SPIXIANA	22	1	69–81	München, 01. März 1998	ISSN 0341-8391

Chromosomes, morphology, ecology and distribution of *Sergentia baueri*, spec. nov., *S. prima* Proviz & Proviz, 1997 and *S. coracina* Zett.,1824

(Insecta, Diptera, Chironomidae).

W. Wülker, I. I. Kiknadze, I. E. Kerkis and P. Nevers

Wülker, W., I. I. Kiknadze, I. E. Kerkis & P. Nevers (1999): Chromosomes, morphology, ecology and distribution of *Sergentia baueri*, spec. nov., *S. prima* Proviz & Proviz, 1997 and *S. coracina* Zett., 1824 (Insecta, Diptera, Chironomidae). – Spixiana **22/1:** 69-81

1. As proposed earlier *Sergentia longiventris* Kieffer is a junior synonym for *S. coracina*. Therefore the *Sergentia* material from the Black Forest, Alps (Lunzer Mittersee) and Far East represents a new species (2n=8), *S. baueri*. The Fennoscandian *Sergentia* with 2n=8 belongs to the species *S. prima* recently described in reservoir lakes of the Baikal area in Siberia.

2. The karyotype of these two species as well as that of *S. coracina* (2n=6) has been investigated.

3. Some morphological data for the species and keys for analysis of chromosomes, larvae, pupae and male adults are provided.

4. *Sergentia baueri* only occurs in small, considerably eutrophied pools. *S. prima* prefers (in Scandinavia) shallow humous to polyhumous lakes, while *S. coracina* prefers deep, sometimes ultraoligotrophic lakes. Nevertheless joint occurrence of *S. prima* and *S. coracina* is observed in Norvegian lakes. *S. prima* and *S. baueri* coexist in the Irkutsk reservoir in Siberia.

5. *Sergentia baueri* extends from West Germany to the Far East of Russia; *S. prima* has been described from Siberia and Fennoscandia; *S. coracina* is holarctic.

Prof. Dr. W. Wülker, Institut für Biologie (Zoologie) der Universität, Hauptstraße 1, D-79104 Freiburg im Breisgau, Germany.

Prof. Dr. I. I. Kiknadze, Dr. I. E. Kerkis, Institute of Cytology and Genetics, Siberian Branch Russian Academy Sciences, Prosp. Akademika Lawrentieva 10, 630090 Novosibirsk, Russia.

Prof. Dr. P. Nevers, Universität Hamburg, Fachbereich Erziehungswissenschaft, Von Melle-Park 8 D-20146 Hamburg, Germany.

Introduction

The genus *Sergentia* is important as an indicator of "mesotrophic" conditions in freshwater lakes (Lenz 1925,1927). Two species in particular are well known in Europe: *S. Coracina* Zetterstedt is an apparently cold stenothermic but euryoxybiontic species that inhabits fairly deep lakes. It occurs not only in Europe (for a summary of data see Brundin 1949) but also in the USA and Canada (Johannsen 1934, Townes 1945, Stahl 1959, 1966). *S. "longiventris"* Kieffer was assumed to be present not only in Fennoscandia (Brundin 1949) but also in the Alps (Brehm 1942, Thienemann 1943, Bauer 1945), the Black Forest of Germany (Lundbeck 1951, Wülker 1961, Nevers 1972), and the USSR (Tschernovskij 1949, Linevich 1981, Proviz et al. 1991, Kiknadze et al.1991, and unpublished data of I. Kerkis and E.

