance of the genus (green in Figs. 1-2) probably shows the relative importance of the littoral areas for the taxocoenoses of the lakes.

Parachironomus Lenz

Four species occurred in 1959-60 samples from Sompiojärvi. Some occasionally found head capsules in the Subatlantic layers may belong to this genus.

Paratendipes Kieffer

Paratendipes albimanus (Meigen) occurred in the recent Sompiojärvi, but was found only once in a suggested Subatlantic core sample.

Phaenopsectra Kieffer

P. flavipes (Meigen) was quite abundant in 1959-60 samples from Sompiojärvi and may well be the species found occasionally in the core samples, first during the 3rd or *Abiskomyia* phase.

Polypedilum (Kieffer)

Six species occurred in 1959-60 samples from Sompiojärvi. Head capsules were found in the core occasionally, the first at the beginning of the 4th chironomid phase.

Chironominae, Pseudochironomini

Pseudochironomus Malloch

Few individuals of *P. prasinatus* were found near the shores in recent samples from Sompiojärvi. Four head capsules (2.3 % of the total) were found between 0.6 and 0.7 m from the suggested Subboreal layers.

Chironominae, Tanytarsini

Cladotanytarsus Kieffer

Five species are known from 1959-60 samples from Sompiojärvi; some of them are described as new (Hirvenoja 1962). The larvae are, however, unknown. This genus appeared in the sediments during the suggested Late Preboreal period.

Corynocera Zetterstedt

C. ambigua Zetterstedt has been in Sompiojärvi the most prominent member throughout the whole history of the lake. It was present in the lowermost sediment (2.7-2.6 m), but no head capsules were found between 2.6 m and 2.2 m (2nd and 3rd chironomid phases with characteristic species *Micropsecra radialis, Heterotrissocladius* sp., *Corynocera oliveri* and *Abiskomyia ? virgo*) or between 1.3 m and 1.4 m (the suggested dry and warm end of a *Chironomus* phase).

Brundin (1949: 784) supposed that *C. ambigua* is a northern species, whose larvae are eurythermous and the pupae coldstenothermous. Up to now it has been found cicumboreal and also in quite southern latitudes (cf. the survey of the literature by Walker & Mathewes 1988: 747). Certain features of its biology have connected its occurrence especially with the northern latitudes and/or the early stages of deglaciated lakes in the northern hemisphere.

According to Mothes (1968) the adult larvae die very soon at room temperature; the optimum for the species is perhaps just that of the mesothermous (Illies 1971: 12-13) conditions. Such conditions prevailed 1959-60 in Sompiojärvi, where the mean summer temperature was 14.5-15°C (manual measurements from about 14:00 to 17:00 from 7-11 stations around the lake every day). The temperature varied from July 18 to July 25 and again from August 15 to August 19 between 18.6°C and 23.5°C and were mostly over 20°C, which may be a limiting factor for many psychrophilous species. The mean monthly temperatures of the surface water in Sompiojärvi from 23. June 1959 (the last small ice chunks were present) to 15. September 1959 (when the temperature of the water was again about 5°C; the first transient ice cover was on 22. September 1959) were as follows (°C):

May	June	July	August	September
6.8	14.2	15.9	14.7	8.6

When the first adults appeared, the water temperature in Sompiojärvi was 5-7°C, corresponding to that of Brundin´s (1949) observations on the pupae. This is lower than the required temperature for the emergence of many other aquatic insects. When the peak of the emergence in Sompiojärvi took place, the water temperature was about 10°C or higher. *C. ambigua* was not found during the studies in the Sompio area1959-61 in the springs (akratopegs). Moreover the influence of cold krenal waters appeared to be negative (cf. Hirvenoja 1960: 158-159). These observations refer also to the fact that the larva of *C. ambigua* is a mesothermous species, the optimum for which is clearly higher than for instance that of *Abiskomyia*.

Mothes (1968) suggests that in Lake Nehmitzsee, Germany, *C. ambigua* is aestivating as eggs, the ecclosion happens in September and the larvae grow up during the winter months. (He, however, did not rear the eggs. It would be worthwhile to study whether the aestivation as smooth eggs for several months is possible.) In Sompiojärvi full grown larvae of the new generation were already to be found in the hitherto examined bottom samples in August 1959. Fjellberg (1972) supposes a two-year life cycle for this species as possible at Lake Omkjelvann, (1 200 m a.s.l., midle alpine zone) southwestern Norway.

Mothes (1968) also discussed the feeding habits of *C. ambigua*. He mentioned that lakes with *Corynocera* have a high transparency and abundant submerged vegetation, and furthermore low planctic primary production and consumption of oxygen. He suggested that during the growing period in winter, larvae eat organic detritus, which originates from the dead Characeae. An earlier paper of the present author (Hirvenoja 1961: 109) commented on opinions expressed in the literature concerning the coexistence of Characeae and *C. ambigua*, and suggested with regard to the sparse distribution of *Nitella* in Sompiojärvi, that the coexistence probably "indicates a similarity in their physical and chemical requirements rather than the dependence of the midge on the Characeae as food". In the shallow Sompiojärvi, *Sparganium angustifolium* was abundant throughout the lake (Fig. 2 in Salmi 1963). Its importance to *C. ambigua* as a food or substratum is unknown, but in Seitajärvi, the nearest lake to Sompiojärvi, a small number of adults of *Corynocera* had (1960) emerged only in the restricted part of the lake, where *Sparganium* was growing. The bottom of Seitajärvi consisted of loose mud (dy), and no Characeae were found in this lake.

Walker & Mathewes (1988: 747-749) have recently also discussed this matter. Therefore the alimentary canals of some larvae from Sompiojärvi preserved in alcohol (1959-60) were opened. The gut contents of these larvae obviously consisted of the algal gyttja of which the bottom of this lake consisted and where different kinds of small algae were discernible in abundance. Fjellberg (1972) also reports at Omkjelvann, Norway, the gut contents consisting of detritus and mineral grains.

The water of the shallow Sompiojärvi was at least 1959-60 during the studies constantly turbid because of the wave action and the loose algal gyttja. From the Characeae, *Nitella flexilis* was very sparse in Sompiojärvi 1959-1960, but oospores already existed in the sediment abundantly between 2.0 m and 1.9 m, immediately after the reappearance of *C. ambigua* in the core samples (cf. Fig. 1). Pollen of *Sparganium* occurs first at about 2.3 m and that of of Potamogeton about 10 cm higher up (cf. Salmi 1963, Fig. 4); *C. ambigua* reappears between 2.2 m and 2.1 m. In Mustajärvi the reoccurrence of *C. ambigua* coincides with the lowermost layer of algal gyttja. This refers to the generally increasing primary production resulting from the rising temperature; both phenomenons obviously benefit the increasing abundance of *C. ambigua*.

From 1959-61 in the Sompio area lakes studied no individuals of *C. ambigua* were found in Lake Posolampi with its bottom being of mud (dy) and peat but totally without *Sparganium*. The relative primary production of the planctic algae is perhaps also correlated with the maximal summer pH values for the water: Sompiojärvi <pH 7.8, Seitajärvi <pH 7.0 and Posolampi <pH 6.5.

C. ambigua obviously benefits from increasing organic matter if the water is well oxygenated. The lavaret (*Coregonus lavaretus*) found earlier was in 1960 not able to live in the above mentioned Lake Seitajärvi (depth <2.5 m) probably because of its low oxygen content in winter. The opinion exists in the literature, that *Corynocera* is polyoxybiont, which thus may be somewhat an overestimation, but considering it as a polyoxyphilous species might perhaps better hit upon the right thing.

Abiskomyia existed in abundance particularly in the core samples of Sompiojärvi, when *C. ambigua* was absent. As mentioned in the discussion about *Abiskomyia*, the latter species occurs in Sweden also and especially in the alpine region, but both species also coexist in Sweden and Finland. Fjellberg (1972) observed a late swarming of *C. ambigua* at Lake Omkjelvann (1 200 m a.s.l., middle alpine zone) Norway on 8 September 1971. The swarming was possible because of two warm days. In Sompiojärvi it emerges in early spring only, but Fjellberg suggests even the possibility of a semivoltine life cycle.

Corynocera oliveri Lindeberg

This species was originally described from shwedish Lapland and Norway (Finnmark) (Lindeberg 1970). Later Tuiskunen & Lindeberg (1986) reported it from Kilpisjärvi, Finland, near the Norwegian and Shwedish borders. The area of the Lake Kilpisjärvi in the most NW corner of Finland, belongs, according to Hyvärinen (1987 Fig. 2) or Eronen (1987 Fig. 2), to the treeless zone not far from the mountain birch woodland and scrub zone; there are still abundant mountain birch strips remaining around the lake. In the sediment of Sompiojärvi a Tanytarsiini, suggested as being *C. oliveri*, coexisted with *Abiskomyia* beetween 2.2 m and 2.4 m, but was not found in the fauna of the waters of the Sompio area in 1959-1961. It was also found in the core of Mustajärvi at 6.4 m. The determination is a little uncertain, because every hypochilum of the head capsules was worn out, but they agree with the illustration of Hofmann (1984b Fig 1: 2). The head capsules originally described for the larvae were found by Hofmann (1984b) from the deposits of the Oldest Dryas of the Lake Lobsigensee, Swiss Plateau, from which *C. oliveri* disappeared after this period; according to Hofmann it also exists as a frequent species throughout a sediment core from Greenland.

Micropsectra Kieffer

M. (Lauterbornia) radialis Goetghebuer (= *L. coracina* Kieffer), which has a wide palearctic distribution, was found in the lowermost core samples of Sompiojärvi.This species, being stenobathic, inhabits according to Brundin (1949: 786; 1956:190) only the profundal of the deep, stratified, well oxygenated oligotrophic lakes in Europe or in very shallow lakes or ponds in the Arctic region. According to Thienemann (1915: 26) the temperature in the profundal of Central European Eifelmaare near the end of the summer stagnation reaches as high as 4.0-4.8°C. The water temperatures on arctic islands (Rakusa-Suszczewski 1963), where a July mean air temperature stays under 5°C, vary within the ranges of those found in springs (akratopegs; <10°C) in Finland. Thienemann (1941, sub *Lauterbornia gracilenta* Holmgren) further reports its mass occurrence in some lakes of the alpine region in North Sweden and lists the distribution as up to Spitsbergen, Bear Island, Novaya Zemlya, Island Vaygach and the New Siberian Islands.

Many species of *Micropsectra* are more or less psychrophilous, but at least the larvae of *M. radialis* are obviously oligostenothermous. In a limnokren near Sompiojärvi (Hirvenoja 1960b, Station 1 in Fig. 1) with a sand bottom and without mud *M. apposita* (Walker), *M. recurvata* (Goetghebuer) and *M. radialis* were the most important species, but M. radialis was found 1959-61 in contrast to the others only in this spring studied on the Sompio area. The temperature on the bottom (depth 2 m) was probably allways under +5°C. The mean and variation range of the surface water temperature corresponding to the manual measurements of lake temperatures given before (p. 14), were as follows (°C):

May	June	July
3.7	7.4	8.6
(3.0-4.5)	(4.5-9.5)	(7.0-11.3)

August	September
8.0	4.5
(6.0-10.0)	(3.5-6.0)

There is a certain risk to use the name *M. radialis*. The subfossil remnants of the found quite large head capsules (some clearly with bidentate premandibles) have in the present study been located under this name to differ them at least from the oligoeyrythermous species, whose antennal projections are more or less conspicuous. For the present author are unknown other species of *Micropsectra* with equally small apical projections on the antennal sockets of the larvae as in *M. radialis* except *M. (Lundstroemia) fusca* (Meigen), which has none. Few individuals of *M. junci* Meigen were 1959 found near the inlet of a small springbrook in recent (1959-60) Sompiojärvi. In the rivulet Kuusioja, flowing to Sompiojärvi, with its mud bottom and mixed ground waters a few individuals of *M. groenlandica* Andersen were captured.

Paratanytarsus Bause

P. hyperboreus (Staeger) and *P. penicillatus* (Goetghebuer) occurred in Sompiojärvi 1959 at the stations where cold krenal waters were mixing with the lake water, but *P. intricatus* (Goetghebuer) was common also in warmer waters. This makes the generic name quite indifferent in this respect as an indicator.

Stempellina Bause

S. bausei (Kieffer) was determinable at the end of the Boreal period, some single ?*Stempellina* capsules later; the material is included in Figures 1 and 2 to *Tanytarsus* spp.

Tanytarsus van der Wulp

In many papers some larval types of the genus *Tanytarsus* have been determined; this has been avoided in the present paper as a quite uncertain task with the 14 species known from the 1959-60 Sompiojärvi studies.

Succession of chironomid phases in Sompiojärvi and Mustajärvi

Because direct datings for the sediment layers studied are not available, it is necessary to describe first the succession of the faunas as far as is possible to determine the species and then to try to determine the periods to which they are likely to belong. Despite the differences between the lakes, the structure of the chironomid taxocoenoses and their changes are similar enough in both of the lakes to allow discussion of them together. Both lakes obviously undergo approximately the same, often similar phases described below, and it is obvious that their characteristic species are obviously widely common to them both.

1st phase with *Corynocera ambigua*

Sompiojärvi between 2.7 m and 2.6 m
In Mustajärvi at 6.8 (?-6.7) m

A *Chironomus-Corynocera* assemblage was found in the lowermost layer of both lakes. In the sample from Sompiojärvi, besides *Corynocera*, meso-eurythermous *Dicrotendipes* sp., oligostenothermous *Micropsectra radialis, Tanytarsus* sp. (?spp.) and a Tanypodinae sp. are present; the head capsule of *Chironomus* belongs to type 3. Mustajärvi, about 90-100 km SW of Sompiojärvi, had during this phase a more sparse fauna, obviously because this lake was nearer the large glacier, which melted later in western than in eastern Lapland. The head capsule of *Chironomus* obviously does not belong to the same species in Mustajärvi as in Sompiojärvi. This oldest fauna of Sompiojärvi reappears after 0.4 m sedimentation and that of Mustajärvi after 0.3 m sedimentation.

The summer water temperatures during the first chironomid phase in Sompiojärvi should have approached near 10°C, because most chironomids (and many other aquatic insects) do not emerge according to the experience in Finland in waters under 8-10°C. The restricted fauna of the more western Mustajärvi refers to a short age as an open lake or to lower water temperature during this phase.

The populations of chironomid species were not dense probably because of the minerogenic sediment. In the literature the production after deglaciation has been described even as higher than it was later because of the nutrients released from the ice (cf. Økland 1975: 140-141). As reported by Brundin (1956: 199-200) from Lake Juvvatnet, Norway, the abundance of the benthon (as to the terminology benthal - benthon see Steffan 1965 and Fittkau 1976, 1977) was at its highest near the glacier obviously because of the allochtonous material melting from it. The change from the 1st to 2nd chironomid phase in the lakes studied here is in the structure of the taxocoenoses.

Walker & Mathewes (1988) reported from Hippa Lake, British Columbia, low chironomid numbers from the basal, mineral rich sediments but a very high concentration in the lowermost organic-rich sample. Brundin (1956: 193) mentions that arctic lakes do not have a dense bottom fauna. Very high numbers were reported by Brodin (1986) from the lowermost layer, immediately above the marine clay in Lake Flarken, south Sweden.

In the pollen diagram of Sompiojärvi (Salmi 1963 Fig. 4) *Pinus* and *Betula* (mostly *B. nana*) are almost equal; *Picea* and *Alnus* are more abundant than later. *Pediastrum tetras* was found by Salmi (1963 Fig. 8) only in the lowermost layer of Sompiojärvi. Furthermore pollen of *Typha* was present in the lowermost layer of the sediment (Salmi 1963 Fig. 4, cf. Sorsa 1965: 378), indicating a July mean of at least 12°C (Iversen 1954, Skre 1979, Kolstrup 1980).

2nd phase, ? extinction of the chironomids

Sompiojärvi 2.6-2.5 m
In Mustajärvi at 6.7 m

The most important feature in these layers was the lack of *Corynocera ambigua* and the most other members of the 1st phase. One head capsule of *Micropsectra* radialis was detected from the sample of Sompiojärvi, but the low number might refer to the extinction of all species for a period corresponding the sedimentation at this level. The head capsule of *Tanytarsus* sp. from Mustajärvi at 6.7 m may belong to the 1st phase in this lake.

M. radialis seems to be lacking in Mustajärvi. It occurs in arctic conditions mostly in the littoral of the lakes as is mentioned by Brundin (1956: 190, sub *Lauterbornia coracina*), its absence might perhaps be explained by the greater depth of the lowermost core samples of Mustajärvi than of those of Sompiojärvi. This is, however, not probable because the layer at 6.7 m may belong to the age of the 1st phase and that at 6.6 m into that of the 3rd phase?

In the pollen diagram of Sompiojärvi (Salmi 1963 Fig. 4) *Alnus* and *Picea* decrease at 2.6-2.5 m, but the latter is already increasing at 2.4 m. Pollen of all aquatic plants, including *Typha*, on the contrary, are absent during the 2nd chironomid phase.

3rd phase with components of the Scandinavian oroarctic fauna

Sompiojärvi 2.5-2.2 m
In Mustajärvi at 6.6-6.5 m

Corynocera ambigua was further absent from the core samples, but the diversity and the abundance beginn to increase. At 2.5-2.4 m of Sompiojärvi *Heterotrissocladius* sp. and ? *Orthocladius* sp. are associated with *M. radialis* (60 %, n = 10), obviously showing the beginning of an amelioration in thermal conditions. As a new species *Abiskomyia* occurred at 2.4-2.2 m of Sompiojärvi. The relative number of *Micropsectra radialis* increased again here at 2.2-2.3 m to 47 % indicating a transient colder climatic period at the end of the phase.

The first occurrence of *M. radialis* in the core of Mustajärvi coincided probably with that renewed somewhat colder period in Sompiojärvi (at 2.3-2.2 m). From both lakes a dark species of Tanytarsini with a broad (?worn-down) median tooth of the hypochilum, probably *Corynocera oliveri* was also associated with increased *Micropsectra*; this fact strengthens the impression of a new deterioration in climate at the end of the phase. *Abiskomyia* was not found in the samples of Mustajärvi, the fauna of which also later somewhat differed from that of Sompiojärvi.

The total number of head capsules of the chironomids begins to show signs of their increasing abundance in both lakes including, especially in Sompiojärvi, species of *Heterotrissocladius*, *Phaenopsectra*, *Chironomus* and some other Chironominae and further species of Tanypodinae and Orthocladiinae.

Sompiojärvi and Mustajärvi belong today to the northern boreal transcontinental subzone of the circumboreal zone (sensu Hämet-Ahti 1981). During the 2nd and 3rd chironomid phases members of the fauna (as far as is possible to determine species) of the arctic - oroarctic zone alone indicate colder conditions in these areas. As oroarctic elements, among identified species can be considered at least (? endemic in Fennoscandia) *Abiskomyia*, but also *Corynocera oliveri*, with much greater distribution, too; about the other taxa extending their distribution to the arctic zone see Thienemann (1941).

Based on the pollen diagram of Sompiojärvi (Salmi 1963 Fig. 4), the end of the 3rd chironomid phase (with the small transient cooling) coincides with the reduction in *Picea* and *Pinus* and an increase in NAP; at this depth (2.3 m) it also appears one decrease in the abundance of the species of *Pediastrum* (Salmi 1963 Fig. 8). At 2.3 m in Sompiojärvi 28 % of various *Pinnularia* species and 15 % of *Cymbella cuspidata* Küzing were present, according to Salmi (1963: 110), the latter species being according to Hustedt (1930: 357) common in fresh waters.

4th phase, beginning the new appearance of *Corynocera ambigua*, first abundance of Orthocladiinae in Sompiojärvi

Sompiojärvi, 2.2-1.9 m
Mustajärvi, 6.4-6.0 m; 14C dating for 6.4 m
10 740±190 B.C. by Salmi (1965). Donner &
Jungner (1974) considered the approximate ages
1 000-3 000 years too old because of the hard-
water effect.