A. Makarchenko). The validity of the species name *"longiventris"*, however, is doubtful. Some investigations indicate that *S. longiventris* may be a younger synonym of *S. coracina*. Wülker (1961) observed that the original material of this species resembles *S. coracina* in pupal morphology. Hofmann (1971) stated that the premandibles of larvae in Fennoscandian material had 2 teeth like *coracina* rather than 4 teeth like *"longiventris"* from the Alps and Black Forest. Therefore he declared *longiventris* and *coracina* to be synonyms. O. A. Schnell (pers.comm.) is convinced that Kieffers specimen of *"longiventris"* from the locus typicus Nedre Sjodalsvatnet in Norway must have been *coracina*. He has found only male adults with antennal ratios of about 4 in this lake. Both *longiventris* and *coracina* are said to have an A. R. of 4 (Goetghebuer in Lindner 1937-54). Brundin (1949) was of the opinion that *S. coracina* and *S. longiventris* can occur sympatrically in the litoral of Fennoscandian lakes. But his *"longiventris"* males had an A. R. of 2.5 (mean) (Berg & Petersen 1956) – much different from the *longiventris* description. *S. "psiloptera"* from Bear Island, described by Edwards (1935), may also not be a valid species. O. A. Schnell (pers.comm.) recently investigated two males in the Museum of Stockholm and found them to belong to the genus *Stictochironomus*. Nevertheless, another large *Sergentia* species (other than *S. coracina*), *S. "psiloptera"* as described by Brundin 1949 and Wülker 1961, may be present at greater northern latitudes.

Outside Europe, the radiation of *Sergentia*-species in the surroundings of Lake Baikal (Proviz et al. 1991) and in the lake itself (Proviz and Proviz 1992, Proviz et al. 1994) and the American species *S. albescens* (Townes 1945) may be mentioned.

On the basis of the pioneering investigations of Bauer (1945), Wülker (1961) relied on the help of chromosome investigations for elucidating the confusing situation of the *Sergentia* nomenclature. This approach proved to be useful. Nevers (1972) found two *Sergentia* species in the Black Forest (Germany), one with 3 chromosomes (*S. coracina*), the other with 4 chromosomes and identical to that described by Bauer in the Lunzer Mittersee. I. E. Kerkis (Novosibirsk) received material for chromosome investigation from Frotveitvatnet near Bergen/Norway (thanks to O. A. Schnell and J. Harvardstun) which also contained (pers.comm.) two different species with 3 (*S. coracina*) and 4 chromosomes. But the latter was not the same as that investigated by Nevers. It belongs to a species recently described in Siberia, *S. prima* Proviz & Proviz 1997 (= *S.* spec. N1 Proviz et al. 1991). In contrast, larvae from the Far East collected by E. A. Makarchenko were similar to the second Black Forest species.

In consequence, if the original *longiventris* is synonymous to *S. coracina* and the northern European *"longiventris"* is *S. prima*, the 4-chromosome-species in Germany, Austria and Far East must be regarded as new. In the present paper we provide the basic data for this new concept and describe the ecology and distribution of the three taxa in question. In subsequent papers data about inversion polymorphism will be discussed. The fourth European *Sergentia* taxon (see above) could not yet be characterized by chromosome analysis.

Materials and methods

The following materials were available for karyotype analysis:

1. *Sergentia baueri*, spec. nov. (*S. longiventris* sensu Bauer 1945, Wülker 1961, Nevers 1972, Kiknadze et al. 1991, Proviz et al. 1991).

Germany: Pool near Hydrobiological Station Falkau/Black Forest ("Feuerlöschteich"), ca. 900m a.s.l., in mud or on *Callitriche*, 30.VI.61, 28 chromosome squashes (chrom. squ.), P. Nevers; pool at "Hinteres Schafhäusle" near St. Peter/Black Forest, ca.720 m a.s.l., nearly stagnant water, deep mud, fairly eutrophied, *Sergentia* very abundant, 1971, 56 chrom. squ., P. Nevers; forest pool near St. Märgen/ Black Forest, ca.920m a.s.l., sandy bottom with thin layer of mud, considerable current, small *Sergentia* population, 28 chrom. squ., 1971, P. Nevers; 1 female adult, 10 pupal skins, 10 larvae, 1996, W. Wülker.