The most important feature during the 4th phase were the reoccurrence of *Corynocera ambigua* and other species already found in the lowermost layer of both lakes. Orthocladiinae, especially the species of *Psectrocladius*, were characteristic. *P. septentrionalis* was the most abundant in the layer between 2.1 m and 2.0 m. In Mustajärvi, *Psectrocladius* is visible as a minority in the layer at 6.4-6.0 m, but a taxocoenose of Orthocladiinae does not develop in this lake (cf. Figs. 1 and 2) . Among the remarkable new taxa in Sompiojärvi appeared the genera *Cladotanytarsus*, indicating obviously incresing amounts of foods (cf. Sæther 1980: 171-172) and *Microtendipes*, which may be associated to the area of the littoral (cf. Hofmann 1983a). At the depth 2.1 m there is the contact of the layers of silt and clay gyttja.

In addition Tanypodinae (*Procladius*, *Ablabesmyia*), *Cryptochironomus*, *Polypedilum*, *Cricotopus*, *Pogonocladius consobrinus*, ?*Zalutschia* and numerous shells of the cocoons of Oligochaeta become visible. Certain members of the assemblages of the previous phases (*Heterotrissocladius*, *Micropsectra radialis*) disappear gradually, which is a typical development of insect fauna in the ameliorating conditions (cf. Coope et al. 1961: 413-415).

One ephippium of *Daphnia* sp. was found at 6.0 m in Mustajärvi. The mite *Hydrozetes lacustris* (Mich.) (E. Karppinen det.), was above this layer more or less regularly to be found in the sediments of Sompiojärvi. Oospores of *Nitella* were also abundantly present in the sediment of Sompiojärvi at the end of this phase.

The chironomid taxocoenose with its new fauna gives an impression of rapidly rising temperature. The number of head capsules increased evenly in relation to the amount of the sediment in both lakes, and the fauna of the end of the phase resembles the recent fauna, found in Sompiojärvi during the studies of 1959-1960.

In Sompiojärvi the relative abundance of the *Betula* pollen continued to increase, *Typha* begans to be constantly present in several layers, while NAP decreases somewhat in the diagram of Sompiojärvi (Salmi 1963 Fig. 4).

In Mustajärvi, according to Salmi (1965), the accumulation of the *Pediastrum* gyttja began at the beginning of the 4th phase at 6.4 m, where *Betula* predominates. He further reported, that colonies of *Pediastrum* exist generally as less than 200 per 100 of tree pollen, but in the lowermost 1.2 m of the *Pediastrum* gyttja there here are over 1 000, at the most 54 000 colonies present. (The lowermost 1.2 m of gyttja included the 4th and 5th chironomid phases of the present paper.) Salmi (1965) continued, that *P. boryanum* predominateds in the lower section and *P. integrum* in the upper section of the sediment.

5th phase, a second transient reduction in number of taxa and rising abundance with a change in fauna

Sompiojärvi 1.9-1.5 m
In Mustajärvi at 5.6-4.4 m; 14C datings for 5.2 m
(T-408) 8 120+150 B.C. and for 4.4 m (T-407)
8 060±140 B.C. (Salmi 1965). Donner & Jungner
(1974) approximated the ages 1 000-3 000 years
too old because of the hard-water effect.

The most striking qualitative phenomenon in Sompiojärvi was the sudden decrease of the genus *Psectrocladius* and other Orthocladiinae, which may relate to the exceeding of some limits of tolerance (?temperature, ?O_2). In Mustajärvi the taxocoenose of the chironomids had nearly been destroyed at 5.6 m. Only one head capsule each of *Glyptotendipes* and *Corynocera ambigua* was found in the whole sample available; this combination is quite peculiar and may result from the mixing of the sediment layers, because *C. ambigua* predominated in the previous sample. In Sompiojärvi, too, the number of head capsules fell to 6 taxa and 22 head capsules in about 2 ml sediment between 1.9-1.8 m. *Polyphemus pediculus* Linnaeus (Cladocera) was found between 1.6 m and 1.5 m in Sompiojärvi.

Nearly the same radiocarbon ages from different layers in Mustajärvi at 5.2 m and 4.4 m might relate to a drying and lowering of the lake level and further to redeposition of the sediments during the later rising or fluctuation of water level. In obviously more stabile Sompiojärvi, the littoral genus *Microtendipes* is abundant perhaps because of the decreased depth of the lake.

Glyptotendipes is one of the commonest genera even in the ponds and pools in Finland. In a shallow (0.2 m) mud pond (20-30 x 100 m) (M2 in Hirvenoja 1960a) the day temperature varied at 8.7.-6.8.1957 between 20° and 27°C); *Glyptotendipes* belonged to the most abundant taxa of the biotope (unpublished data of the writer).

The *Pediastrum* gyttja begins to accumulate at 1.7 m in Sompiojärvi. Vivianite occurs here, according to Salmi (1963: 107), on both sides of the *Pediastrum* and clay gyttja contact at 1.8-1.4 m. The ending of the accumulation of the clay gyttja may perhaps indicate the melting of the last glaciers on the fells of Nattastunturit. In Sompiojärvi the relative abundance of increasing *Betula* culminates at 1.9 m. At 1.7 m the pollen diagram of Sompiojärvi shows clearly a new rise, and reduction in non arboreal pollen (NAP); in 1.6 m culminate also the relative abundances of the species of *Pediastrum* (Salmi1963 Figs. 4 and 8).

6th phase, third reduction of taxa and abundance, culmination of *Chironomus* abundance

Sompiojärvi 1.5-1.2 m
Mustajärvi 4.0 -3.2 m

The development of the chironomid taxocoenoses culminates again in a reduced number of head capsules in the sediment unit; and with this, especially in Sompiojärvi comes strong dominance of the genus *Chironomus*. Perhaps because of the longer (40 cm) distances between single sediment pieces available from the core of Mustajärvi a similar strong and short dominance of *Chironomus* has not been detected in Mustajärvi. Besides the relative abundance of *Corynocera ambigua*, the abundance of *Microtendipes* in Sompiojärvi decreases, perhaps because of the high temperature and reduced precipitation at the beginning of this phase. The predominance of *Chironomus* shows an obviously certain decline in oxygen standard. The situation resembles that of the present mesotrophic or meso-eutrophic lakes (Sæther 1979, cf. Whiteside 1983).

At the depth of 4 m in Mustajärvi *Cyclocypris laevis* O.F.Müller (Ostracoda) (K.J.Purasjoki det.), a species of small bodies of water with abundant vegetation (Enckell 1980: 143), was found.

Salmi (1963: 110) reports *Fragilaria pinnata* Ehrenberg in Sompiojärvi as the commonest species of the diatom flora 'at the top of zone IV' corresponding to the end of the 5th chironomid phase of the present paper, whereas *Aulacoseira ambigua* (Grun.) Simonsen was dominant during the *Chironomus* phase. The diatom flora thus shows the same relationships between the chronozones as between the chironomids. *Fragilaria pinnata* seems to be a quite indifferent littoral species. *A. ambigua* (cf. Hustedt 1930: 91, 142, 1957: 204, 231, 1959: 161, 1962: 257), however, is, besides being an alkaliphilous species of the more eutrophic waters, also oligosaprobious (mesooxybiontic), corresponding to the characteristics which also may indicate the coexisting species of *Chironomus* in Sompiojärvi. According to Lepistö (1988), *A. ambigua* is a species of clearly eutrophic waters.

7th phase, the beginning of the 3rd *Corynocera ambigua* period

Sompiojärvi 1.2-0.8 m; 1.2 m corresponds according to Salmi (1963) to 14C age 6 340±200 B.C. based on the layers of the Tanka-aapa bog.
Mustajärvi 2.8-?2.4 m

Between 1.3-1.2 m in the profile of Sompiojärvi the relative abundance of *C. ambigua* began to increase, indicating obviously better O_2 conditions. At the 1.2 m level is a layer of fine sand (Salmi 1963 Fig. 4), possibly a result of the powerfull rains and great amounts of water from the fells of Nattastunturit. *C. ambigua* began immediately to predominate in the next layer of sediment. There are altogether 3 layers of fine sand, and the relative abundance of *C. ambigua* was in Sompiojärvi higher than ever. In the layer between 0.9 m and 0.8 m the abundance of the head capsules was the highest; this corresponds to the last fine sand layer. The relative number of individuals of the other taxa increased later.

Interpreting the rapid change in the fauna based on the first fine sand layer, its pure physical influence in covering the lower sediments may be of importance in some cases, as has been emphasized especially by Warwick (1975, 1980, 1989). In Sompiojärvi, however, the changes in the fauna began already below the first sand layer, which may indicate the importance of the gradual increasing precipitation only.

The influence of the rains suggested to have increased is not visible in the samples from Mustajärvi as drastically as in Sompiojärvi. There are probably differences between the lakes as to their water sources, because Sompiojärvi is lying near a group of fells, and Mustajärvi may have been already more paludified. The number of polyoxyphilous *Corynocera ambigua* began, however, to increase somewhat also in Mustajärvi, but in contrast, the relative abundance of some other Tanytarsini increased in this lake. The suggested smaller flow of water into Mustajärvi together with quite a high water temperature might have caused less suitable conditions for *Corynocera* in Mustajärvi than in Sompiojärvi. If the layers between the lakes, however, are correctly compared, it would probably not be only pure chance (cf. Alhonen 1970b, Hofmann 1983a), that in Mustajärvi the found remnants of Crustacea were in the following succession *Bosmina* sp. in 3.6 m, *Daphnia cristata* G.O. Sars in 2.8 m and *Alona quadrangularis* O.F. Müller in 2.4 m.

Salmi (1963: 109) locates in Sompiojärvi the zone limits V/VI on the basis of *Alnus* and NAP around 1.0-1.1 m.

8th phase, an interlude during the 3rd *Corynocera ambigua* period

Sompiojärvi ?0.8-0.6 (?0.5) m
Mustajärvi 2.4-2.0 m

In Mustajärvi the relative number of *C. ambigua* decreases in the chironomid taxocoenose perhaps because of the periods of decreasing precipitation; the conditions seem to benefit other Tanytarsiini and Chironomini (especially *Dicrotendipes*). In Sompiojärvi the layers between 0.8 m and 0.6 m with their increased abundances of *Microtendipes* may for the same reason reweal increased littoral areas.

9th phase, the end of the 3rd *Corynocera ambigua* period

Sompiojärvi 0.6 (?0.5)-0.0 m
Mustajärvi 1.6-0.0 m

Orthocladiinae, mostly species of *Psectrocladius*, again characterize the uppermost layers of Sompiojärvi. Their relative abundance was still increasing near the end of the phase corresponding with the uppermost layers of Mustajärvi. Nearly all head capsules of this 2nd period of abundance of *Psectrocladius* in Sompiojärvi are belonging to other species of this genus than to *P. septentrionalis* in contrast to the 4th chironomid phase in Sompiojärvi.

In Mustajärvi the relative and absolute abundance of *Corynocera ambigua* increases abruptly at 1.6 m, but decreases at 1.2 m, where the abundance of *Microtendipes* increases. Moreover the total number of head capsules decreases in 1.2 m.

In Sompiojärvi (Salmi 1963, Fig. 4) the pollen of *Picea* began to increase at 0.5 m. This corresponds the times of increasing abundance of Orthocladiinae among the chironomids.

Attempts to date the chironomid phases

The 14C-years B.P. for the conventional delimitation of the chronozones (Mangerud & al. 1974) are as follows:

Subatlantic	1 000-2 500
Subboreal	2 500-5 000
Atlantic	5 000-8 000
Boreal	8 000-9 000
Preboreal	9 000-10 000

Subatlantic period

According to Lamb (1977a: 373) the Subatlantic period existed climatically from c. 1 000 - 500 B.C. onwards and the observations "indicate significant cooling of world climate". Frenzel (1975: 108) gives to the change of climate of this time the age 2 750 B.P. According to Mörner (1980 Fig.1) the SA /SB temperature drop in Gotland was -3.7°C.

The lower boundary of the Subatlantic period in Sompiojärvi was suggested by Salmi (1963 Fig. 4) as being at the level of 0.5 m, where the amount of pollen of *Picea* begins to increase. The beginning to the 9th chronomid phase is to be seen in the sample taken between 0.6 m and 0.5 m in Sompiojärvi. Tolonen (1983) draws the isochrones of the arrival of postglacial *Picea* to the present study district as between 3 500-3 000 B.P.

The sample from 1.6 m in Mustajärvi may correspond to the lower boundary of the Subatlantic period; the sudden increase in the relative abundance of the polyoxyphilous, mesothermous *C. ambigua* may indicate precisely the decreased water temperature and therefore better O_2 respiration value. A colder climate gives more possibilities also for the Orthocladiinae, the relative abundance of which increases also in Sompiojärvi.

A reduction of abundance in the chironomid taxocoenose of Sompiojärvi was not detected, which could correspond with certainty with that in Mustajärvi 1.2 m. Digerfeldt (1988 Fig. 11) described a subatlantic lowering of the lake level in the Lake Bysjön, South Sweden, which might correspond the depth 1.2 m in Mustajärvi with decreasing abundance of the head capsules and transient increasing abundance of littoral *Microtendipes*.

Psectrocladius becomes abundant during the Subatlantic period also in the sediments of Lake Poolsee, North Germany (Hofmann 1983a). Olander (1992) describes from the Lake Orajärvi, southern Finland increased abundances of *P. septentrionalis* and *Heterotrissocladius* during the Subatlantic period; single head capsules of these species were present also in Sompiojärvi during the Subatlantic.

Juikenttä (Vanhakenttä), one of the dwelling sites of the Saami communities (lapps) at Sompiojärvi, was studied by Carpelan (1967, 1974, 1987, 1993). According to him (1993: 44), the site was inhabited for almost 3 000 years (the Subatlantic period), up to the mid-17th century. Juikenttä was about 700 m from the outlet, near the first rapids in the River Mutenianjoki. Considering the distance of the site from the shore of recent Sompiojärvi, where the fishermen during the present century had their cottages, a question arises about some (?artificial) lowering of the water level of the lake during modern times. According to Carpelan (oral communication) the northern side (= the side of the lake) of the ancient dwelling site resembled a shore. It contained a stratum of remains, including among other items bones of animals and scales of fishes. The site of this possible ancient shore suggest the existence of a much larger Sompiojärvi with large shallow shore areas during older periods. This could agree also with the abundance of littoral genus *Microtendipes* during the early chironomid phases (Fig. 1).

Atlantic and Subboreal periods

In his Fig. 16, Frenzel (1975) locates a time of change in the climate a little before 8 000 B.P. According to Lamb (1977a: 372-373) the Atlantic period (c. 8 000-5 000 B.P) "spans most of the warmest postglacial times, and has also been variously known as the Postglacial Climatic Optimum". For the last 500 years of the period, however, he summarizes deteriorations in climate. Furthermore according to him, during Subboreal times (c. 5 000-2 500 B.P.) "the climate generally regained its former warmth, and may, in some centuries, have been a little warmer than at any time since Boreal times in Europe, but was apparently subject to recurrent fluctuations, particularly of rainfall, differentiating one century from another".

The paleotemperatures measured by Mörner (1980) from Lake Tingstäde Träsk in Gotland represent during the Atlantic and Subboreal periods temperatures above those of the present, but show a transient decline for instance around 5 000 B.P. Digerfeldt (1988) reports from the end of the Atlantic period and from the Subboreal period lake-level fluctuations in South Sweden. Around approximately 5 000 B.P. also in Finland phases of maximum production of the littoral Cladocera and certain species of the diatom flora were observed and are suggested to reflect extended shallow-water areas (Alhonen 1970a, 1971, 1972, Donner et. al. 1978: 272). Korhola (1992) reports lake-level lowering also in S Finland at 7 000-6 500 B.P.

The level for the beginning of the Atlantic period is possible to locate with quite great certainty in the sediments of Sompiojärvi. As mentioned earlier, in the sediment of Sompiojärvi the 1.2 m level corresponds (Salmi 1963) to the 14C age 6 340±200 B.C. in the Tanka-aapa bog. The same level is also the level of the first fine sand layer, the end of *Chirono-*

mus dominance (or the 6th phase), and further the beginning of the strong dominance of the polyoxyphilous chironomid species *Corynocera ambigua*. This age of the wood found must thus be very near the general change in the climate in northern Finland. The fine sand layers in the gyttja were suggested by Salmi (1963) as arising from alluvial times.

According to the isochrone map for the spread of *Pinus* (Eronen 1987: Fig. 3) it arrived in the central areas of north Finland c. 8 000 B.P. As illustrated by Salmi (1963 Fig. 4) pollen of *Pinus* increased in the sediment of Sompiojärvi around 1.1-1.0 m, where NAP is also in minimum; Salmi located the pollen zone limit V/VI at this depth. As is to be seen, the change in climate (= the change in the chironomid assemblage and obviously in the precipitation) happened somewhat earlier (at the level 1.2-1.3 m). This obviously shows the time period of the immigration and maturation of the trees and other vegetation (cf. discussion in Coope et al. 1961: 415 and Lamb 1977a: 231).

The corresponding increasing abundance of *Corynocera ambigua* in Mustajärvi is weakly characterized. It was the result perhaps of the high temperature in a flat (and ?paludified) area connected with a slow water supply and later local relatively dry climate beginning at the final stage of the Atlantic period. In Sompiojärvi near the fells the drier periods were perhaps compensated by a cooler local climate, perhaps also by greater amounts of water direct from the fells or by abundant cold ground waters during the times of "normal" precipitation. The bottoms of the rivulets which flowed into Sompiojärvi were in many places full of holes, due to flowing ground waters. Some 1959-60 observed rivulets were near the lake well watered although the upper courses were dryed up. Perhaps therefore for the determination of the boundary between the Atlantic and climatically more variable Subboreal times no clear qualitative changes in the chironomid assemblages are to be seen in Sompiojärvi.

Boreal and Preboreal periods

According to Lamb (1977a: 371-372) "a renewed rise of temperature setting in about 8 300 B.C. led to the sustained warm climates of postglacial times" during the Preboreal period; further, according to him during the Boreal period, c. 7 000-6 000 B.C., temperatures continued to rise. According to Frenzel (1975:108) "a nearly general warming seems to have occurred at about 9 250 b.p." Already before 9 000 B.P. the mean summer temperature in the Lake Tingstäde Träsk, Gotland was, according to Mörner (1980), corresponding to that of present times and to the opening of the Gulf of Bothnia (cf, Hyyppä 1960, 1966). Approximately from the same time at the beginning of the Boreal period Digerfeldt (1988) reports lowering of the lake levels in southern Sweden.

Boreal period

The boundary of the Boreal and Atlantic periods sensu Salmi (1963, Fig. 4) is roughly in accordance with the present zoological observations. The 6th (*Chironomus*) phase is suggested here being the Boreal 2 period.

A meromictic situation during Boreal 2 with varved sediments and with the *C. anthracinus* type as the most abundant taxa was suggested by Hofmann (1983a) in Poolsee, Holstein, Germany. Donner et. al. (1978) illustrate from Työtjärvi, southern Finland several floristic and faunistic changes from the layers accumulated after the levels with radiocarbon ages for A° 8 600 B.P. and for P° 8 900 B.P. Furthermore certain changes in some other studied sediment cores (Alhonen 1970a, 1971, 1972, Brodin 1986) resemble the suggested changes from the 6th to the 7th chironomid phase in Sompiojärvi.

The boundary of the Preboreal and Boreal periods should, according to Salmi (1963), fall between 1.5 m and 1.4 m in the Sompiojärvi profile. This coincides with the boundary of the 5th and 6th chironomid phases being clearly a time of major biological changes.

Salmi (1963:109) writes: "The zone limit IV / V lies between 1.4 m and 1.5 m. From below the amount of NAP decreases rapidly here, and so does column of old *Picea*. The pollen columns of *Artemisia, Salix, Typha* and on the whole those plants which are presented on the right of the diagram run out at that point or decrease significantly." Salmi (1963: 112) also reports and discusses *Hippophae rhamnoides* pollen from Kalkkarovuoma bog in the Mustajärvi area at the level corresponding with approximately the same boundary. According to him, this could indicate proximity of the sea shore. He further reports in detail the occurrence of the remains of several Mollusca from the sediment of Kalkkarovuoma, most of which are in his age scale from the Boreal period, some, however, being from the Preboreal; there is unfortunately no precise information on the Mollusca of Mustajärvi (Salmi 1965). (From Sompiojärvi, remains of Mollusca have not been preserved in the sediment.)

Comparing the pollen diagrams of Sompiojärvi (Salmi 1963) with those given by Sorsa (1965, especially Kaakkurilampi, Fig. 10), the boundary between the chronozones PB and BO seem to correspond in Sompiojärvi to a greater depth, 1.9 m, where the relative maximal abundance of *Betula* culminates. This depth coincides also with the boundary of the 4th and 5th chironomid phases of the present study, which shows a sudden reduction in certain Orthocladiinae. This phenomenon obviously reflects for many taxa of the 4th chironomid phase a too-high and too-sudden rise in temperature. According to Mörner (1980 Fig. 1) the temperature in Gotland exceeded that of the present near 9 000 B.P. The Boreal period could according to these facts, include approximately the 5th (BO1) and with certainty the 6th (BO2) chironomid phases in Sompiojärvi and Mustajärvi.

At the level 1.7 m in Sompiojärvi the sedimentation of clay gyttja ceases (Salmi 1963 Fig. 4) resulting probably from the melting of most parts of the local glaciers on the Nattaset fells. According to Sorsa (1965 Fig. 29) the lowermost layers of the site he studied on the Nattaset fells also belong to BO1. Salmi (1963: Fig. 4) reports from Sompiojärvi (1.8 m) also pollen of *Ephedra distachya* from the layers, comparable the lower parts of the 5th chironomid phase of the present study. The Finnish records of *Ephedra* have been discussed thoroughly by Tynni (1959) and Sorsa (1965: 377; cf. Paus 1988: 135). The pollen from Sompiojärvi seems to be a quite late date, especially if the layers in question are included in the Boreal period.

Transient low lake levels were reported by Digerfeldt (1988) at the beginning of the Boreal (BO1) period from south Sweden. Further, Brodin (1986) reports from the southern Swedish Lake Flarken FeS-coloured layers from the late Preboreal even until the early Boreal period. These may perhaps relate to the conditions which caused the "ecocatastrophe" found in Sompiojärvi (1.9-1.8 m) but especially in Mustajärvi (5.6 m) at the boundary of the 4th and 5th chironomid phases.

Preboreal period

In his revision of the literature Behre (1978: 101) divides and characterizes the Preboreal in Europe as follows:

V Boreal	beginning at 9 000 B.P.	warm
IVc Late Preboreal	a. 9 600 B.P.	temp
IVb Youngest Dryas	ca. 9 600 B.P.	cold
IVa Friesland	10 200 B.P.	temp
III Younger Dryas		cold

The "ecocatastrophe" stage being obviously very warm is included in the present study to BO 1. The previous chironomid taxocoenose had, at least in Sompiojärvi during the suggested Late Preboreal a partial modern analoque during the Subatlantic period. This may well reflect the conditions suggested for the Late Preboreal (IVc) by Behre (1978).

The Youngest Dryas (IVb) sensu Behre (1978), discussed also as the Piottino oscillation (Zoller 1960, Lang 1962, Küttel 1977, Behre 1966), could perhaps be found in Sompiojärvi in the layer between 2.3-2.2 m during the later part of the 3rd chironomid phase. The last mentioned faunal phase could correspond to the depth of 6.5 m in Mustajärvi. It reflects chironomids of a stronger tundra ecosystem, even that of the arctic parts of the Fennoscandian mountains. It was preceded by a stage, which probably cannot be considered colder, but which already offered similar or even better possibilities for the distribution of certain northern types of vegetation in Finland (cf. Kalela 1961).

One could ask if this suggested deterioration corresponds to that transient small decline mentioned by Mörner (1980) from Gotland during the preboreal warming (around 10°C) or to a similar event illustrated in several papers near the beginning of the Preboreal from the Greenland ice core (Johnsen et al. 1992, Taylor et al. 1993; cf. also Kunz & Reanier 1994). Unfortunately the determination of the chironomid taxocoenose in Bondestam et al. (1994) gives little possibilities for comparison with the conditions in southern Finland, where for instance *Corynocera ambiqua* occurred even during the final part of Younger Dryas chronozone.

Possible changes in temperature after the end of the Younger Dyas, towards the warm Preboreal biozones Ammann & Lotter (1989: 124), for instance, consider to be minor fluctuations. Behre (1978: 100) himself, writes as follows:

".....Die inzwischen zahlreichen pollenanalytischen Untersuchungen in Tessin und im Berner Oberland zeigen, dass dort die Klimadepression vor der jüngeren Dryaszeit bis etwa 9 500 B.P. reichte, ohne dass in den meisten Fällen eine zwischenzeitliche Erwärmung erkennbar ist.

In den übrigen Teilen Europas war der Klimarückschlag im Präboreal deutlich schwächer als in der jüngeren Dryaszeit. Deshalb ist er nur in wenigen geeigneten "empfindlichen" Gebieten und Profilen sicher zu fassen."

There are a number of varve chronological consecutive stages of the ice-marginal formations in southern Finland. Findings regarding their ages are summarized by Saarnisto (1991) as follows:

Central Finland (Preboreal)	10 150-10 300 y.a.
Pielisjärvi (Preboreal)	10 400-10 500 y.a.
Salpausselkä II (Younger Dryas)	10 600-10 800 y.a.
Salpausselkä I (Younger Dryas)	11 100-11 300 y.a.

Saarnisto (1991: 8), among others, writes as follows:

"Rapid climatic amelioration took place 10 000-10 100 radiocarbon years B.P. when tundra wegetation was replaced by birch forests. This date may correspond in calendar (varve) years approximately to 10 600 y.a (Zolitschka 1990). The initiation of rapid ice retreat from Salpausselkä II was also the result of climatic warming and, on the basis of the revised varve chronology it started at 10 600 y.a. "

The ice marginal formations in Finland have appeared to be readvance phases of the ice as has been summarized by Rainio (1985 Fig. 3, 1991) or Nenonen (1992). The continuum of their ages does not, however, give many suggestions as to the temperatures between the perhaps colder readvance phases and thus aid us in locating the chironomid phases. Reasons have also been expressed for the opinion (cf. Nenonen 1993: 42) that a readvance of a glacier is possible even during continuously rising temperature.

The current opinion of Finnish paleontologists and geologists, which has appeared in several discussions and in the literature is that north Finland should not have been deglaciated before the Preboreal period (Hyvärinen 1972, 1973, 1975, Donner & Jungner 1974, Ignatius et al. 1980). The present author is, however, unfortunately not able to find sufficient evidence in the literature to locate the chironomid phases indicating one very cold (Y in Figs. 2 and 3) period of time after a relatively warm (X) stage in the Preboreal period.

The periods Y and X

Comparing the pollen diagrams of Sorsa (1965) from Aapalampi to that of Salmi (1963) from Sompiojärvi, the period of *C. ambigua* absence as well as the preceding milder stage of its presence (1st chironomid phase) belong to the "0-section" sensu Vasari (1974 Fig. 8, 1978 Fig. 4). Sorsa (1965: 393) has seen in the pollen profile of Tankavaara, not far from Sompiojärvi, "high arctic" features during a short section, which according to him belongs to the Younger Dryas and may be correlated to the 2.6-2.5 m layer of Sompiojärvi.

Concerning occurrence of *Corynocera ambigua*, *Micropsectra* and *Heterotrissocladius* in European lakes

C. ambigua is often recorded among the earliest inhabitats of the lakes on the deglaciated or periglacial area:
The larva of *Corynocera ambigua* was first described from the Younger Dryas deposits in Denmark by Andersen (1943 sub *Dryadotanytarsus edentulus* n.g., n.sp.). Andersen (1938) reports a *Dryadotanytarsus - Microtendipes - Chironomus* assemblage from deposits near Næstved, Denmark from Younger as well as Older Dryas deposits, but this assemblage was absent during the warmer Allerød Interstadial.

Fjellberg (1972) reports *C. ambigua* from Late-Weichselian deposits in southern Norway.

According to Hofmann (1983b), *C. ambigua* was already present in Lobsigensee, Swiss Plateau, in the lowermost parts of the Oldest Dryas period, but this and many other species disappeared at the end of that period, obviously due to the rising temperature.

In Lake Meerfelder Maar in south-western Germany *C. ambigua* occurred during the Late-Glacial - Preboreal chronozones, according to Hofmann (1984a).

Schakau & Frank (1984) report *C. ambigua* from the deposits of the Younger Dryas in Lake Tegeler See in eastern Germany, but here also the abundance of the other species was relatively high, and no greater qualitative changes were found during the history of the lake.

According to Bondestam et al. (1994: 199), the oldest deposits of their study in the sites of the Salpausselkä foreland, Finnish Karelia, belonged to last part of the Younger Dryas. *C. ambigua* was abundant even in the lowermost layers.

C. ambigua may be absent from some lakes during the Younger Dryas:

Berglund & Digerfeldt (1970) studied a Late-Glacial lake at Torreberga, Scania, south Sweden and list some taxa from the Allerød to Preboreal. It seems characteristic, that *C. ambigua* is absent here in about 2/3 of the layers of the Younger Dryas chronozone; during this period there are several layers without any chironomid head capsules.

According to Hofmann (1983a), *C. ambigua* and some other species were present in the lowermost layers of Lake Poolsee in Holstein. These were replaced by *Micropsectra* during the Younger Dyas, but after this period *Corynocera* recurred again in the Poolsee samples up until the Atlantic period.

In the eutrophic Großer Segeberger See, Holstein, northern Germany, *C.ambigua* occurred in enormous numbers before the Allerød interstadial, when it disappeared and was seen again during Boreal 2 (Hofmann 1978).

Chironomid taxa which in the Poolsee were, according to Hofmann (1983a), restricted to the Late-Glacial times were, among others, *Micropsectra* and *Heterotrissocladius*.

In the Grossensee, also in north Germany, the most common taxa during the Allerød were, according to Günther (1983), *Microtendipes*, *Dicrotendipes*, *Chironomus* and Orthocladiinae, but during the Younger Dryas *Heterotrissocladius subpilosus* and *M. radialis*, among others, were observed; *M. radialis* occurred in this lake from the Allerød up to the Subboreal chronozone.

According to these given examples, the local conditions obviously offer different combinations of ecological factors for the existence of *Corynocera ambigua* as well as at least for *Micropsectra* during the same suggested periods observation. This seems to be connected somewhat to geographical site; the Younger Dryas seems to be suitable for *C. ambigua* at southern latitudes. Depending on the geographical site other kinds of psychrophilous chironomid taxocoenoses may occur during a cold period (see Levesque et al. 1993). Bondestam et al. (1994: 197) suggested for the Younger Dryas in SE Finland (Karelia) very continental conditions with a reasonably thin snow cover (cf. Alley et al., Mayewski 1994) and summer temperatures between 7-10°C likely.

The July means of colder parts of the Younger Dryas have been approximated at 6-8°C lower than today in western Norway by Larsen & al. (1984; cf. Rind et al. 1986). According to Johnsen et al. (1992), the cold glacial stages were ~7°C colder than the mild ones, and 12-13°C colder than at present in Greenland.

Edwards et al. (1993: 967) approximated on the basis of their results from the Greenland ice cores, that the Younger Dryas stadial had occurred between 12 940±260 and 11 640±250 calendar years ago, being 1 300 years long. Marthinussen (1961: 169) reports distinct melting (drainage) even during the phase of maximum advance of the Younger Dryas in the Repparfjord-Stabbursdal area, north Norway. Melting in a very cold but not constantly frozen lake should obviously cause sedimentation without chironomids (cf. Berglund & Digerfelt 1970). Such a stage seems to lack in Sompiojärvi or Mustajärvi, but every centimetre of the cores were not available for the study from the coldest stage.

The redeposition of the chironomid head capsules during the first 3-4 phases must be in the lakes of the present study extremly slight, because there is to be seen a logical sequence of the quite rare species according to their temperature preference, without any signs about widely distributed, common species, which also should be present in the redeposited material.

Paus (1992, cf. 1990: 149) suggests a transient amelioration in NW Europe during the Younger Dryas (cf. also the given figure in Kerr 1993), which the present author also has tryed to adjust to the succession of the chironomid taxocoenoses. If there has been the first period of a restricted melting (1st chironomid phase) before Preboreal in the study area, the readvance of the glacier in eastern Lapland during the Younger Dryas stadial (?2nd chironomid phase) seems to be more probable, as has been proposed by Lamb (1977a, Fig. 15-19).

The changes have been rapid. Dansgaard & al. (1989) and Johnsen et al. (1992) report, that the duration of the transition from the Younger Dryas to the Preboreal (~7°C) in Greenland was estimated to approximately 50 years only (see also Mayewski 1994).

A possible Late Weichselian melting of the present study area (see Fig. 143 in Sauramo 1958, Hyyppä 1936; Starkel 1977 Figs. 5-6) might perhaps find its explanation in such an atmospheric circulation pattern and direction of winds proposed by Lamb & Woodroffe (1970; cf. Lamb 1977b). But as mentioned, a Late Weichselian melting in any part of Lapland has been rejected by current opinion.

Sompiojärvi and Mustajärvi are both in the extensive ice divide zone of Central Lapland (cf. Lundqvist 1980, Fig. 5; Sutinen 1984, Fig. 6), where the erosive and depositional action of the continental ice sheet has invariably been very weak (Penttilä 1963, Kujansuu 1967). According to Hirvas (1991) the overmost youngest till beds belong to the Middle and Late Weichselian stages, which may be locally separated by sand and gravel; more precise datings for the overmost till beds are unfortunately lacking.

If the continental ice stayed in Lapland during the Younger Dryas and no melting during that period cannot be shown, then the nearest suitable period is perhaps during a Post-Allerød warmer cycle. This is included by Taylor et al. (1993 Fig. 2) in the Allerød oscillations and named by Johnsen et al. (1992 Fig. 2) interstadial 1a.

The surface lake water temperature of near 10°C had been needed for the emergence of the taxa of the 1st chironomid phase. Conspicuous is the occurrence of the more or less eutrophilous *Chironomus* spp. (red in Figs. 2 and 3) during the earliest stages but their scarcity in increased organic matter (gyttja!) in modern Sompiojärvi and Mustajärvi.

There are great differences in the ages of the lowermost sediments in eastern Lapland. According to Sorsa (1965) those at Pyhätunturi do not beginn before the Atlantic period; the lowermost layers from the Nattaset fells at Sompiojärvi beginn during BO1. During BO2 begin the deposits in the Kalkkarovuoma bog (Salmi 1963), but in the same district Mustajärvi seems to be much older.

According to Salmi (1963: 110), the three lowermost samples (2.7-2.4 m) from Sompiojärvi display a few large-lake diatom flora: *Amphora ovalis* Kützing, and *Aulacoseira arenaria* Moore, *Stephanodiscus astraea* (Ehr.) Grun. The great majority are, according to him, however, small-lake diatoms, the commonest species in the silt being *Aulacoseira distans* (Ehr.) Simonsen. This species is (Hustedt 1930: 93, 1962: 264) an oligostenothermous littoral species in pools and ditches. It forms 53 % in the lowermost (2.7 m) sample and 34 % at 2.3 m, but the next sample (2.2 m) contains (Salmi 1963) coenobia of this species of only 16 %. Hustedt (1957: 422) lists *A. distans* as a diluvial relict (gacial relict) in central Europe. *A. distans* occurs (Round 1981: 15) only in lakes with low concentrations of nutriens, but according to Lepistö (1988) it is occasionally abundant also in mesotrophic and eutrophic lakes. *A. arenaria* is (Round 1965: 208) characteristic of melt waters in semiarctic regions. Hustedt (1930: 110, 1962: 370) says that *Stephanodiscus astraea* is not an oligostenothermous species, but occurs in northern Germany in eutrophied lakes especially during the winter and early spring. It was found by Salmi (1963) in deposits included here in chironomid phases 2 and 3 (2.6-2.4 m).

Ice dammed lakes existed first along the sides of the glacier. Most of them, according to Penttilä (1963: 44), have probably been small and nearly complete without bottom sediments, a large part of their bottoms consisting of marginal ice. According to Hyyppä (1960: 28, cf. Fig. 3), one of the largest ice-dammed lakes has been in the area of the Lokka reservoir south of Sompiojärvi, which today is part of it. Boulder fields, from which some perhaps could be ancient shore lines of other phases of ice dammed lakes, exist on both sides of Sompiojärvi. Sompiojärvi with a cold ice bottom appears to be a very unprobably habitat for the members of the 1st chironomid phase with species of the somewhat termophilous tube dwellers in the sediment.

This ice-dammed lake of the Sompio area, which discharged its waters eastwards, might have been suitable for the arrival of northern *Gammarus la-*

custris G.O. Sars (Crustacea), according to the theory of Segerstråle (1954), which says *G. lacustris* immigrate from the northern or north-eastern refugia near the Arctic Ocean to north Finland. The theory has been questioned by Ökland (1969: 131-132; cf. Väinölä 1994). *G. lacustris* was not found by the present author during the studies of the lakes of the Sompio district from 1959-61 in Sompiojärvi or in its nearest surroundings except in the small lake (or tarn) Posolampi and in one spring (akratopeg) connected with it by a canal. The species has also later (Nenonen & Nenonen 1972) been found in Posolampi, at the time when it already was connected with the present Lokka reservoir, which covers the area of the ancient large ice-dammed lake.

Some remarks

The most serious problem of the present study is the dating of the lowermost oldest layers. The earlier studies of chironomid midges are from southern Finland (Alhonen & Haavisto 1969, Kansanen 1985, Olander 1992, Räsänen et al. 1992, Bondenstam et al. 1994) and give no or very little possibilities for comparison with the present results, because most study areas have been long covered by the water. The present study area appears to have existed during the deglaciation as a landscape, where parts of the glaciers alternated with more or less large melted lakes on dry sites for very long periods of times.

Frey (1988) writes about communities of diatoms, cladocerans and dipterous larvae and their interpretation in paleolimnology as follows:

"The questions asked about them, and by extrapolation about the other groups as well, are: 1) to what extent can these remains be used to determine past conditions in lakes and their controlling influences, and 2) for a given region are there any common patterns of change among lakes, or does each lake respond completely individualistically?"

The lakes of the present study seem to show that the chironomid communities respond only to a certain extent individualistically. According to the examples mentioned above in the text different plant or animal taxa or taxocoenoses show also often approximately simultaneously changes in their occurrence.

A precise application (cf. Sæther 1979, 1980) of classical chironomid lake typologies to the littoral lakes (sensu Brundin 1956) Sompiojärvi (conductivity 1959 1.6-2.0 mS/m, Ptot 1984 <0.20 µg/l) and Mustajärvi is not easy, even when one is using fresh recent materials, because characteristics of the types since the observations of Thienemann (1920) have been based mostly on the profundal fauna of the stratified deep lakes. It is pure chance, that both lakes studied in the present paper are "*C. ambigua* lakes", i.e. more or less dominated by this species nearly throughout their history. This type may regionally be quite common today in northern latitudes, but for instance from the 1959-61 studied three littoral lakes of the Sompio district the two other lakes, with more acid and humic waters nearly without *Corynocera* at present, may be more common in northern Finland.

Some lakes are probably more suitable objects for studies than are others. Sompiojärvi is obviously suitable for paleolimnological studies because it lies not far from a boundary of northern boreal and oroarctic (Hämet-Ahti 1981) biogeographical zones. The change in such a site is probably more easily demonstrated with the aid of fauna than in localities situated far from boundaries.