Russia: Far East: Lake Teploe, Chabarovsk region, 15.V.89 and 23.V.89, 7 larvae, 10 prepupae, E. A. Makarchenko.

We saw chromosomes of the Siberian "*S. longiventris*" during a visit of Dr. V. Proviz in Germany in 1995. Two rearings (larva, pupal skin, male adult) from the Irkutsk reservoir were sent 1996.

2. *Sergentia prima* Proviz & Proviz 1997 ("*longiventris*" sensu Brundin 1949, Berg & Petersen 1956).
Norway:Frotveitvatnet, 1.VI.90, 7 chrom. squ.; VIII.94, 33 chrom. squ., O. A. Schnell.
Sweden: Smaland, Grimsgöl, NO of Vaxjö (county Gardsby), extremely polyhumous lake, max. depth 4.8 m (see Brundin 1949, 360-384), 8.V.80, 1 chrom. squ. with larval body, W. Wülker.
Denmark: North Sealand, Gribsø (55°59'N, 12°16'E), humic lake, 50 m a.s.l., max. depth 11m, 20.VII.61, 1 chrom. squ., I. C. Petersen. 2 pupal exuviae, sent by C. Lindegaard 1996; 28.4.1997 25 pupal exuviae, 6 male adults, 5 female adults, C. Lindegaard. We saw chromosome photographs of *S. prima* from Siberia thanks to Dr. V. Proviz.

3. *Sergentia coracina* Zetterstedt.
Germany: Titisee/Black Forest, 845 m above sea level (a.s.l.), (see Lundbeck 1951), max. depth 39.5 m, maximal abundance of *Sergentia* 15 m, 6.IV.61, 15 chrom. squ., W. Wülker; 20.IV.1996, 60 male adults, 7 female adults, W. Wülker and R. Rössler; Feldsee/Black Forest, 1109 m a.s.l., max. depth 34 m, max. abundance *Sergentia* 20-28 m, 21.IV.60, 9 chrom. squ., W. Wülker.
Switzerland: Vierwaldstätter See, ca.200-500 m N of Hydrobiological Institute Kastanienbaum (ETH Zürich), from ca. 20 m depth, 24.III.71, 66 chrom. squ., P. Nevers.
Finland: Hietajärvi, 2 chrom. squ., E. Koskenniemi.
Norway: Frotveitvatnet (slightly polyhumous lake, 266 m a.s.l., 1.VI.90, 4 chrom. squ.,VIII.93, 13 chrom. squ., O. A. Schnell; Askjelldalsvatn, (ultra)oligotrophic lake, 810 m a.s.l., Secchi-disk depth 10-12 m, 31.VII.90, 4 chrom. squ., 30.VII.91, 17 chrom. squ., O. A. Schnell; Grondalsvatnet (oligotrophic lake), VIII.93, 4 chrom. squ.,O. A. Schnell.
USA: Indiana, Angola County, Crooked Lake, 41°16'N, 85°29'W, from 20 m depth, 34 chrom. squ., P. Nevers; Wisconsin, Green Lake, 43°50'N,89°2'W, at a place where the bay of Green Lake village meets with the main lake, from 20 m depth, 18 chrom. squ., P. Nevers.

Specimens were fixed with a fresh mixture of 96 % ethanol and glacial acetic acid (3:1). The squash technique was routine (Keyl & Keyl 1959). Phase contrast was used to analyze the puffing pattern, particularly the nucleoli and Balbiani ring positions. Metaphase chromosomes were studied in spermatogonial mitosis in prepupae.

The terminology of larval structures follows Pinder & Reiss 1983 and Saether 1980.

Results

Sergentia baueri, spec. nov.

Bauer 1945, *Sergentia longiventris*, chromosomes.
?Tschernovskij 1949, *Sergentia* group *longiventris*, larva.
Wülker et al. 1969, *Sergentia longiventris*, hemolymph proteins.
Nevers 1972, *Sergentia longiventris*, chromosomes, male adult (drawing hypopygium).
Kiknadze et al. 1991, *Sergentia longiventris*, chromosomes, description of larva (both of Far East population).
Proviz et al. 1991, *Sergentia longiventris*, chromosomes, hemolymph proteins.

We dedicate this species to Prof.Dr. Hans Bauer/Tübingen in recognition of his valuable contributions to the cytotaxonomic knowledge of chironomid midges. We have chosen to use its banding pattern as a standard.

Holotype: Chromosome preparation SH B17, leg.P. Nevers, pool at Schafhäusle near St. Peter/Black Forest, ca.720 m a.s.l., in Zoologische Staatssammlung München. – Paratypes: chromosome preaparation SH B18; adult male Nr.13, Schafhäusle near St. Peter, leg.P. Nevers, in Zoologische Staatssammlung München; 1 adult female, 5 pupal skins, 5 larval heads, forest pool near St. Märgen/Black Forest, leg. W. Wülker, in Sammlung Wülker.

Karyotype (Fig. 1), description, if not otherwise stated, based on the monomorphic West European population.

2n=8; three pairs of long chromosomes and a pair of short chromosomes are observed in metaphase (Fig. 1a). There are four polytene chromosomes in salivary gland cells. Chromosomes I and II are metacentric, chromosome III is a real submetacentric, and chromosome IV is acrocentric (telocentric)

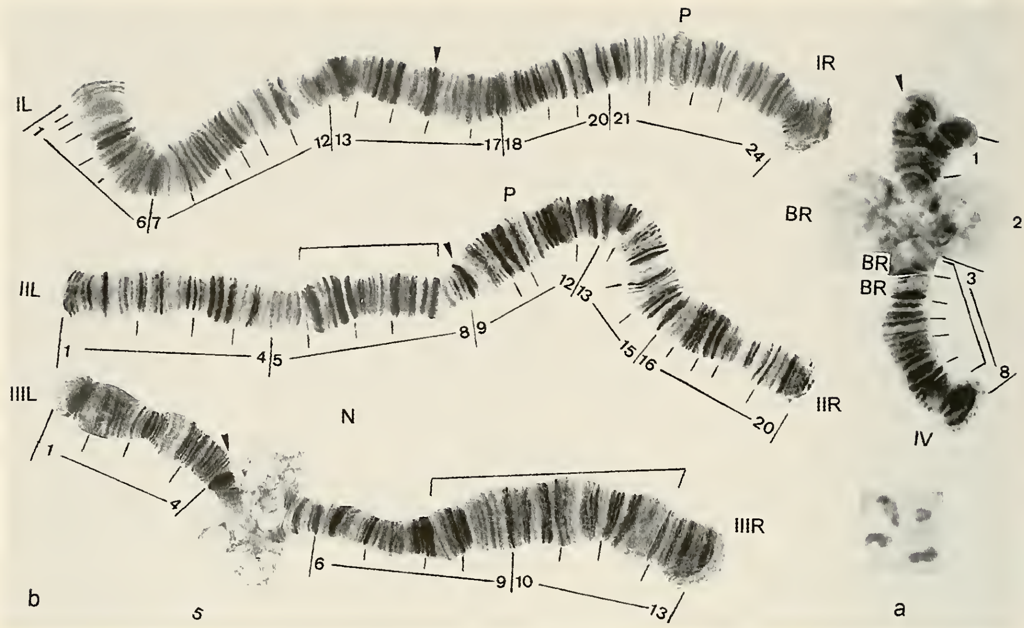

Fig. 1. Chromosomes of *Sergentia baueri*, European population. **a.** Mitosis figure (spermatogonia). **b.** Salivary gland chromosomes. **N:** nucleolus, **P:** puff, **BR:** Balbiani ring, arrow heads: centromeres or telomeres.