It is evident, that different taxa or taxocoenoses may give detailed information, obtainable from only one of them. This is a very wide field with many possibilities (see for instance Williams 1989, Bondestam et al. 1994), which needs a team of willing specialists. Remains of Cladocera were often present in abundance in the cores of Sompiojärvi and Mustajärvi, but they were usually not picked up and examined because of the lack of a willing specialist known to the author at the beginnig of the study 1964. *Eubosmina obtusirostris* Sars, *Bythotrephes longimanus* Leydig, *Daphnia longispina* (O.F. Müller), *D. galeata* Sars, *Bosmina longirostris* (O.F. Müller) and *Chydorus sphaericus* (O.F. Müller) occurred (T.Sohlberg det.) in the samples of plankton taken by the author from Sompiojärvi in the summer 1959 (cf. Hofmann 1978, 1983a, 1984a).

The often-used remains of Chaoboridae were not found in the cores, but this family was not present in any of 1959-61 studied lakes of the Sompio area either. Some very few unknown jaws of larger insect larvae (?Hydrophilidae) were present in some few samples of the present study. The abundant occurrence of different kinds of objects suggested being the remains of the cocoons of different taxa of aquatic Oligochaeta, was remarcable. Species of this taxon have been widely used as indicators of the water quality, but unfortunately their cocoons obviously are still not possible to determine.

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APPENDIX I

Fig. 1. Fjelds (Nattaset) and ponds of the NW spring area of Sompiojärvi.

Fig. 2. The paludified eastern spring areas of Sompiojärvi near the inlet of the rivulet Kuusioja.

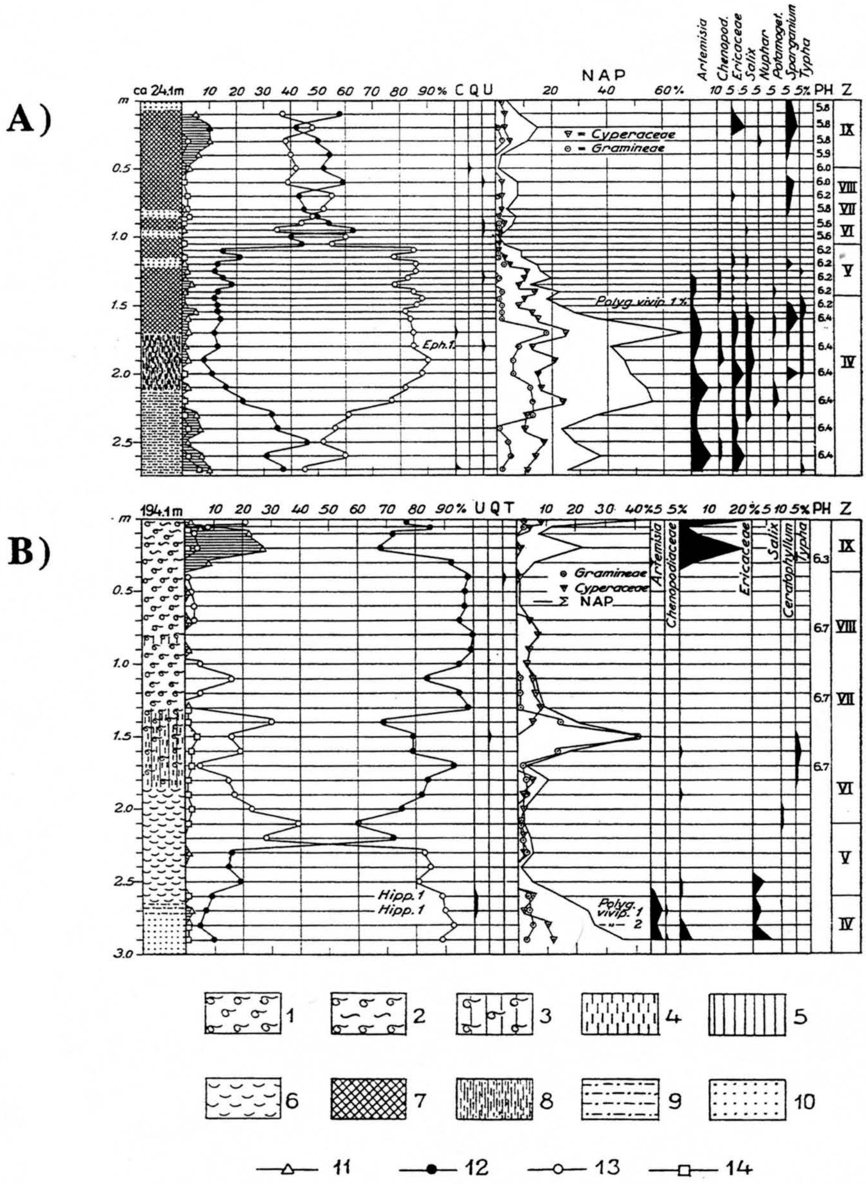
Fig. 3. Sompiojärvi seen from its outlet at the beginning of the Mutenianjoki rivulet.

Fig. 4. Mutenianjoki, Juitsa, and small rapid during the low water in July 1959. On outermost left was the ancient dwelling site of a Saami community (lapps) called Juikenttä (Vanhakenttä).

Fig. 5. The ancient path to Norway marked with piles of stones, beginns at the northern shore of Sompiojärvi.

APPENDIX II

Sediments and pollen diagrams of the Sompiojärvi (A) and Kalkkarovuoma (B) sample series. Figures from the paper of Salmi (1963) with permission of Societas Biologica Fennica Vanamo.



Key to symbols. 1 = *Bryales* peat, 2 = *Bryales-Sphagnum* peat, 3 = *Bryales-Carex* peat, 4 = *Phragmites* peat, 5 = *Carex* peat, 6 = lime ooze, 7 = *Pediastrum* ooze, 8 = clay ooze, 9 = silt, 10 = fine sand, 11 = *Picea*, 12 = *Pinus*, 13 = *Betula*, 14 = *Alnus*, C = *Corylus*, Q = *Quercus*, T = *Tilia*, U = *Ulmus*, Eph. = *Ephedra*, Hipp. = *Hippophae*, NAP = non-arboreal pollen.

Oulanka Reports 18: 37—52. 1998

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The biodiversity of the fauna in some shore pools of the Lokka Reservoir in northern Finland with descriptions or redescriptions of the species of *Chironomus* Meigen (Dipt., Chironomidae) found in them

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Hirvenoja, M. 1998: The biodiversity of the fauna in some shore pools of the Lokka Reservoir in northern Finland with descriptions or redescriptions of the species of *Chironomus* Meigen (Dipt., Chironomidae) found in them. — Oulanka Reports 18: 37—52. ISSN 0358-3651.

Macroinvertebrates from some pools near the highest shore level of the regulated Lokka Reservoir in northern Finland were collected and partly reared. The species found are listed. *Psectrocladius (Mesopsectrocladius) barbatipes* Kieffer is new to the fauna of Finland. The occurrence of *Lyncheus brachyurus* (O.F.M.) (Crustacea, Branchiopoda, Conchostraca) in the study area is discussed. Adults and immature stages of *Chironomus* Meigen found in the pools are described or redescribed. Lectotype designations of *C. (Lobochironomus) storai* Goetghebuer and *C. (L.) mendax* Storå are confirmed. *C. (L.) improvidus* sp.n. is described as a new species. Tentative determination keys for the pupae of "*Einfeldia* s.lat." in the Lokka pools and for the males found in Finland are presented.

Introduction

The Lokka Reservoir (about 27°40′E, 67°55′N, area 413 km^2) and its nearest semiterrestrial environment together comprise to a certain extent because of the changeable water level an unstable complex of habitats. The water level of the reservoir is lower during the winter, when it is covered by ice, but energy demands are greatest. Near the shore of the maximal water level there are also usually inundated hollows. Some of them may be periodically dry. The pools or ponds exist with or without any direct open contact to the reservoir proper and at least the smallest are totally frozen under the snow in winter. The snow melts during the last weeks of May and the melt waters also raise the level of the dam basin proper quite soon to the same level as the pools. Many of the pools may obviously therefore often avoid a totally true dry phase without any moisture in the bottom mud. It has, however, not been possible for the author to follow the changes of the aquatic or possible dry phases of the pools discussed here.

The species found in the pools studied at Lokka

A search was made especially for larvae of chironomids for karyological studies and/or rearings as adults from the network of small pools (depth <0.5 m) near the NE shore of Lokka on 22. June 1995 (coordinates 7544:520; see Heikinheimo & Raatikainen 1971). Members of other taxa netted from these pools together with the chironomids were preserved directly in alcohol. The rearing happened in the field without any laboratory equipment, for instance without the aeration. Only a quite small number of red larvae were found. The adults which emerged belonged to four species. The material for the karyological studies appeared later to be not good enough for studies of the chromosomes. The 20 taxa, which coexisted in 1995 in the few pools studied from the site are listed below:

Lumbriculidae: 3 individuals, 2 of which were *Lumbriculus variegatus* (Müller) and one immature ?*Stylodrilus heringianus* Claparede.

Mollusca: *Pisidium* sp., one large individual.

Crustacea: *Daphnia pulex* (De Geer) was quite abundant showing it also obviously had a relatively stable, long aquatic phase in the summers.

Hydracarina; *Piona uncata uncata* (Koenike), one individual.

Ephemeroptera: *Leptophlebia vespertina* (Linnaeus), 3 larvae.

Heteroptera: *Callicorixa producta* (Reuter), 2 females.

Trichoptera: *Limnephilus* spp. 2 larvae.

Coleoptera: *Colymbetes paykulli* Erichson, *Rhantus notatus* Fabricius, one adult example from both. Determined according to the key of Nilsson (1982) 2 larvae of *Agabus congener* (Thunberg) were also present. Adults of *A. congener* have not been found, but instead those of *A. lapponicus* (Thomson) have been sampled in abundance from the lakes, which prior to this study existed on the study area; unfortunately, the latter species is not present in the key of Nilsson (1982).

Diptera, Dixidae: *Dixella aestivalis* Meigen, one reared female.

Diptera, Culicidae: *Culex pipiens* Linnaeus, one larva.

Diptera, Chaoboridae: *Cryophila lapponica* Martini 5 larvae and *Mochlonyx culiciformis* (De Geer) 2 larvae.

Diptera, Chironomidae: *Ablabesmyia phatta* (Egger), 9 individuals: larvae, pupae and a reared male adult. *Psectrocladius (Mesopsectrocladius) barbatipes* Kieffer, one male (with the pupal exuviae), new for the fauna of Finland. *Endochironomus impar* (Walker) 4 larvae. *Chironomus* s.str. sp.(?spp.) 7 individuals, *C. (Lobochironomus) storai* Goetghebuer 1 male and 2 females, *C. (L.) mendax* Storå, 2 females, *C. (L.) improvidus* sp.n., one male.

Species of the genus *Chironomus* Meigen reared from the pools at Lokka

The main sampling work was done for the larvae of the Lokka Reservoir proper. It appeared, however, that there are great taxonomical difficulties also in the determination of the few species of *Chironomus* living in the pools. There is a need to tackle this problem quite thoroughly and this is why in the next chapter the difficult species found are described as completely as possible from the sparse material.

Chironomus s.str. sp.

Material: 1 reared female with its pupal exuviae, June 22. 1995 Lokka pools (M.H.).

Female (Fig. 1A5)

A pale species; sutal stripes, hind part of postnotum and abdomen brown. Dorsocentrals 30, acrostichals 15 in number on small pale spots. Palps (2-5) 60, 250, 250 and 340 µm. Wing 4.3 mm. On P_2/Ta_1 83 and P_3/Ta_1 87 sensilla chaetica were counted. *LR*: P_1 1.68, P_2 0.56, P_3 0.69. *BR*: P_1 2.0, P_2 1.1, P_3 2.5. Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1700	1700	1950
Tibia	1450	1700	2100
Tarsus 1	2300	965	1450
Tarsus 2	1200	500	850
Tarsus 3	950	350	610
Tarsus 4	850	250	360
Tarsus 5	340	200	200

The spermathecae are oval, nearly 300 µm long and 150 µm broad; 37 setae were counted on a pale area of sternite 8.

Pupa (Fig. 1A1-4)

Exuviae 9.5 mm long, antero-dorsally darker and relatively strongly granulated to the base of the wing sheats, where instead of the granulation a thin reticulate structure can be seen. Frontal apotome with cephalic tubercles, up to about 180 µm long and 110 µm broad, each with a small preapical seta. Basal ring 170-200 x 110 µm, its tracheal patch with about 16 tracheoles across, nearly 3 µm in diameter.

Strong shagreen on tergites 2-6 present, spreading on tergites 4 and 5 laterally over the D setae. Paratergites 5 and 6 are spinulated; analcorners of these segments with longer spinules. On segment 2 pedes spurii B and about 90-100 hooklets in the hookrow; the hooks in the middle of the row with minute dorsal denticles. Other intersegmental orally directed small spinules behind the armament of tergites 4-6 are abundantly present. Points on the pleural region of segment 4 are abundantly present

Parasternite 2 and 3 shagreened. Fine shagreen on the postero-lateral corner of sternite 1 is present. The sternite 2 is broadly shagreened, but the shagreen on sternite 3 is absent approximately between the V setae; on the 4th sternite the spinules are also reduced laterally. Patches of spinules are on the anterolateral corners of the sternites 5-7, but on sternite 5 there is also a weak longitudinal group medially

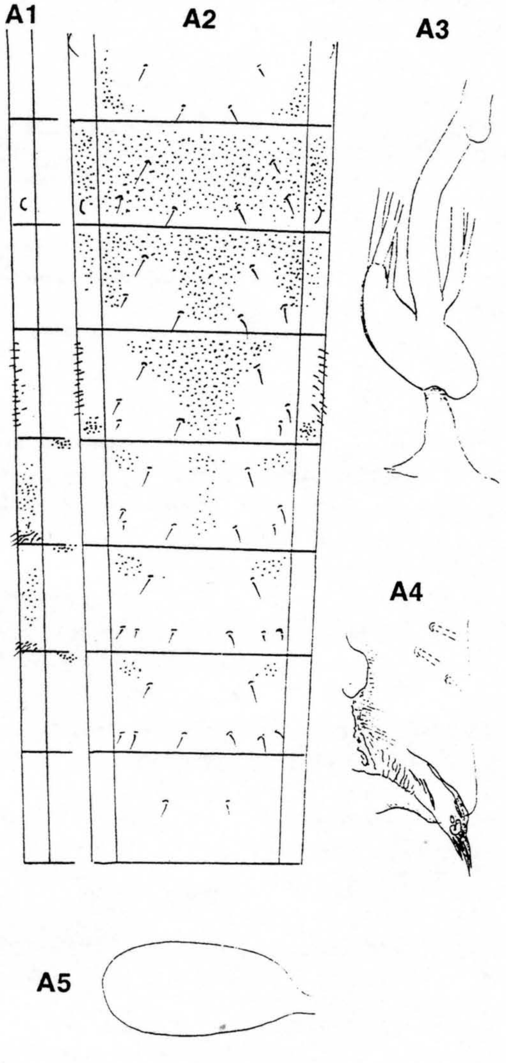

Fig. 1. *Chironomus* s.str. sp. "Lokka pools". Pupa: paratergite (A1), sternite (A2), posterior thoracal tracheal bladder (A3), anal spur of segment 8 (A4) and spermatheca of the adult female (A5).

present. On sternite 8 no spinules were obserwed.

Lateral setae on segments 1-8: 1, 3, 3+1, 3+1, and taeniate 4, 4, 4, 5 . Spurs on segment 8 have 2-3 evenly strong teeth apically. Anal lobe fringe of taeniae somewhat irregularly arranged, apically pluriserial, the number being 95-114. One dorsal taenia on both sides on the proximal third of the anal segment is present.

Larva (Fig. 3C1-7)

There is in the material collected in 1989 from the same pools one larval exuviae associated with one pupated individual, the anal spur which seems to be similar to that in the exuviae described before. (It was not possible to study the other characters of this pupa!) The mouthparts and the coloration of the head capsule resemble those of the larva described below as *C. mendax*, but the antenne is shorter, about 190 µm; proportions of the lengths of the segments are 100 : 26 : 9 : 9 : 5. Pecten epipharyngis has 12 teeth. The details of the sensory field of the labrum are difficult to observe clearly (? a little damaged), but the setae S_I seem to taper apically; the long *Ch* setae are perhaps of the same type as has been illustrated for *C. mendax* (Fig. 3B 2).

Comments

The present description of the species found is given so it could possibly be used later to name the species.

The anal spur of the pupa resembles that illustrated by Ryser et al. (1985, Fig. 10) for *Chironomus striatus* Strenzke, which coexists in the pools of the Alps with certain species of the subgenus *Lobochironomus*. The coloration and the *LR* value given before for the female correspond also to those given by Strenzke (1959) for *C. striatus*. The adult female has quite large spermathecae of a not very usual shape (Fig. 1A5), which obviously has not been described in any connection. The pupa of *C. striatus* in the key of Langton (1991) seems also to be different in some details.

The present species is neither *C. acerbus* Hirvenoja, known earlier from a forest pool very near the present study area, nor *C. sollicitus* Hirvenoja or *C. riihimakiensis* Wülker, both of which are known from (different) fresh water pools in Riihimäki, southern Finland. From the species of the *riihimakiensis* group of *Chironomus* described from Russia (Kiknadze et al. 1992) the females are not known and the descriptions of the pupae give little possibilities for comparison, however they are indeed also inhabitants of small water bodies.

Except for the occurrence of the intersegmental spinules (plesiomorphously) behind the sternite 4-6, the exuviae of the present *Chironomus* sp. have not any features, which could connect them to the known pupae of *C. piger* Strenzke, *C. pseudothummi* Strenzke or *C. riparius* Meigen, which are common in the small water bodies in Finland, too (cf. also Paasivirta, Lahti and Perätie 1988). Ryser et al. (1985) mentioned several partly conspecific species of *Chironomus* found in alpine pools.

C. (Lobochironomus) storai Goetghebuer

Syn. *Chironomus luctuosus* Storå

The type material

The syntypes, 3 pinned males with the type labels Nr. 4984, 4985 and 4986, which correspond to the original description (Storå 1937) are in the collections of the Zoological Museum, Finnish Museum of Natural History (Helsinki). In their dried state the specimens are very dark. Type Nr. 4984 was provided with the original pinned slide prepared by Storå; there is in this slide the hypopygium (mounted in gummi arabicum? on a piece of celluloid). From this male individual the present author removed the legs on one side and mounted them after heating in Euparal in a slide (two cover glases); this has been attached to the same pin. Type 4984 has been designated and labelled by the present author as the lectotype, which is confirmed here.

In the lectotype the *LR* value is 1.39 and BR 2.2. Sensilla chaetica were observed on P_2 8 and on P_3 9. Measures of the legs of the Lectotype (µm):

	Fore leg	Mid leg	Hind leg
Femur	1 620	1 500	1 550
Tibia	1 280	1 420	1 810
Tarsus 1	1 780	900	1 210
Tarsus 2	980	580	780
Tarsus 3	800	420	550
Tarsus 4	580	210	320
Tarsus 5	220	190	190

In the Zoological Museum in Helsinki in the series of the pinned specimens there are also two females from Kuusamo, R. Krogerus leg., obviously originally determined by R. Storå as *C. luctuosus*, in spite of the fact, that he does not mention these female individuals in his paper (Storå 1937:260). Without preparation the impression is, that they are conspecific with the males. When mounted in Euparal the following results can be obtained: *LR* (N=2) 1.45-1.51. On Ta_1/P_2 (N=2) 107-115 and on Ta_1/P_3 (N=1) 97 sensilla chaetica were counted. Spermathecae are oval, 150 µm long, with a <30 µm long neck, similar to those in the female from the Lokka pools described below.

The new material of *C. storai*

2 males, 1 female, 1(3) pupa(e), 1 associated larval exuviae June 1995 and 3 larvae (with one intersexual adult), June 1989 from the Lokka pools (M.H.); 3 males, and 6 pupal exuviae, September 1967 from the rockpools in Bränskär, Tvärminne, southern Finland, B. Lindeberg leg.