(Fig. 1b). The chromosomal length relationships are I=II>III>IV. The centromeric bands are only slightly heterochromatinized. It is important to note that the polytene level of chromosome IV is two times less than that of the other chromosomes of the complement. This phenomenon is a special feature of the genus *Sergentia*. A nucleolus is localized in chromosome III (arm IIIR); Balbiani rings can be found in chromosome IV.

Inversion polymorphism is prevalent only in Siberia and the Far East populations (arms IIL,IIIR and IV, brackets in Fig. 1). The inversions in IIL and IIIR were fixed in the Far East populations.

Chromosome I can be identified by the constriction in region 24 and a specific puff in region 22 of arm IR.

Chromosome II is characterized by a constriction in region 19 and by a series of thick bands in regions 17-18 of IIR, as well as region 6 in arm IIL. A large puff is developed in region 11 (IIR) in 35 % of the investigated specimens. According to Nevers (1971) the Balbiani ring is open at this site.

Chromosome III has a nucleolus in arm R (region 5). It is located near the centromeric band (Fig. 1).

Chromosome IV has several Balbiani rings (BRs). BR1 is usually well developed in all larvae. It starts to become inactivated in some salivary gland cells in prepupae. BR2 and BR3 are less frequently found in an active state. Different combinations of the active states of these BRs have been observed. A BR-like structure was sometimes found at the very end of chromosome IV (Fig. 1).

Larva (based on Kiknadze et al. 1991, p. 28 and plate 43). Length IV.instar 10.5-12 mm, red. Lateral and ventral tubuli absent. Head width 0.42-0.53 µm, yellow, but frontoclypeus , surrounding area and gula brown (Fig. 3a). Eye spots not connected. Antenna with 5 segments; second segment with Lauterborn organs. Length of segments 1-5 (in µm) 98:28:14:14:6. Antennal blade extends to base or tip of segment 5. Ring organ in basal third of basal segment, R=25µm. Width segment 1 at ring organ 28 µm. A.R.=1.6. Premandible with 4 teeth (Figs. Wülker 1961, Kiknadze et al. 1991) and extended brush. Pecten epipharyngis (Fig. 3b) tripartite as in other species; fig. 43 in Kiknadze et al. 1991 must be out of focus. Mandible yellow brown in lower ⅔, distally brown or even dark brownish. 5 inner teeth, the apical one larger but others of equal length, distal tooth short. Seta subdentalis long, slightly curved, sometimes serrated. Inner bristles (setae internae) split in 5-10 dichotomous parts. Mentum with 4 middle and 6