Male

The ground color of the pale parts obscurely yellowish. Thorax and abdomen dorsally dark; 31-33 *dc* bristles on pale spots. In the fore leg *Fe* proximally shortly often pale, *Ti* evenly dark, Ta_1 also proximally pale, but darkens towards the tip, where the pigmentation corresponds to that of the last tarsal segments. The mid and hind legs are more or less pale, but if strongly pigmented, the femora are the darkest.

AR 3.7-3.9. Frontal tubercles about 20 µm. Palps (2-5): 70-80, 250-380, 250-300 and 320-380 µm. Wing 3.5-3.9 mm. *LR*: P_1 1.53-1.60, P_2 0.59-0.64, P3 0.65-0.70. Number of sensilla chaetica: (distally in) P_2/Ta_1 9-13, P3/Ta1 7-12. *BR*: P_1 2.2-2.5, P_2 2.3-2.7, P_3 4.6-5.8. Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 300-1 430	1 400-1 550	1 500-1 600
Tibia	1 070-1 250	1 320-1 430	1 650-1 820
Tarsus 1	1 700-1 900	810-860	1 120-1 210
Tarsus 2	850-950	450-500	640-680
Tarsus 3	700-780	310-380	450-510
Tarsus 4	590-650	220-260	300-320
Tarsus 5	250-300	140-180	150-200

Hypopygium as in Fig. 6A; processus analis apically round, 30-35 µm broad, constricted proximally, very similar to other species of "*Einfeldia* s.lat.".

Female

The coloration of the female as well as the not emerged mature pupa, corresponds to that of the male described before; dorsocentral setae on light spots, 40-41 in number on one side. On P_2/Ta_1 117 and P_3/Ta_1 95 sensilla chaetica were observed on

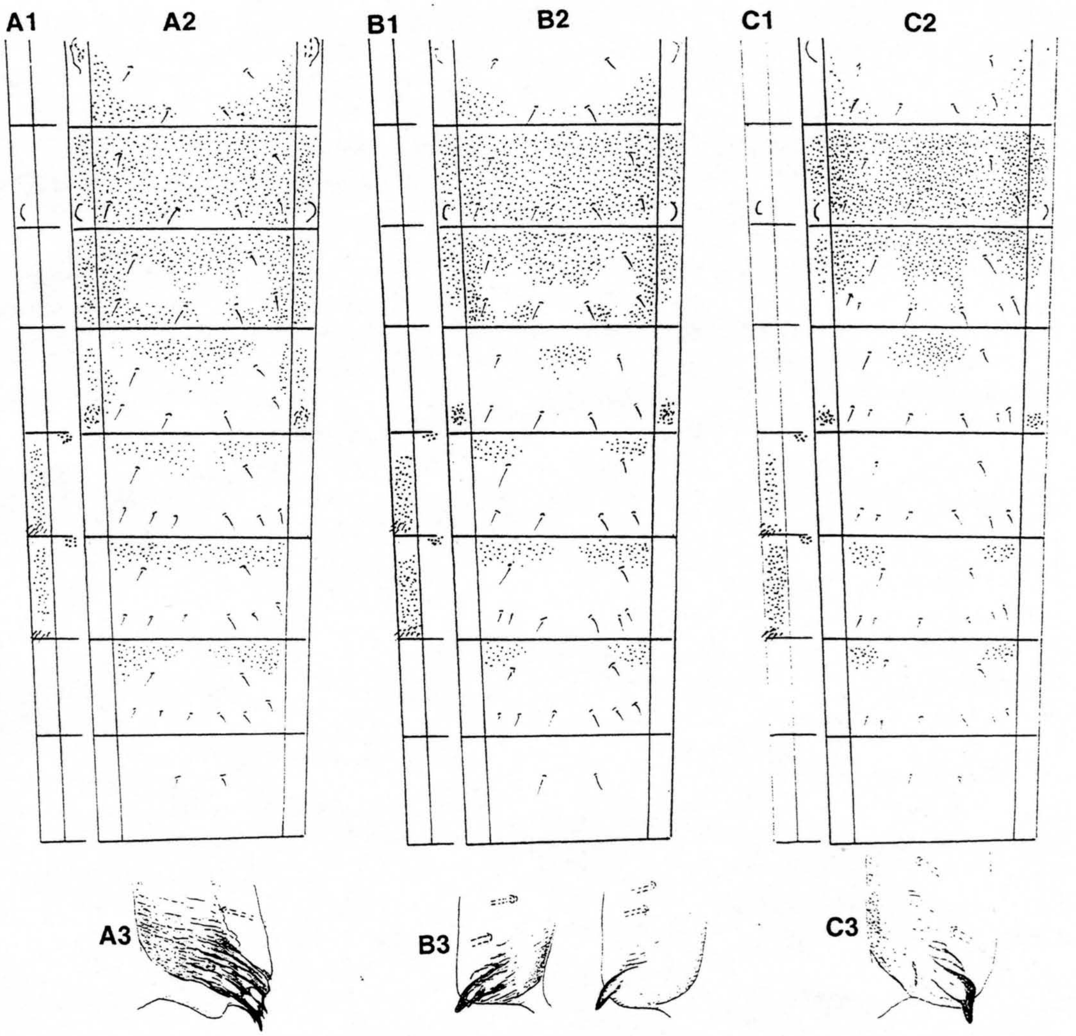

Fig. 2. Pupa: paratergite (A1, B1, C1), sternite and parasternite (A2, B2, C2) and anal spur of segment 8 (A3, B3, C3) in *Chironomus (Lobochironomus) improvidus* sp.n.(A), *C.(L.) storai* Goetghebuer (B) and *C. (L.) mendax* (Storå) (C).

the pupa (position in the slide very good) but 66 (difficult to count)-78 respectively in the emerged specimen, witch the following measurements: *LR*: P1 1.65, *P2* 0.54, *P3* 0.63. *BR*: *P1* 1.3, *P2* 1.2, *P3* 1.1. Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 400	1 500	1 550
Tibia	1 150	1 450	1 790
Tarsus 1	1 900	780	1 120
Tarsus 2	810	410	640
Tarsus 3	660	300	500
Tarsus 4	560	200	250
Tarsus 5	260	140	150

The spermathecae (Fig. 6A 2) similar to that in the original material from Kuusamo, oval, 160 µm long, with a short indistinct neck; 30-42 setae were counted on a large pale part of sternite 8.

Pupa (Fig. 2B1-3, Fig. 4C)

Exuviae 9.5-10.5 mm long, quite evenly darkened, antero-dorsally moderately granulated to the base of the wing sheats, where instead of the granulation a thin reticulate structure can be seen. Frontal apotome with cephalic tubercles, up to about 150 μm long and 80-100 μm broad, each with a small preapical seta. Basal ring 160-170 x 80-90 μm, its tracheal patch with about 10 tracheoles across, about 2.5 μm in diameter.

Shagreen on tergites roughly the same type as illustrated by Pinder and Reiss (1986: 10.19F) spreading on tergites 2 and 3 not to the anterior-median adhesion marks, but reaches especially anteriorly and posteriorly on tergites 4-6(7) more towards the lateral row of the adhesion marks (a variable "X form"). Paratergites 5 and 6 spinulated; anal corners of these segments with longer spinules. On segment 2 pedes spurii B and 60-81 hooklets in the hook row, the latter in the middle narrowly broken; most of the hooks with some minute dorsal denticles. Other intersegmental orally directed small spinules close behind the armament of tergites 4-5 are present. Points on the pleural region of segment 4 were not observed.

Parasternite 2 and 3 densely shagreened. Fine shagreen on the posterior and lateral parts of sternite 1 is present. Sternite 2 is shagreened broadly, but the shagreen on sternite 3 is reduced between the V setae; there are, however, spinules near the lateral and hind borders of the sternite. On the 4th sternite there is only an antero-median patch of spinules present. Patches of spinules are present on the antero-lateral corners of the sternites 5-7, but on sternite 8 no spinules were obserwed.

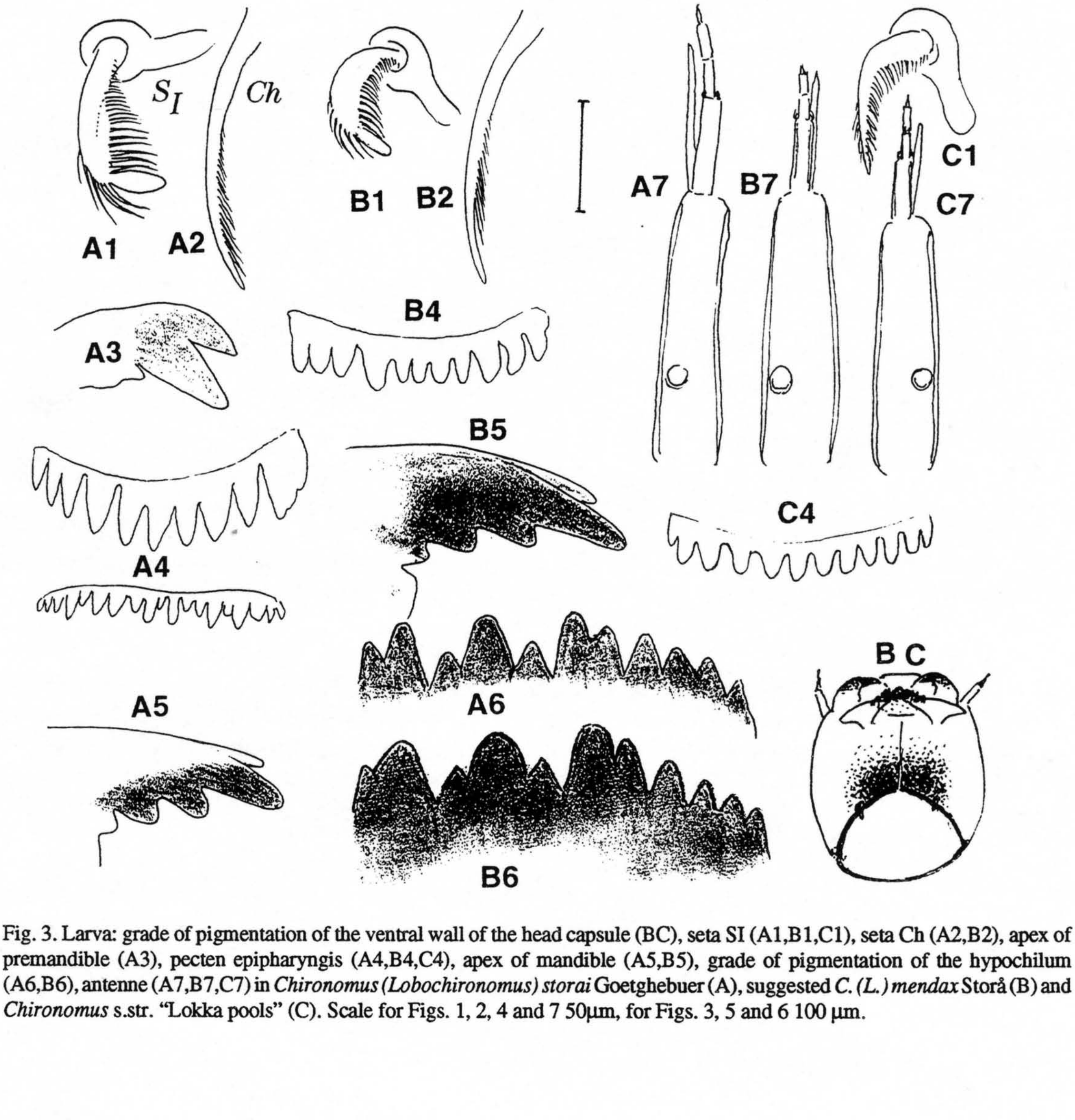

Fig. 3. Larva: grade of pigmentation of the ventral wall of the head capsule (BC), seta SI (A1,B1,C1), seta Ch (A2,B2), apex of premandible (A3), pecten epipharyngis (A4,B4,C4), apex of mandible (A5,B5), grade of pigmentation of the hypochilum (A6,B6), antenne (A7,B7,C7) in *Chironomus (Lobochironomus) storai* Goetghebuer (A), suggested *C. (L.) mendax* Storå (B) and *Chironomus* s.str. "Lokka pools" (C). Scale for Figs. 1, 2, 4 and 7 50μm, for Figs. 3, 5 and 6 100 μm.

Lateral setae on segments 1-8: 0, 3, 3+1, 3+1, and taeniate 4, 4, 4, 4-5. The spurs on segment 8 are from one blunt tooth, which may be accompanied by 1-3 much smaller teeth. The anal lobe fringe of the taeniae somewhat irregularly arranged, apically pluriserial, the number of taeniae being 101-126. One dorsal taenia on both sides on the proximal half, near the middle of the anal segment is present.

Larva (Fig. 3A1-7)

About 13 mm long, in the live animal quite red. The lateral tubules of segment 7 >180 µm; the ventral and anal tubules long, not measurable with certainty in the present slides. Head capsule about 850 µm long, 700 µm broad, very pale with dark teeth; foramen occipitale has a dark margin ventrally up to the triangulum. Claws of the anterior pseudopods pale, shortly finely serrated; claws of the posterior pseudopods also pale.

In the sensory field of the labrum S_I about 70-80 µm long feathered on one side except apically on both sides; the apical hair is large, somewhat oval, much broader than the others. The long *Ch* setae feathered on the apical half nearly up to their apex.

Pecten epipharyngis with 17-18 teeth of different size; in the larva associated with the adults, however, 10 large teeth only.(There is a question of whether the larvae are conspecific!)

Premandibles apically and proximally a little pigmented; the dorsal tooth seems to be a little shorter than the ventral tooth; both teeth are, if viewed from the apex, quite broad. Mandibles pale; dentes 3-5 dark,the most proximal (6th) tooth, which is a little broader (4:7) than one half of the preceding inner teeth (5th; see Hirvenoja & Michailova 1998). Only the teeth of the hypochilum are dark. Paralabials with about 40 striae, which are absent in the anterior half, the anterior edge of which is smooth.

Antennae up to 230 µm long. Lauterborn organs very small. Antennal blade reaches to the 4th segment. RO about in the apical part of the first third of the first segment. Last segments together about as long as the distance from RO to the apex of the first segment; proportions of the lengths of the segments:

100 : 32 : 13 : 13 : 6
100 : 33 : 11 : 11 : 6

Comment

The sampling sites (Kuusamo: Village with a church and Isosuo) of the type material of *C. storai* is only about 200 km south of Lokka. The present species has been determined as *C. storai* Goetghebuer also because of the male characteristics, which in most details corresponds with that of the type material. The females associated with the original male material agree well with the females of the new material.

The material from Tvärminne, southern Finland was determined to be conspecificious with the individuals from Lokka especially because of the similar pupal exuviae. The coloration of the adults in the present material is variable. Some fresh, not pigmented individuals may because of their dark fore tibiae resemble *Einfeldia pectoralis* Kieffer, in which, however, the femora are only for a short distance dark at the apex and the thorax is dorsally very pale without pigmentation between the scutal stripes; the *BR* values of *E. pectoralis* are also a little higher.

Ryser et al. (1985: 397) suggest an arcto-alpine distribution for *C. storai.* Its occurrence also in the SW archipelago of Finland corresponds in this respect to the distribution pattern of some other species, which is illustrated for instance in Jansson (1980, 1986: 32).

Chironomus (Lobochironomus) mendax Storå

The type material (males)

The adult males of *C. mendax* have according to the original description (Storå 1937: 260-261) multicoloured legs, and the thorax is yellow with well separated dark scutal stripes. The syntypes, two pinned males in the collections of the Zoological Museum, Finnish Museum of Natural History (Helsinki), have a scutum with dark brownish well separated scutal stripes; the obscurely yellowish ground color (yellow with a brownish nuance) is clearly visible. There is in the Zoological Museum, Helsinki, however, also a 3rd pinned male individual (mentioned also in the original description) from the type locality of *C. mendax,* which is Kuusamo, Isosuo (23.7.1935, R. Krogerus leg.). This individual has been provided with a label "*mendax*" and with a pinned preparation of the hypopygium (mounted in gummi arabicum? on a piece of celluloid), perhaps the same from which Storå (1937: 260) has drawn the Fig. 4 for his description. The slide has been dried and there are air bubbles in it. Appendage 1a is no longer in precisely the same position as in the Fig. 4 of Storå, but has been pressed into a more typical position, resembling those in the hypopygia of the designated syntypes. This specimen has not been labelled by Storå as a type, perhaps because it has, in contrast to the two males with the type labels, a darker scutum (luna *mendax*!).

The hypopygia of the type individuals were studied and mounted in Euparal by B. Lindeberg in connection with the type questions presented by Ryser et al. (1985) when preparing their paper. The rest of the body of the pinned type Nr.4988 has been mounted to the same object glass in Euparal and designated and labelled by the present author as the lectotype, which is confirmed here.

The lectotype has among others an antenna (*AR* 3.1), but also one whole middle leg, from which it was possible to count 5 sensilla chaetica near the apex of Ta_1.

The hypopygium of *C. mendax*, illustrated in the present paper (Fig. 6C), belongs to an individual from Inari, Kortejärvi, northern Finland, 26.6.1971, P.Virtanen leg.; it has been preserved in the Zoological Museum, Helsinki, and prepared by B. Lindeberg. It is similar to those of the original syntypes, but its condition is better and it shows more details. Unfortunately also this individual has no fore tarsi.

The suggested females of *C. mendax* from Lokka pools

Material: 2 females, one of them with pupal and larval exuviae, Lokka pools (M.H.)

(The individuals are somewhat damaged.) The ground color of the pale parts obscurely yellowish, but the thorax and the abdomen are relatively dark; dc setae on pale spots, 38-42 in number. All femora proximally pale with an apical dark quarter. Two proximal quarters and the apical quarter of the tibiae darker than their third quarter. Fore tarsus less pigmented than those of the mid and hind legs, but also apices of Ta_1 and Ta_2 may be shortly darker than their proximal parts. Palps (2-5): 60-80, 300-320, 300-330, and 430-450 µm. Wing 4.5-5.2 mm. *LR*: P_1 1.38-1.42, P_2 0.57-0.58, P_3 0.71-0.71. Number of sensilla chaetica: P_2/Ta_1 104-120, P_3/Ta_1 124-132. *BR*: P_1 1.5-2.7, P_2 1.3-1.7, P_3 3.1-3.7. Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 900-1 900	2 000-2 050	2 150-2 200
Tibia	1 790-1 850	1 940-1 950	2 320-2 350
Tarsus 1	2 550-2 560	1 110-1 130	1 650-1 660
Tarsus 2	1 280-1 300	620-670	950-950
Tarsus 3	950-950	450-480	660-670
Tarsus 4	830-850	300-320	400-420
Tarsus 5	370-410	200-210	230-240

Spermathecae about 200 µm long, oval; the ductus spermathecae beginnt before its proximal end (Fig. 6C 1).

The associated pupal exuviae from Lokka pools (Fig. 2C1-3, Fig. 4B)

Exuviae 8.5 mm long, quite evenly darkened, antero-dorsally moderately granulated to the base of the wing sheats, where instead of the granulation a field of fine dark spines can be seen. Frontal apotome with cephalic tubercles, up to about 80 µm long and 70 µm broad, each with a small preapical seta. Basal ring 130 x 65 µm, its tracheal patch with about 10 tracheoles across, about 2 µm in diameter.

Shagreen on tergites roughly the same type as illustrated by Pinder and Reiss (1986: 10.19F) spreading on tergite 2 less over the anterior-median adhesion marks anteriorly or laterally than on the tergites 3-6 towards the lateral row of the adhesion marks (a variable "X form"). Paratergites 5 and 6 spinulated; anal corners of these segments with longer spinules. On segment 2 pedes spurii B and about 85 hooklets in the hookrow, the row is broken in the middle; most of the hooks with one minute, dorsal denticle. Other intersegmental orally directed small spinules close behind the armament of tergites 4-5 are present. Points on the pleural region of segment 6 were not observed.

Parasternite 2 and the anterior half of parasternite 3 spinulated. A very fine, sparsely shagreen on the posterior and lateral parts of the sternite 1 is present. Sternite 2 is shagreened broadly, but the shagreen on sternite 3 is reduced posteriorly; sternite 4 has an antero-median patch of spinules, but the sternite 5 is smooth. Small patches of spinules are on the antero-lateral corners of the sternites 6-7 present, but on sternite 8 no spinules were obserwed.

Lateral setae on segments 1-8: 0, 3, 3+1, 3+1 and taeniate 4, 4, 4, 4-5. Spurs on segment 8 with one apical tooth. Anal lobe fringe of taeniae proximally uniserial, apically pluriserial, the number of taeniae being about 80. Two dorsal taenia on both sides on the proximal half of the anal segment are present, the one near the middle and the other proximally of the anal segment.

The exuviae of the associated larva from Lokka pools (Fig. 3B1-7)

Head capsule about 800 µm long and 700 µm broad. The foramen occipitale is provided with a dark margin and the ventral wall of the head capsule has a dark spot, which reaches anteriorly about to the middle of the head and laterally towards the genae not much over the posterior tentorial holding marks on the foramen occipitale. Claws of the anterior and posterior pseudopods a little darkened.

On the sensory field of the labrum S_1 (the position in the slide is bad) perhaps 70-80 µm long feathered on one side except apically on both sides; its most apical hair is broader than the others, but obviously narrower than in *C. storai*. The long *Ch* setae feathered on the apical half, but the bare apex is about 3 times longer than in *C. storai*.

Pecten epipharyngis with 11 teeth. Premandibles apically and proximally darkened. Mandibles apically dark. The most proximal (6th) tooth is broader (2:3) than one half of the preceding inner teeth (5th). Hypochilum apically longer dark than in *C. storai*. Paralabials with about 40 striae, which are absent in the anterior half, the anterior edge of which is smooth.

Antennae (the apex not straight in the slide) obviously a little shorter than in *C. storai*, over 200 µm. Lauterborn organs small. Antennal blade reaches to the 4th segment. RO about in the apical part of the first third of the first segment. Proportions of the lengths of the segments: 100 : 31 : 11 : ? : 6

Comment

The present material has been determined as *C. mendax*, because of its coloration among other factors. Also the type locality of *C. mendax* is only about 200 km south of the Lokka area. According to the description of Storå (1937) *C. mendax* resembles *E. dilatatus* Goetghebuer (*E. palearcticus* Ashe, cf. Cranston and Ashe 1990: 278). In *E. palearcticus* the thorax as well as the legs except for the darkened tarsi should be according to Goetghebuer (1937-1954: 30) pale green.

A species, which according to the literature may have as the adults multicoloured legs like *C. mendax*, is *E. dissidens* Walker, the pupa of which has, however, both frontal tubercles and frontal warts. The found exuviae from the Lokka pools, determined here as *C. mendax* have the cephalic tubercles only. The few specimens of *E. dissidens* from Finland preserved in the Zoological Museum, Helsinki, have nearly unicolorous legs, but the males have a typical hypopygium (Fig. 6D) with styli, which are not expanded proximally (cf. Pinder 1978, Fig. 58 H, 151 D). The number of sensilla chaetica is 13-22 on $P_{2\text{-}3}$ in these specimens, being thus much higher than in *C. mendax*.

Ryser et al. (1985) have determined a species from Abisko, Sweden as *C. (L.) mendax,* because of the similarity with the illustration of the hypopygium by Storå (1937, Fig. 4); the appendage 1a resembles in this figure that of *Einfeldia dissidens*, but the stylus is similar to the type specimens of *C. mendax*. The characters given by Ryser et al. (1985) or by Langton (1991) for the pupal exuviae do not allow us to identify this species with the single pupal exuviae of the suggested *C. mendax* female from the Lokka pools. The head capsule of the larva of *C. mendax* sensu Ryser et al. (1985: 389) has a pale head, but that from Lokka has, as mentioned before, a dark spot on the ventral wall of the head capsule. (Because of a possible erroneous association new materials are now needed.)

Chironomus (Lobochironomus) improvidus sp.n.

Material: The holotype: 1 reared male specimen with its pupal exuviae, from the Lokka pools in the author´s collection.

Male

The ground color of the pale parts yellowish. Thorax and abdomen dorsally dark, sutellum and all legs pale; 27 *dc* setae on very distinct pale spots. *AR* 3.7. Frontal tubercles about 20 µm. Palps (2-5): 80, 300, 300 and 370 µm. Wing 4.2 mm. *LR*: P_1 1.54, P_2

0.59, P_3 0.72. Number of sensilla chaetica: (distally on) $P_{2\text{-}3}/Ta_1$ 6. *BR*: P_1 2.6, P_2 2.0, P_3 3.9. Legs in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 450	1 600	1 650
Tibia	1 250	1 350	1 650
Tarsus 1	1 930	910	1 400
Tarsus 2	950	520	730
Tarsus 3	800	370	550
Tarsus 4	630	260	330
Tarsus 5	290	160	200

Hypopygium as in Fig. 6B; processus analis apically round, 40 µm broad, constricted proximally. Appendage 1(+1a) probably not possible to distinguish from that of some relatives with certainty; appendage 1a directed approximately to the apex of the processus analis. Appendage 2 nearly 5 times as long as broad.

Pupa (Fig. 2A1-3, Fig. 4A)

Exuviae 9.5 mm long; with a quite pale abdomen; cephalothorax a little darker, antero-dorsally relatively weakly granulated to the base of the wing sheats. Frontal apotome with cephalic tubercles, up to about 150 µm long and 100 µm broad, each with a small preapical seta. Basal ring 140 x 60 µm, its tracheal patch with about 10 tracheoles across, about 2.5 µm in diameter.

Shagreen on tergites roughly the same type as illustrated by Pinder and Reiss (1986: 10.19F), spreading on tergite 2 not over the anterior-median adhesion marks, but reaches more anteriorly and laterally on tergites 3-6. Paratergites 5 and 6 spinulated; anal corners of these segments are provided with longer spinules. On segment 2 pedes spurii B and 73 hooklets are present in the hook row, which is in the middle narrowly broken; some of the hooks with one minute dorsal denticle. Other intersegmental orally directed small spinules close behind the armament of tergites 4-5 are present. Points on the pleural region of segment 4 were not observed.

Fine shagreen on the anal and lateral parts of sternite 1 is present; a few indistinct spines are also visible on the anterolateral mounds, but other parts of the parasternite 1 are bare. Sternite 2 shagreened broadly and also the parasternite of this segment are shagreened. The shagreen on sternite 3 is reduced from an area between the V setae and there are on the sternite 4 only an antero-median patch and on the lateral sides longitudinal patches of spinules present, but on both segments also parasternites are spinulated. More or less complete rows of spinules are on the anterior part of the sternites 5-7 present. On sternite 8 no spinules were observed.

Lateral setae on segments 1-8: 0, 3, 3+1, 3+1, and taeniate 4, 3-4, 3-4, 4. Spurs on segment 8 partly reticularly chitinized, with one apical tooth, which is accompanied by 1-2 smaller teeth. Anal lobe fringe of taeniae somewhat irregularly arranged, their number being 73. One dorsal taenia on both sides on the proximal half of the anal segment is present.

Comment

Determined according to the key of Pinder and Reiss (1986: 320) the pupal exuviae of the new species could belong to the *Einfeldia* group C as well as those of the two other species from the Lokka pools, though the anal spur is more complicated. Following the line of thought, which is presented in Hirvenoja (1997: 217), the abundant spinulation of the sternites and parasternites in *C. improvidus* gives an impression of more of a plesiomorphous grade than is seen in the exuviae of *C. storai* and *C. mendax*.

The adult specimen described here is very similar in comparison to many other species, which are in different papers have included in "*Einfeldia* s. lat.".

Concluding remarks

The diversity of the macroinvertebrates from the shore pools in 1995 was calculated (without the individuals of *Daphnia* not counted) using the often used diversity index (H') of Shannon & Weaver. The relatively low index 2.630 obtained, perhaps more reflects the ecological limitations in the type of the biotopes studied than defects in the sampling or determination of the species.

In the material taken on 9. June 1989 from the same pools as 1995 among others the chaoborid species were not found and culicid species were represented by the following inhabitants of temporary vernal pools: *Aedes communis* DeGeer, *A. diantaeus* Howard, Dyar & Knab and *A. excrucians* (Walker). These have been earlier found in temporary snow melting pools in the study area (cf. Hirvenoja (1961, 1962d) sometimes coexisting with *Mochlonyx culiciformis*. On the contrary *Cryophila lapponica* had not earlier than 1995 been found here. Rearing attempts were also rather unsuccesful in 1989, but *Endochironomus impar*, *C. storai* and *Chironomus* s.str.sp. were present in both years. The differences in the other taxa between different years might refer to a somewhat labile fauna because the stability of the aquatic phase. There is, however, a two weeks difference between the sampling days (9.6.1989-22.6.1995), which gives enough time for the vernal culicids to disappear because of the emergence, which was found to occur about in the middle of June 1961 (Hirvenoja 1962).

From the material of 1989 individuals of *Endochironomus impar* were reared and among others one male adult emerged. All the larvae had a typical hypochilum of *E. impar*, which resembles that of *Tribelos intextus* (Walker). Pinder and Reiss (1983, Fig. 10.26B) have illustrated a maxillar sclerite (cardo) with several apically smooth denticles for *E. impar*. Such a cardo was not found in the larvae studied from the Lokka pools (Fig. 4), but the dorsal sclerites of the head, as well as the plumose seta premandibularis did agree well with those illustrated in Fig. 10.26F by Pinder and Reiss (1983) for *E. impar*.

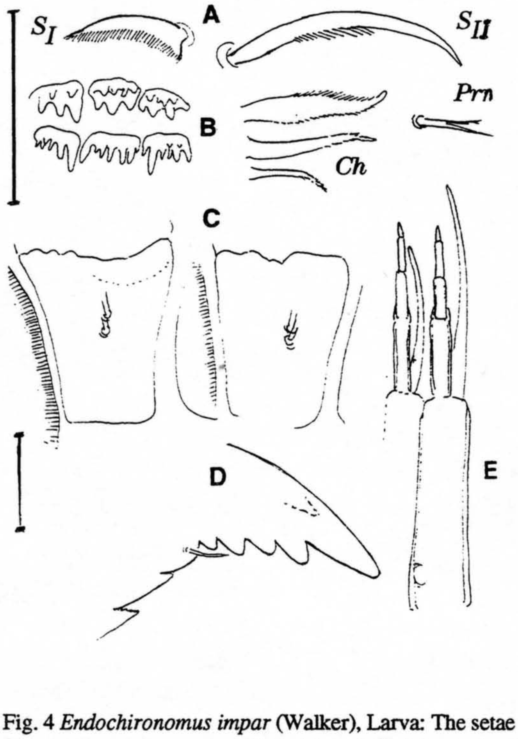

Fig. 4 *Endochironomus impar* (Walker), Larva: The setae S_I, S_{II} and *Prm* (seta premandibularis) and *Ch* (chaetae) of the labrum (A). Pecten epipharyngis in different positions (B). Two examples from the "maxillar sclerite" (cardo) (C). Apex of the mandible (D). Variation in the antenne (E). Scales 50 µm.

The Lokka Reservoir itself, with a muddy (dy) or peat bottom is a mesotrophic or meseutrophic *Chironomus* biotope (Hirvenoja & Michailova 1998). Like in the most aquatic habitats in northern Finland the conductivity of its water is low (in Lokka roughly around 2.0 mS/m, pH 6.5-6.7).

In the zooplankton of Lokka in June 1984 large species of Cladocera, such as *Daphnia galeata* Sars, *Holopedium gibberum* Zaddach and *Bythotrephes longimanus* Leydig were observed in abundance. However, in a large "pond", which was dammed by the peat rafts, *Ophryoxus gracilis* Sars was found at the same period in abundance instead of the species mentioned above. Furthermore in the most northern part of the reservoir, in the plankton of the inundated lake Sompiojärvi, where the bottom consisted of ooze (gyttja), at the same time *Eubosmina obtusirostris* Sars predominated (as it did in 1959 before the damming of Lokka). Because also areas with a sand bottom are to be found in some parts of the Lokka resevoir, different kinds of niches are abundantly present.

An interesting feature in the regulated lake, which may be an important sign from the conditions and composition for some other components of the fauna, is the finding of one individual of *Lyncheus brachyurus* (O.F.M.) (Crustacea, Branchiopoda, Conchostraca) from the shore of the Lokka reservoir 1984; the individual found had penetrated into a large pupal exuviae of a *Chironomus* sp. Because *L. brachyurus* is a species of temporary waters, it obviously reflects the influence of the regulation of the water level, which leaves parts of the area more-or-less regularly dry. It is not known if the large, only partly drying reservoir proper can function as a breeding site like the temporary waters, or if the specimen found originated from the inundation pools to the reservoir, where it was found.

This Lokka find is obviously the third recorded in Finland. Kuusela and Torssonen (1981) reported *L. brachyurus* from Sattajärvi, Tornio, northern Finland and discussed its occurrence in Finland and in northern Europe. Sattajärvi is an eutrophic lake 78 hectares in area, with a temporary vernal water body, which has been used as a natural rearing pond for whitefish.

The taxonomy of the genus *Chironomus* has been considered to be difficult and to need karyological determination. Especially the morphological details of the pupal exuviae found among others on the sternites seem, however, to give possibilities for the morphological determinations at the species level. The preparations of the exuviae may be good to done as described in Hirvenoja (1997: 215).

Figures 1A3 and 5 are illustrations from the small posterior tracheal bladders, which are to be found in the cephalothorax of the pupal exuviae near the base of the sheats of the halteres. They have not otherwise been included here in the descriptions or determination keys because of their unknown variability. Shilova (1980) as well as Pinder and Reiss (1983) have found among others differences in the *si* setae of mandibles in the larvae of *Einfeldia*, which also in the present species seem to have some differences, however they too uncertain to draw reliably from the present sparse material.

Three of the species described or redescribed before belong morphologically to the pupal or larval group C of *Einfeldia* in Pinder and Reiss (1983, 1986). The pupae of this group are among the species, which are often included to *Einfeldia*, relatively plesiomorphous in some respects. In comparison to *E. pagana* (Meigen) and *E. pectoralis* they have still intersegmental spinules behind the tergites 4 and 5 and further also the paratergites 6 are spinulated. To this their larvae seem to be (plesiomorphously) inseparable from those of the genus *Chironomus*. Ryser et al. (1985; cf. Langton 1991) have delimitated certain species of the group C as the subgenus *Lobochironomus* of the genus *Chironomus*. A combination of the group C of *Einfeldia* alone with *Chironomus* s.str. obviously gives a paraphyletic genus, but a delimitation of the adults of "*Einfeldia* s.lat. "into different subgenera is perhaps also a quite complicated task.

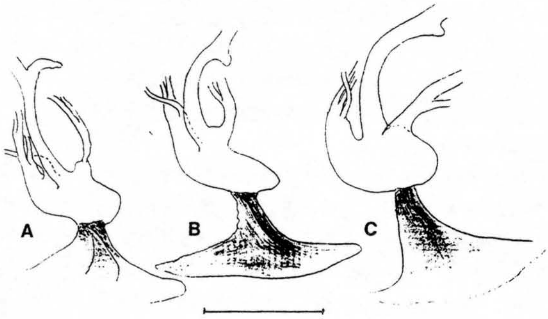

Fig. 5. Pupa: posterior thoracal tracheal bladder (see text p. 00) of *C. (L.) improvidus* sp.n. (A), *C.(L.) mendax* (Storå) (B) and *C. (L.) storai* Goetghebuer (C). Scale 100 µm.

Summarizing the descriptions above in the present paper, the pupae of the three species can be tentatively be keyed as follows:

1(2) Parasternite (1)2-4 more-or-less spinulated; along the lateral parts of these sternites spinules are also present. (Spur of segment 8 partly reticularly chitinized, with one apical and some smaller additional teeth)........................*improvidus* sp.n.

2(1) At most parasternite 2 and 3 spinulated (spur of segment 8 not with reticular structures)...............................3

3(4) Spinules along the lateral and hind borders of sternite 3 present; patches of spinules distinct on the antero-lateral corners of sternite 5.................................*storai* Goetghebuer

4(3) The hind corners (near setae V3-4) of sternite 3 not spinulated; patches of spinules on sternite 5 are absent ....*mendax* Storå

A tentative key for the male adults of "*Einfeldia* s.lat." found in Finland

From Finland have up to now been found the most European species, which have been included to *Einfeldia*, the status of which has changed from a subgenus to a genus (cf. for instance Kieffer 1924, Goetghebuer 1937-1954, Pinder 1978, Pinder and Reiss 1983, 1986, Cranston, Dillon, Pinder and Reiss 1989, Ashe and Cranston 1990). The dark species *E. carbonaria* (Meigen), the pupa (Langton 1991) of which has both the frontal warts as well as cephalic tubercles, has not been found. Further the green species *E. palearcticus* Ashe (syn. *dilatatus* Goetghebuer) and *C. (Lobochironomus) montuosus* Ryser, Wülker & Scholl., the latter being obviously very similar to *C. (L.) storai*, have also not been recorded from Finland.

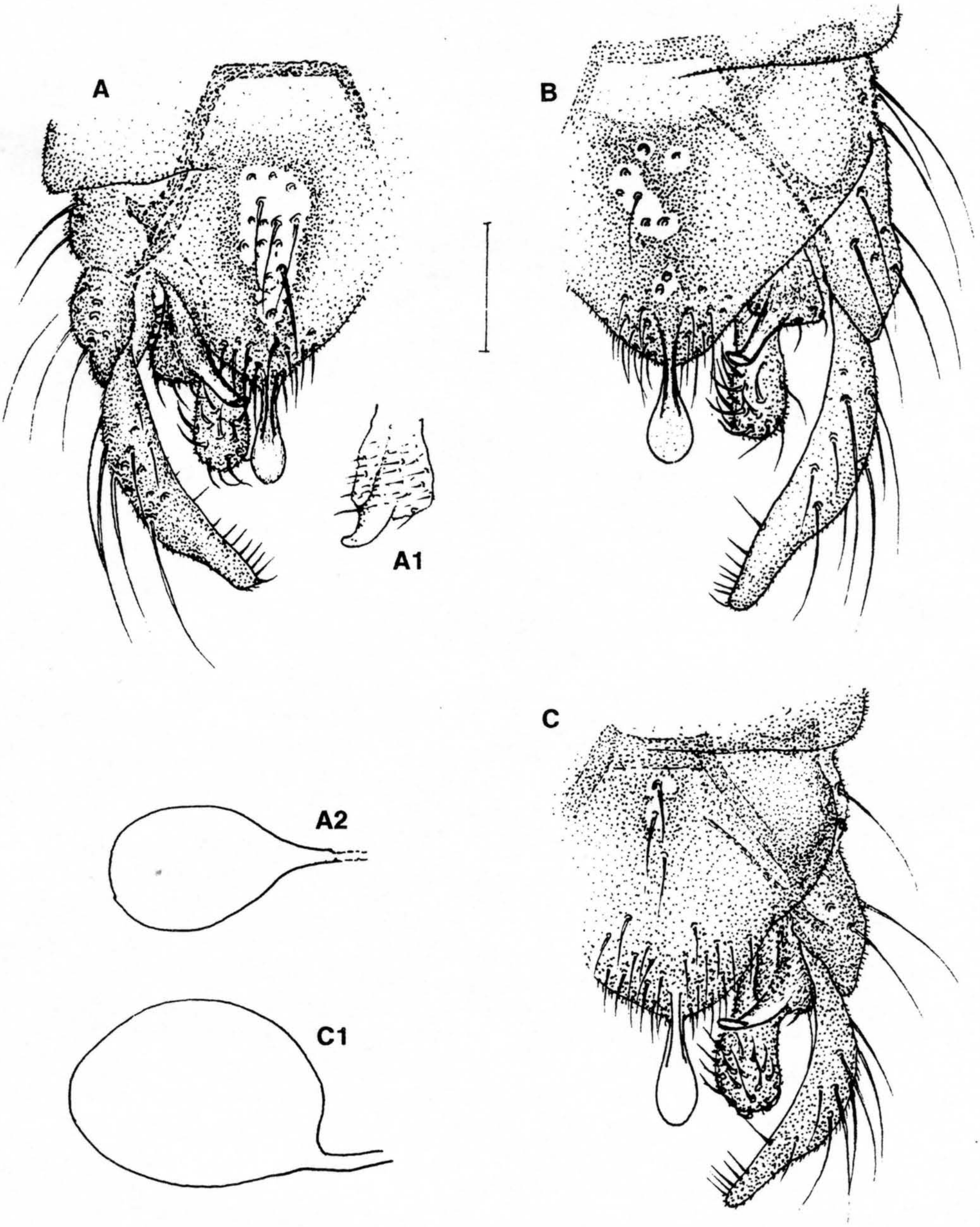

Fig. 6. *Chironomus (Lobochironomus) storai* Goetghebuer, hypopygium of the male (A), appendages 1+1a ventrally (A1), spermatheca of the female (A2). *C. (L.) improvidus* sp. n., hypopygium of the male (B). *C. (L) mendax* (Storå), hypopygium of the male (C), spermatheca of the suggested female (C1). Scale 100 µm.