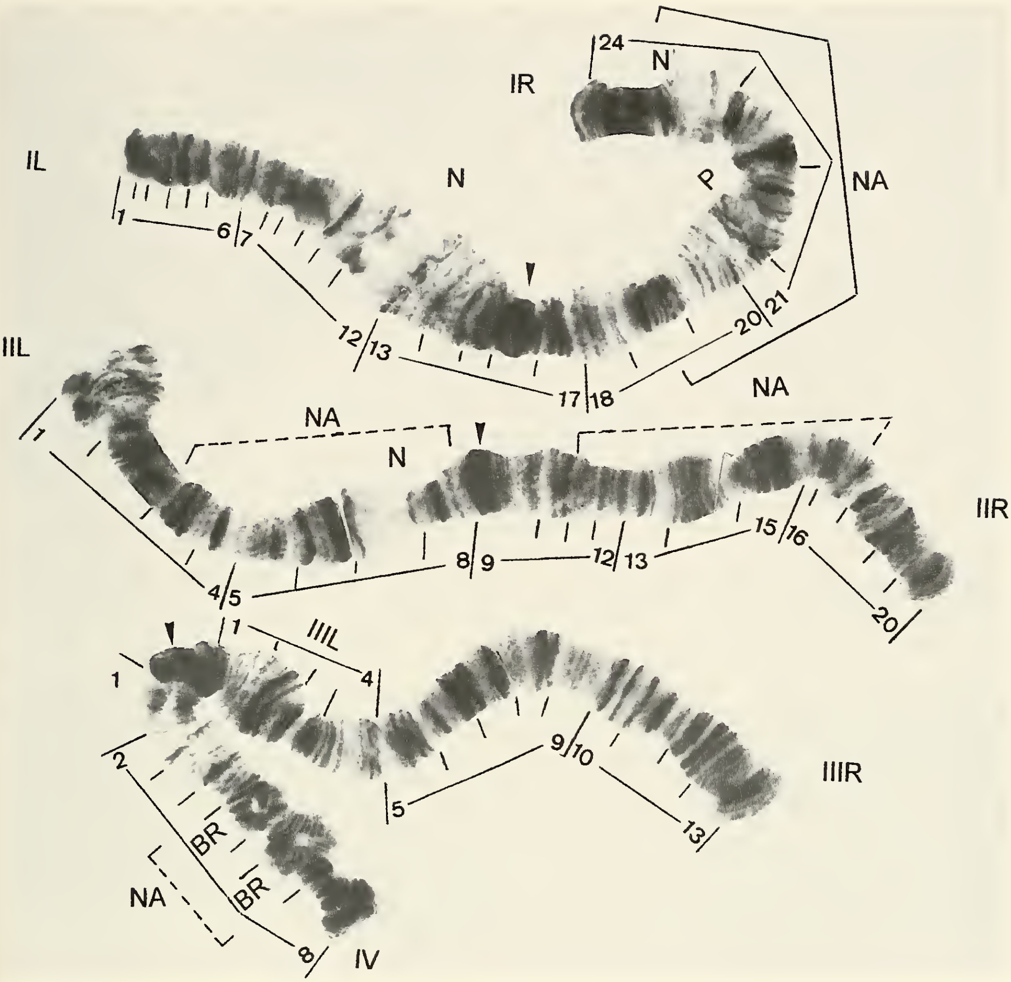

Fig. 2. Chromosomes of *Sergentia coracina*, Vierwaldstätter See. Brackets with solid lines: fixed inversions, brackets with interrupted lines: floating inversions.

pairs of lateral teeth, colour dark brown. The two inner middle teeth a bit lower than the outer medians and of approximately equal width. Lateral teeth set along one straight line. Ventromental plates about the same width as mentum, slightly curved. The striae have a terminal part with straight edges and a more posterior part disappearing in distal area. Connections between both parts barely visible (Fig. 3c). In fig. 43A Kiknadze et al.1991 the ventromental plates seem incorrect.

Pupa (Langton, pers.comm). Anterior and median points of tergites III and IV of similar size (this character is best observed under low power). Anterior band points vary gradually in size to the median points producing the effect of a wide but indistinct band broadly joined to the median patch. Darker exuviae with golden to brown combs on segment VIII. Length 5.6-9.8 mm (m=7.4, n=25). 28-63 anal lobe taeniae (m=49.6, n=25).

Adult male (Fig. 4a). Clearly smaller than *S. coracina*, slightly bigger than *S. prima* (Tab. 1) Diagnostic characters are the low A. R., the long and narrow, more or less parallelsided anal point, the angulate end of the gonostylus.