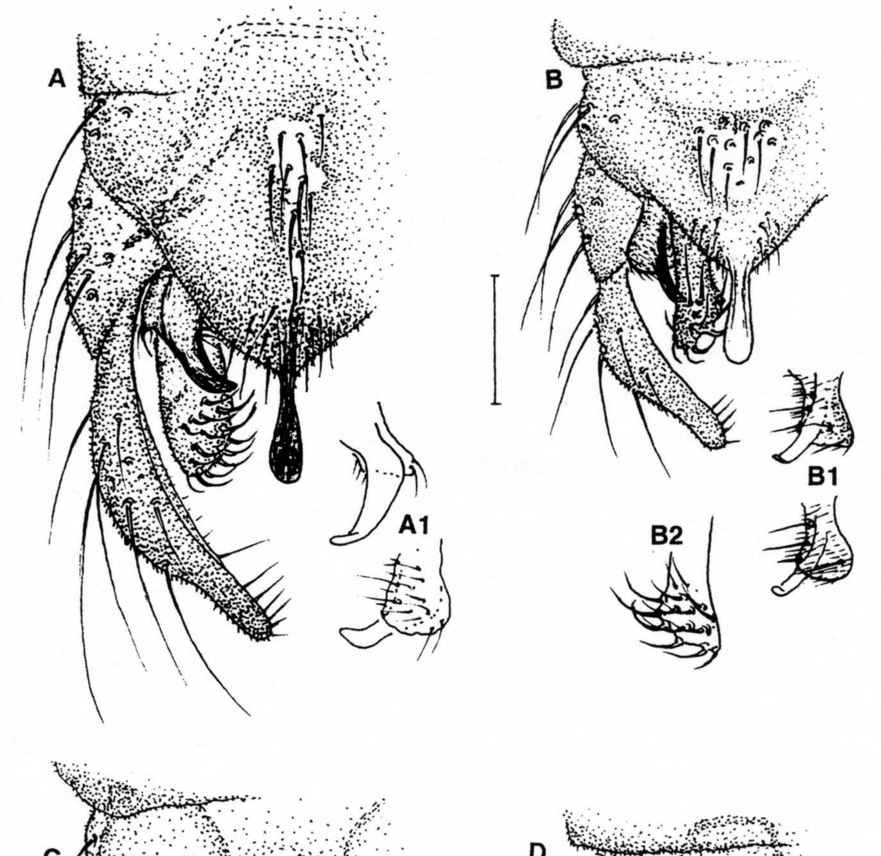

Fig. 7. *Einfeldia pectoralis* Kieffer, hypopygium of the male (A), different views from appendages 1+1a (A1). *E. longipes* (Staeger), hypopygium of the male (B), appendages 1+1a ventrally (B1) and apex of appendage 2 (B2). *E. pagana* (Meigen), hypopygium of the male (C). *E. dissidens* (Walker), hypopygium of the male (D) and appendages 1+1a ventrally (D1). Scale 100 µm.

To better describe the position of the new species *C. (L.) improvidus*, a tentative key has been compiled here for the male adults on the basis of the Finnish material, which partly (B. Lindeberg, P. Virtanen and J. Tuiskunen leg.) is in the collections of the Zoological Museum, Finnish Museum of Natural History (Helsinki) or in the author´s collections in Vantaa, Finland.

The classical names for the details in the male hypopygium have been used here, because they give more freedom in attempts to find the origin for the organs. In "*Einfeldia* s.lat." the appendage 1a of the male hypopygium seems to be plesiomorphously near the grade, which can be found in *Tribelos* Townes, *Camptochironomus* Kieffer or *Tanytarsus* v.d.Wulp for instance. The organs allways originate from an earlier grade of the same organ, or they may arise from the fusion of two different organs like in the simple examples of the different types of nephridia (protonephromixium, metanephromixium etc.), which arise from the combinations of the protonephridium, metanephridium, coelomoductus, ectoderm and mesoderm (see Fig. 259 in Marshall and Williams 1974). The current literature about the Chironomids seems, on the contrary, to homologize the genitalia of the Chironomids with the convergent forms in Hymenoptera without any evidence about the true evolutionary connections between them. Such a practice necessarily puts an end to the evolutionary speculations about the relationships.

1(2) In the hypopygium the appendage 1a has been reduced, forming into the lengthened appendage 1 an apical claw (*Chaetolabis*)..*macani* (Freeman)

2 (1) A short appendage 1a is present.............................3

3 (4) Anal point broad, nearly parallel sided; a pale, greenish species (*AR* 3, *LR* 1.25, *BR* <3).............*pagana* (Meigen)

4 (3) Anal point narrow, constricted proximally.............5

5 (6) Gonostylus not clearly swollen basally. Appendage 1a directed nearly backwards. *AR* 2.5, *LR* c.1.5. Number of sensilla chaetica 14-22 on $P_{2\text{-}3}$. Thorax dark; legs with dark bends, (in the Finnish specimens nearly unicolorous)........... ....*dissidens* (Walker)

6 (5) Outer margin of gonostylus clearly swollen in basal half. Appendage 1a directed more-or-less obliquely towards the anal point...7

7 (8) Pale greenish. Legs nearly unicolorous with brunescent $Ta_{(2)3\text{-}5}$; the apices of Ta_1 may also be shortly darkened. Scutal stripes, thorax ventrally and abdomen dorsally brunescent; *AR* c.3, *LR* 1.7, $BR(P_1)$ 2.6; sensilla chaetica 3-4 in number on $P_{2\text{-}3}$..*longipes* (Staeger)

8 (14) $BR(P_1)<3$. Thorax between the scutal stripes usually more-or-less darkened...9

9 (8) Darker species, pale parts with yellowish shade (in the material preserved in alcohol)..10

10 (11) Thorax brownish yellow or darker, scutal stripes dark. Legs yellow with dark bends, or more darkened, nearly unicolorous. Abdomen dark brown, segment 1 according to the original description brown olive. *AR* 3.1. and sensilla chaetica, 5 in number on P_2 of the lectotype..................*mendax* Storå

11 (10) Scutum dorsally clearly dark; coloration of the legs otherwise...12

12 (13) Legs more-or-less dark; *Fe* and *Ti* of P_1 dark or *Fe* proximally less pigmented, Ta_1/P_1 at least proximally paler than the rest of the fore tarsus. *AR* 3.5-4.2, *LR* 1.30-1.64, BR/P_1 2.2-2.5; sensilla chaetica 6-13 in number on $P_{2\text{-}3}$.......... ....*storai* Goetghebuer

13 (12) Legs (and scutellum) pale; *AR* 3.7, *LR* 1.54, BR/P_1 2.6; sensilla chaetica 6 in number on $P_{2\text{-}3}$.......................... ....*improvidus* sp.n.

14 (7) BR >3 (?>2.8). Thorax dorsally pale, scutal stripes, metanotum and abdomen dorsally dark. All femora pale or shortly apically dark; Ti/P_1, dark, other *Ti* and Ta_1 apically shortly and in all legs $Ta_{(2)3\text{-}5}$ more-or-less darkened. *AR* 3.3-3.4, *LR* 1.40-1.68, BR/P_1 ?2.8-4.1; sensilla chaetica 5-9 in number on $P_{2\text{-}3}$..*pectoralis* Kieffer

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Oulanka Reports 18: 53—61. 1998

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Chironomus coaetaneus sp.n. (Diptera, Chironomidae) from the Lokka Reservoir, northern Finland

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Hirvenoja, M. 1998: *Chironomus coaetaneus* sp.n. (Diptera, Chironomidae) from the Lokka Reservoir, northern Finland. — Oulanka Reports 18: 53—61. ISSN 0358-3651.

The adults and pupae of *Chironomus coaetaneus* sp.n. have been described from the Lokka Reservoir in northern Finland and compared to some of the suggested nearest relatives.

Key words: taxonomy, Chironomidae.

Introduction

Huge swarms of the chironomids along the shores of the Lokka Reservoir (about 27°40´E, 67°55´N) may in the morning especially around the Midsummer wake up the excursionists by singing in different changing tones. This shows, that there are several species present (see Sotavalta 1941, 1944, 1947, 1952). The swarms are usually above the tree tops, where they are impossible to sample if the individuals do not come down to rest.

One of these species used to be *Chironomus coaetaneus* sp.n. (coaetaneus = contemporaneous) described below as new to science. Attempts have been done to get larvae of the new species for the karyological analysis, but they have not succeeded. To be able to make morphological comparations, redescriptions are given below also from the sympatric material, which is available from two other species suggested that they are nearly related to the new species. The morphology of the pupa of *C. coaetaneus* shows relationships to *C. plumosus* Linnaeus (sensu auctt.) and *C. entis* Shobanov, larvae of which from Lokka have been available also for karyological studies.

The last mentioned two species belong to a group of sibling species with small differences. Because there are obviously morphological and karyological differences also between the populations, the populations from Lokka have for the present been treated here under the names *C.* pr. *plumosus* Linnaeus and *C.* pr. *entis* Shobanov. The special karyological differences will be discussed in another connection (Michailova under preparation).

Chironomus coaetaneus sp. n.

Adult specimens from the swarms or emerging adults with their pupal skins from the surface of the water in 9.6.1989 from the Lokka Reservoir, Sodankylä, northern Finland; two floating pupal exuviae (9.6.1989) and one exuviae from the same site (21.6.1984) are also available.

Male (N=5)

Coloration very dark. Frontal tubercles in the head about 40 µm. *AR* 5.0-5.5. Palps (2-5) in µm: 90-100, 300-340, 290-310, 300-320. Dorsocentrals on pale spots 53-70 in number. Wings 5.4-6.2 mm. *LR*: P_1 1.07-1.12, P_2 0.56-0.61, P_3 0.66-0.70. Number of sensilla chaetica: (distally in) P_2/Ta_1 11-15, P_3/Ta_1 8-14. *BR*: P_1 5.9-6.2, P_2 3.5-5.7, P_3 5.0-5.7 Legs (*Fe-Ta5*) in µm:

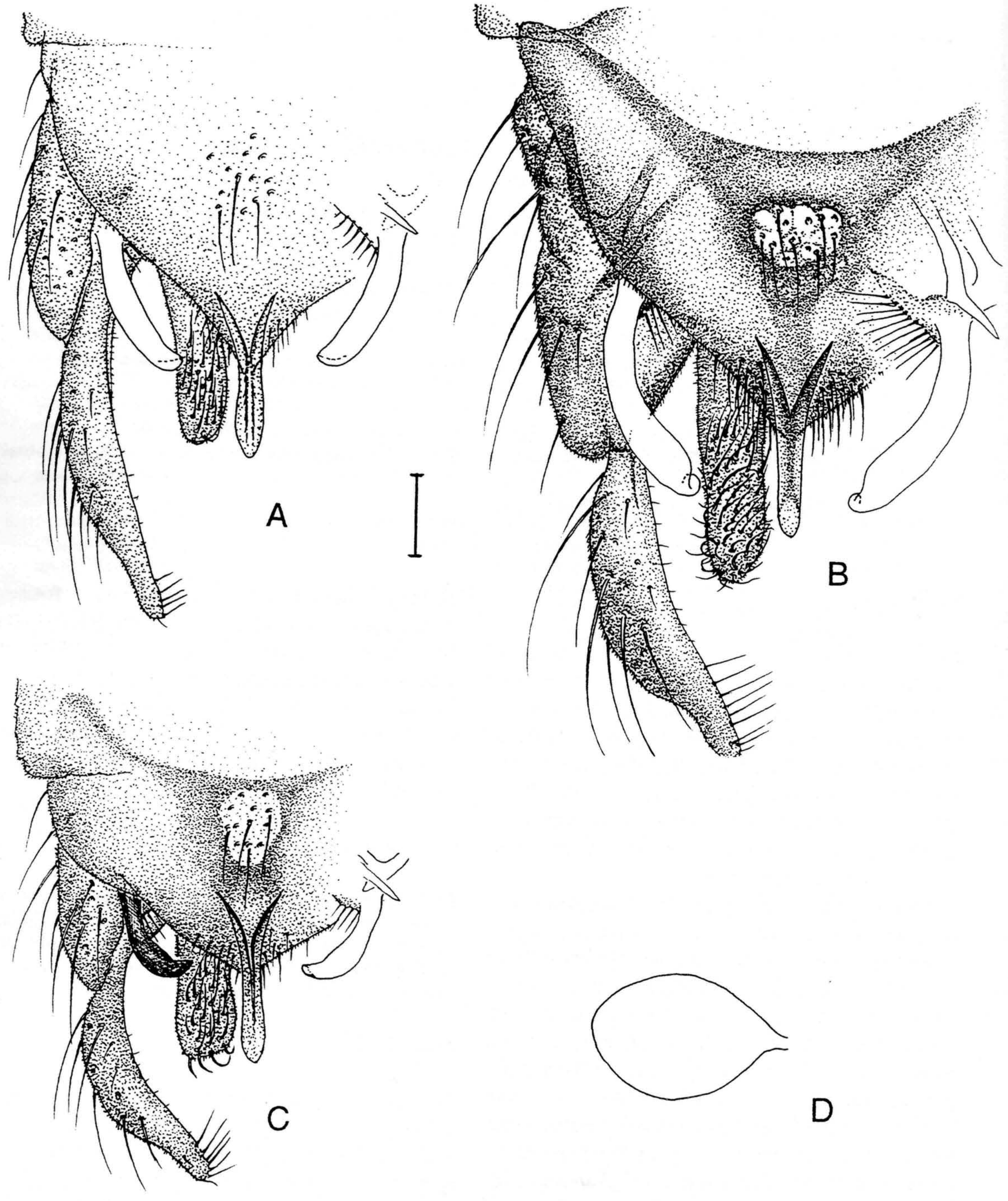

Fig. 1. Hypopygium of the males in the Lokka populations: *Chironomus* pr. *plumosus* Linnaeus (A), *C.* pr. *entis* Shobanov (B), *C. coaetaneus* sp.n. (C). Shape of the spermatheca of the female of *C. coaetaneus* sp.n. (D). Scale = 100 µm.

	Fore leg	Mid leg	Hind leg
Femur	1 630-1 900	1 830-2 000	2 170-2 390
Tibia	1 700-2 110	1 780-2 000	2 280-2 460
Tarsus 1	2 000-2 100	1 070-1 150	1 590-1 670
Tarsus 2	1 150-1 300	670-710	1 020-1 050
Tarsus 3	720-800	460-500	710-740
Tarsus 4	540-610	330-340	410-430
Tarsus 5	280-300	220-230	250-260

Hypopygium dark (Fig. 1C). The anal point proximally 60-70 µm broad, usually constricted a little before the paler, about 35-40 µm broad apex. The dark appendage 1 is a little expanded in its apical half, but narrows towards the knob. Appendage 2 about 3 times as long as broad.

Female (N=5)

Coloration as in the male. Palps (2-5) in µm: 90-100, 270-310, 270-380, 290-310. Dorsocentrals 59-91 in number. Wing 6.0-6.3 mm. *LR:* P_1 1.14-1.18, P_2 0.53-0.57, P_3 0.64-0.68. Number of sensilla chaetica: P_2/Ta_1 58-79, P_3/Ta_1 76-82. *BR:* P_1 1.5-2.0, P_2 2.5-3.2, P_3 3.8-5.0. Legs (*Fe-Ta5*) in µm:

	Fore leg	Mid leg	Hind leg
Femur	1 670-1 960	1 960-2 170	2 220-2 390
Tibia	1 740-1 960	1 960-2 070	2 500-2 610
Tarsus 1	2 000-2 170	1 090-1 150	1 650-1 780
Tarsus 2	1 000-1 300	630-700	960-1090
Tarsus 3	650-760	410-480	670-760
Tarsus 4	520-650	280-330	370-430
Tarsus 5	260-390	220-330	260-300

Spermathecae oval, 190-220 µm long, 160-170 µm broad.

Pupa (N=5)

The relative pale exuviae about 16.5 mm long. Cephalic tubercles about 150 µm long and 120 µm broad, each with a subapical seta. Thorax anteriorly and dorsally in the area of the dc setae more darkened than the other parts; the granulation somewhat developed anteriorly, otherwise restricted to a mid lateral patch of small granulation, not reaching the suture dorsally. Basal ring about 250 µm long, 110-140 µm broad. In the posterior, thoracal tracheal bladder (Fig. 2A) most of the tracheas arise separately from the bladder.

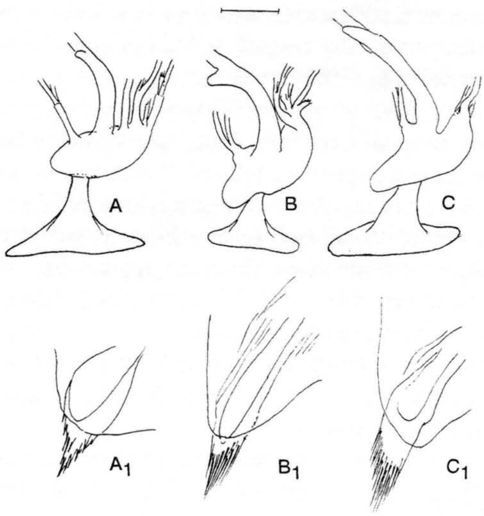

Fig. 2. Posterior thoracal tracheal bladder and sporn of segment 8 in the pupal exuviae of *Chironomus coaetaneus* sp.n.(A, D), *C.* pr. *entis* Shobanov (B, F) and *C.* pr. *plumosus* Linnaeus (C, G). Scale = 100 µm.

Shagreen on tergites 2-8 typical of the genus. Paratergites smooth, but on the posterior corners of the segments 5-7 patches of strong spinules are present; opposite to the other related species the patches of segment 7 are a little weaker than the corresponding patches on the segments 5 and 6 and may be difficult to see in bad preparations. On segment 2 99-105 hooklets present, the medial hooklets with minute dorsal denticles; other intersegmental minute orally directed spinules present behind the armament of the tergites 4, 5 and 6. On segment 4 typical pedes spurii A are present, but no points on the pleural region were observed.

Sternite 1 is provided with a not dense group of median spinules, but sternite 2 is densely spinulated; spinulation on parasternite 2 is present. Lateral short longitudinal rows of spinules and medially a quite large patch of spinules are present on sternite 3; on sternite 4 a few spinules are present on the anterior corners only. On sternite 5-7 the patches spread medially and backwards and may be nearly fused on sternites 6-7. Patches of spinules are also present on both sides of sternite 8 around its ventro-medial seta.

Lateral setae on segments 1-8: 0, 3, 3, 3, (and taeniated) 3, 4, 4, 4. About 10 teeth form the short quite compact spurs of segment 8. Anal lobe with one dorsal taenia on each side, the lateral fringe with more than 100 taeniae, which are in apical part often characteristically tangled, apically also multiserial; then reliably difficult to count.

Taxonomical comment. From species discussed in the present paper the adults of *C. coaetaneus* are the darkest and smallest; without microscopical studies they more resemble *C. anthracinus* Zetterstedt or *C. pilicornis* (Fabricius). Even the appendage 1 of *C. coaetaneus* is totally dark; the first appendages of the sibling species near *C. plumosus* are pale (cf. Lindeberg & Wiederholm 1979), except in *C. bonus* Shilova and Djvarscheischvili, where its top is brown black (Shobanov in Litt.).

The pupae have plesiomorphous features, such as large median patches of spinules on sternite 3, minute intersegmental spinules behind the armament of the tergite 6. (Partly plesiomorphous are patches of spinules on the hind corners of segment 7.) Possible candidates for plesiomorphous structures are also the scattered tracheas arising from the posterior thoracal tracheal bladder in comparison to the others illustrated in Fig. 2.

Chironomus pr. *entis* Shobanov

On 22.6.1995 from the surface of the water an emerging male individual with its pupal exuviae was captured from Lokka.

Male (N=1)

AR 5.4 (length of 12th antennal segment 2.5 mm). Palps (2-5) in µm: 100, 270, 350, 430. Thorax quite dark, but the shoulders are pale; 72 dc setae on pale spots. Wings 7.4 mm. Legs dark brown. *LR:* P_1 1.22, P_2 0.59, P_3 0.69. Number of sensilla chaetica: (distally on) P_2/Ta_1 28, P_3/Ta_1 17. *BR:* P_1 7.7, P_2 1.7, P_3 4.5. Legs in µm :

	Fore leg	Mid leg	Hind leg
Femur	2 300	2 600	3 140
Tibia	2 450	2 550	3 180
Tarsus1	3 000	1 500	2 200
Tarsus2	1 600	810	1 360
Tarsus3	950	640	980
Tarsus4	750	420	550
Tarsus5	420	300	310

Abdominal tergites dark brown with hairs on pale, or pale brownish spots. In the hypopygium the membranous part of the quite dark processus analis a little narrower in the middle than apically (40 µm), the distance of its proximal corners from another 100 µm. The pale appendage 1 apically swollen, 280 µm long, with a narrow knob; a little brownish appendage 2 is 330 µm, roughly 4.5 times as long as medially broad.

Pupa (N=2)

The associated pupal exuviae from Lokka (22.6.1995) and the exuviae from Posolampi found in August 1961.

Exuviae 18.5-22.0 mm long. Cephalic tubercles about 250 µm long and 170 µm broad. Basal ring about 300 x 150 µm. In the posterior small thoracic tracheal bladder (Fig. 2B) the "dorsal" posterior pair of small tracheas arises with a short common origin near the base of the large "dorsal" thick (connecting) trachea; the "apical" tracheas seem to arise from the bladder near another.

On segment 2 there are 99 hooklets present; the median hooks with minute dorsal denticles. Other intersegmental, orally directed, but very small spinules present close behind the armament of the tergites 4 and 5, but not behind that of the 6th tergite. No spinules on the paratergites present except strong patches on the hind corners of segments 5-7. A few minute spines on the pleural region between the l setae on segment 4 present.

Posterior half of sternite 1 and the whole sternite 2 spinulated. Spines on the parasternite not observed in the exuviae from Lokka, but a few were present in that found from Posolampi 1961. Lateral longitudinal rows of spinules on sternite 3 spread in anterior part of the sternite medially but are separated from each other; on sternite 4 spinules on the anterior corners only spreading shorter medially and posteriorly. On sternite 3 posteriorly a median weak group of spinules. On sternites 5-7 the antero-lateral patches spread medially and backwards and are medially fused on sternites 6-7. Patches of spinules on both sides of sternite 8 around its ventromedial seta present.

Lateral setae on segments 1-8: 0, 3, 3, 3, (and taeniate) 4, 4, 4, 4. Spurs on segment 8 with more than 10 long narrow teeth. Number of the lateral taeniae is about 240; 2 dorsal taeniae on the proximal third of the analtergite on one or both sides present.

Taxonomical comment. Available for the morphological comparison were from Coll. Shobanov two males and one female, each one of the males with their pupal exuviae and the female with its pupal and larval exuviae. Results of the comparison:

- The two males, the colour of which varied, agreed quite well with the found single male individual from Lokka. A single specimen available from Lokka is, however, darker and in the hypopygium the pale appendage 1 has apically a little different shape (Fig. 3). The *AR, LR* and *BR* values and the numbers of tarsal sensilla chaetica agree quite well. From the key characters used by Shobanov in his unpublished key, the number of the median setae of the 2nd sternite (41 in the specimen from Lokka) should be, however, much higher in *C. entis* Shobanov.

- The pupal exuviae from Lokka agree also quite well with those of Shobanov. Differences were found in the shagreen of the 3rd sternite, where in the material of Shobanov patches of a triangular median spinules may occur anteriorly. In the specimen from Lokka there are no median patches of spinules on sternite 3.

The female pupal exuviae, which is here included to *C.* pr. *entis* was found by the writer floating on the surface on 8. August 1961, which shows, that the species inhabited the study area before the damming of Lokka. In the exuviae from Posolampi there is - in contrast to the material of Shobanov - a weakly triangular patch posteriorly in the 3rd sternite (Fig. 2B).

Several larvae found in Lokka show the characteristic of *C. entis* described by Shobanov (1989).

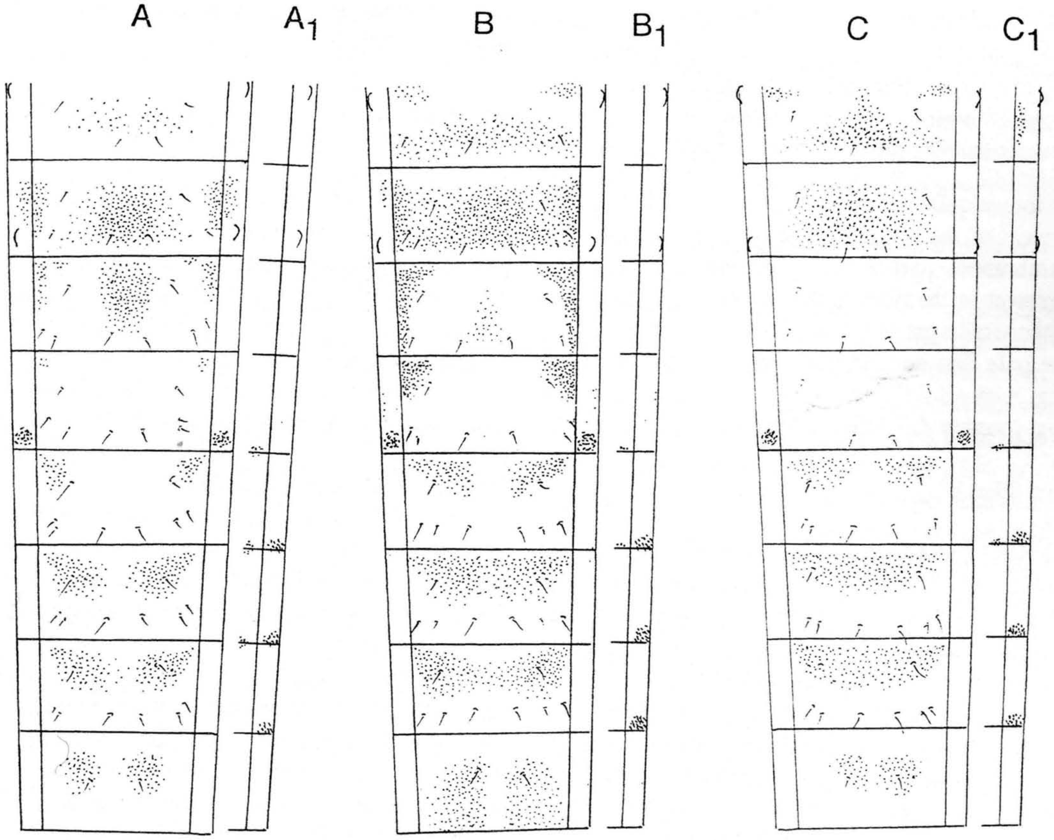

Fig. 3. Scheme of the spinulation of the abdominalsternite and parasternite (A-C) as well as paratergite (A1-C1) of the pupal exuviae from the Lokka populations in *Chironomus coaetaneus* sp.n. (A), *C.* pr. *entis* Shobanov (B) and *C.* pr. *plumosus* Linnaeus (C). (Visible in dark field or phase contrast.)

Chironomus pr. *plumosus* Linnaeus

During the last week of June 1995 a reared male specimen with associated larval and pupal exuviae from Lokka.

Male (N=1)

AR 5.8 (length of the 12th antennal segment 2.1 mm). Palps (2-5) in µm: 100, 280, 360, 430. Coloration quite dark, but the thorax between the scutal stripes is pale; dorsocentrals 47 in number. Wings 7.7 mm. Abdomen with indistinct light borders of the segments. Legs pale; *LR:* P_1 1.22, P_2 0.58, P_3 0.68. Number of sensilla chaetica: (distally on) P_2/Ta_1 23-25, P_3/Ta_1 17-19. *BR:* P_1 6.6, P_2 1.9, P_3 6.1. Legs (*Fe-Ta5*) in µm:

	Fore leg	Mid leg	Hind leg
Femur	2 600	2 650	3 150
Tibia	2 500	2 600	3 230
Tarsus1	3 050	1 510	2 190
Tarsus2	1 700	940	1 250
Tarsus3	970	650	1 000
Tarsus4	900	410	550
Tarsus5	440	330	350

Abdomen quite dark without abrupt pale parts at the borders of the segments. In the hypopygium the membranous part of the processus analis a little narrower in the middle than apically (40 µm), the distance of its proximal corners from another 70 µm. The pale first appendages parallel sided, 200 µm long, with a foldlike knob; appendage 2 is 250 µm long, roughly 4.5 times as long as medially broad.

Pupa (N=1):

Exuviae 17 mm long. Cephalic tubercles about 300 µm long and 200 µm broad. Basal ring about 300 x 120 µm. Paratergites 1 are narrowly spinulated, but the other paratergites are smooth, except for the strong patches of spinules on the hind corners of segments 5-7. In the hookrow there are 78 hooklets, the median ones with minute doral denticles; other orally directed intersegmental spinules were clearly present behind tergites 4-5. Points on the pleural region were not observed on segment 4.

Sternite 1 and 2 widely spinulated; there is separately on sternite 1 a small patch of spinulae near the antero-lateral mounds (?pedes spurii B). Spinules absent on sternites 3 and 4. On sternites 5-7 spinules present anteriorly, spreading from the anterior corners more or less together medially and extending a little posteriorly; patches of spinules on both sides of sternite 8 around its ventromedial seta present.

Lateral setae on segments 1-8: 0, 3, 3, 3, (and taeniate) 4, 4, 4, 4. Spurs on segment 8 with several long very narrow teeth. Anal lobe fringe with 180 taeniae. One dorsal taenia on the proximal third of the anal segment.

Taxonomical comment. The reared pupa of *C.* pr. *plumosus* has features, which correspond to the current concept about *C. plumosus* Linnaeus (see Langton 1991). Similar pupal exuviae are known in southern Finland from Marsjön, Inkoo (June, 1966) and Kirmusjärvi, Sammatti (August 1993 M. Heino and V. Englund leg.). The head capsule of the reared larva corresponds mainly with the description of Shobanov (1989).

Discussion

Many of the adult specimens among the nearest relatives of *Chironomus plumosus* are difficult or perhaps even impossible to distinguish between reliably at the species level from the form, the key characters of which have been given under this name by Lindeberg & Wiederholm (1979). Except for the sibling species there are perhaps also other species, like *C. coaetaneus*, which are morphologically quite different when they are adults, but can be brought into the same range of species.

All known pupae, which can be considered as the nearest relatives of *Chironomus plumosus* found in Finland, have roundish patches of enlargened spinules dorsally on the anal corners of the segments 5-7 at the posterior end of the otherwise smooth paratergites of these segments. *C. coaetaneus* has these plesiomorphous patches, too on the same segments. Therefore *C. coaetaneus* has been taken here to belong to the relatives of *C. plumosus.* The feature mentioned can obviously be used as an easily verifiable phylogenetically founded key character to the grouping of the pupae of the *Chironomus plumosus* aggregate among the pupae of this genus. The spinules in these patches have been obviously apomorphously strengthened in *C. plumosus* and its nearest relatives, whereas *C. coaetaneus* with its weaker patches on segment 7 perhaps indicates a more plesiomorphous stage.

Larvae of the *Chironomus plumosus* aggregate known from Finland are different from the larvae of the genus *Chironomus*, in which lateral tubules are present on the 7th and ventral tubules on the 8th abdominal segment (often called "*plumosus* type larvae"), because of (if not worn out) the apically needlelike dorsal tooth in the premandibles; it is also in many other species somewhat narrower than the ventral one, but not needlelike.

The results of the morphological comparison of the Lokka populations can be summarized as follows:

Males

1 (4) Appendage 1 pale, *LR* value about 1.2, number of sensilla chaetica in *P2* 23-33, in *P3* 17-19 2

2 (3) Darker and larger species (Wing 7.5 mm. The length of 12th antennal segment of *C. entis* according to Shobanov > 2.4 mm). Appendage 1 more club shaped .... *C.* pr. *entis*

3 (2) Smaller, pale species. (Wing 6.5 mm. The length of the 12th antennal segment according to Shobanov < 2,2 mm). Appendage 1 more parallel sided .... *C.* pr. *plumosus*

4 (1) Dark, also the appendage 1 dark, *LR* value 1.07-1.12, number of sensilla chaetica in *P2* 11-15, in *P3* 8-14 .... *C. coaetaneus* sp.n.

Females

Females of *C.* pr. *entis* or *C.* pr. *plumosus* are not available from Lokka. The studied female specimen of *C. entis* from Coll. Shobanov had 160-170 sensilla chaetica on *Ta1/P2-3*. The females of *C. coaetaneus* studied have, on the contrary, only 58-82 sensillae respectively.

Pupae

1 (2) Paratergite 1 shagreened, sternite 3 and 4 smooth .... *C.* pr. *plumosus*

2 (1) Paratergite 1 smooth, lateral groups of spinules on sternite 3 and 4 present 3

3 (4) Parasternite 2 clearly shagreened, a large median patch of spinules on sternite 3, on sternite 4 a few antero-lateral spinules only. Intersegmental minute spinules behind the armament of tergite 4-6 .... *C. coaetaneus* sp. n.

4 (3) Parasternite 2 smooth or sparsely shagreened, sternite 3 medially smooth or weakly shagreened; sternite 3 and 4 with lateral longitudinal patches of spinules, which anteriorly spread meadially. Intersegmental minute spinules behind the armament of tergite 4-5 .... *C.* pr. *entis*

Chironomus pr. *entis*, *C.* pr. *plumosus* and *C. coaetaneus* are probably widely distributed in Lokka. It should be noted, that the sampling was restricted to quite a small (5 x 10 km) area on the northern part of Lokka (total area 413 km^2). It was impracticable during the short trips to work in different parts of the reservoir, why attention was paid to the region of the shore area south of Mutenia (coordinates 7530-7535:518-523; cf. Heikinheimo & Raatikainen 1971).

The phenologies of the species treated here are unknown.

A few adults and pupae of *C. coaetaneus* were found in 1984, but most were found 1989 from the water surface; in 1995 only a single male was captured from a swarm. The emerging individuals or the floating exuviae of this species were found not very far from the shore of Lokka (depth 2-4 m). Red chironomid larvae were found at that time as scattered individuals at different sites, but especially in 1995 their abundance was quite high in the deepest (about 5-6 m) sites of the study area (perhaps in the valley of the inundated Riestonjoki).

There are also other species differences between the years in the results of the sampling. The reasons to this, may be in the differences in the times of the trips (16-23. June 1984, 7-17. June 1989 and 19-26. June 1995), differences between the years or perhaps also differences in the local changed conditions resp. faunas of the reservoir; see the water chemistry in Hirvenoja & Michailova (1998). Because of the relatively short summer, the emergence periods of many species in the Sompio Lapland are empirically found to be in June; some species may, however, have two or even more (*Corynoneura*) emergence periods. (Also a yearly, from spring to autumn, moving univoltine emergence period may perhaps also be possible; like that of *Cricotopus festivellus* Kieffer, which is known to the author from southern Finland.)

Especially the chironomid fauna of a few aquatic habitats are known in Finland. Also that of Lokka is sparsely known. Therefore the list of species (Appendix) collected during the 1984 excursion may give some information about the situation in the reservoir at that time.

There is some confusions in some determination of the materials of *Endochironomus tendens* (Fabricius) and *E. albipennis* (Meigen) collected from Finland. It may be worthwile mentioning in this connection with the species in the list, that for instance the abdominal segments of the pupal exuviae of the latter species are not in some populations armed clearly with strong teeth. In the adults of *E. albipennis* (the type specimens in Paris are not studied!) there are, however, sensilla chaetica situated in the middle of Ta_1 of P_{2-3} only, whereas the corresponding sensillae in *E. tendens* are on the apical part of Ta_1 of P_{2-3}. (The type specimens of *E. tendens* have not been found in the Collection Fabricius, Copenhagen, but it has been understood here, that *E. tendens* is a species, the pupal exuviae of which have a fringe of taeniae in the anal segment of two different lengths.)

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Appendix I

List of species captured from the study area in the Lokka Reservoir during the excursion in 1984. (Included are also the finds of J. Tuiskunen).

Vermes

Lumbriculidae
Lumbriculus variegatus (Müller)

Enchytraeidae sp.

Hirudinae
Glossiphonia complanata (Linnaeus)

Crustacea

Isopoda
Asellus aquaticus Linnaeus

Insecta

Plecoptera
Nemoura cinerea (Retzius)

Ephemeroptera
Arthroplea congener Bengtson
Leptophlebia vespertina (Linnaeus)
Siphlonurus lacustris (Eaton)
S. alternatus (Say)

Odonata
Aeshna caerulea (Ström)

Heteroptera
Callicorixa praeusta (Fieber)
Gerris lateralis Schummel

Trichoptera
Apatania sp.
Cyrnus flavidus McLachlan
Holocentropus dubius (Rambur)
Limnephilus nigriceps (Zetterstedt)
L. pantodapus McLachlan
Limnephilus sp.
Phryganea bipunctata Retzius

Coleoptera
Agabus sp.
Rhantus suturellus (Harris)
Gyrinus aeratus Stephens

Diptera, Chironomidae
Podonominae sp.
Ablabesmyia monilis (Linnaeus)
Procladius simplicistilus Freeman
Procladius sp.
Parakiefferiella bathophila (Kieffer)
Psectrotanypus varius (Fabricius)
Zalutschia tatrica (Pagast)
Z. tornetraskensis (Edwards)
Heterotanytarsus apicalis (Kieffer)
Orthocladius sp.
Cricotopus polaris (Kieffer)
C. festivellus (Kieffer)
C. ?intersectus (Staeger)
C. ?reversus Hirvenoja
C. ?sylvestris (Fabricius)
Psectrocladius calcaratus (Edwards)
P. limbatellus (Holmgren)
Limnophyes ?difficilis Brundin
L. exiguus (Goetghebuer)
L. smolandicus Brundin
Mesosmittia flexuella (Edwards)
Chaetolabis macani Freeman
Chironomus pr. *anthracinus* Zetterstedt
C. coaetaneus sp.n.
Chironomus spp.
Dicrotendipes lobiger Kieffer
D. modestus Say
Endochironomus albipennis (Meigen)
Glyptotendipes ?gripekoveni Kieffer
G. paripes (Edwards)
Microtendipes nigellus Hirvenoja
Parachironomus sp.
Paratanytarsus laccophilus (Edwards)
Tanytarsus aberrans Lindeberg
T. gregarius Kieffer
T. niger Andersen
Tanytarsus sp. (parthenogenetic)