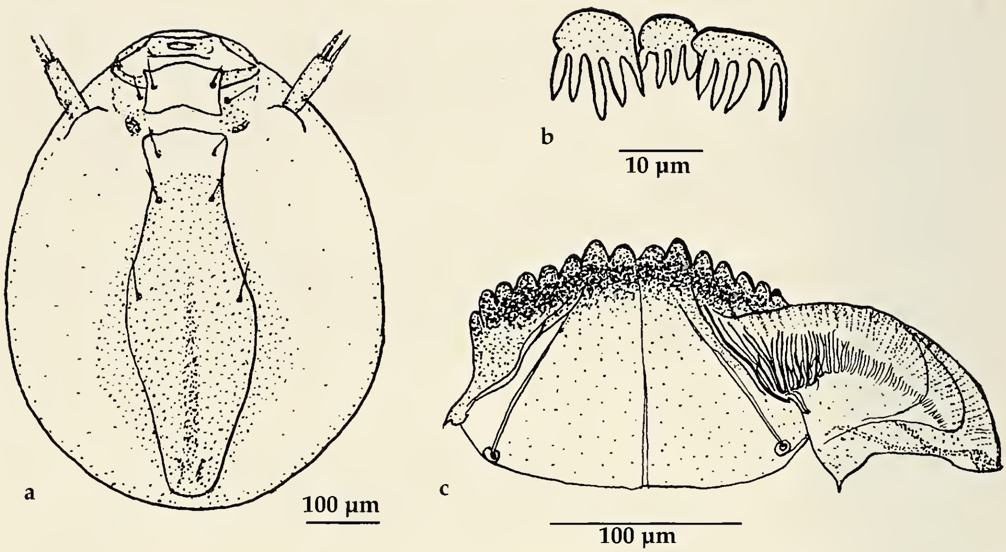

Fig. 3. *Sergentia baueri*. a. Head of larva, dorsal view. b. Pecten epipharyngis. **c.** Ventromental plates, drawing V. Proviz (unpublished).

Adult female (Fig. 5) n=1 (freshly emerged). Head: Length antennal flagellomeres 80:103:130: 130:124:252 µm. Frontal tubercles absent. Ocular ratio= 0.35. Temporal setae ca. 25. Thorax: Dorsocentral setae 39,36, acrostichal setae 21. Wing membrane with setae, squama setae about 30. Front tibia of legs with rounded scale, middle tibia with 1 spine, hind tibia with 2 spines. Sensilla chaetica hind leg in 2-3 rows, more than 100. Abdomen: Genitalia: Gonocoxapodeme VIII without clear branch on base of dorsomesal lobe, gonapophysis VIII: dorsomesal lobe large, apodeme lobe sigmoid, ventrolateral lobe brushlike as usual. On both sides of labia an additional bowlike sclerite. Endoskeleton of typical form (Fig. 5). Coxosternapodeme light (but very young individal). Gonocoxite IX with 3 bristles. Postgenital plate triangular. Spermathecal ducts nearly straight.

Sergentia prima Proviz & Proviz 1997.

Brundin 1949, *Sergentia longiventris*, distribution, ecology.
Berg & Petersen 1956, *Sergentia longiventris*, larva, adult male, female.
Wülker 1961, *Sergentia longiventris* "Brundin material", larva, pupa.
Proviz et al. 1991, *Sergentia* spec. N1, karyotype, hemolyph proteins.
Proviz & Proviz 1997, *Sergentia prima*, original description, karyotype, larva.

Karyotype. 2n=8, Centromeres heterochromatinized. Nucleoli in IL and in IIR. Inversion polymorphism in chromosome arms IR, IIIL, IV.

Chromosome I : Typical puff in group 22 of *S. baueri* is located in distal position (group 19), but band groups in the middle part inverted and areas near the centromere exchanged (complex inversion). Arm IL more or less identical with that of *S. coracina*, nucleolus also in same position.

Chromosome II: in arm IIR a constriction beyond the distal third (group 21 in *S. baueri* and 20 in *S. prima*). A nucleolus can be found close to the centromere. In arm IIL, the typical dark groups (identical with group 6 in *S. baueri*) are not far from the centromere (group 11 in *S. prima*).

Chromosome III: In IIIR the typical groups 5-6 are next to the centromere but apparently in inverted position. Terminal end fan shaped with 4 characteristic dark band groups.
IIIL is also fan shaped when homozygous but with mostly light bands. Both banding patterns differ by a very long inversion and are thus fully separated in heterozygotes.

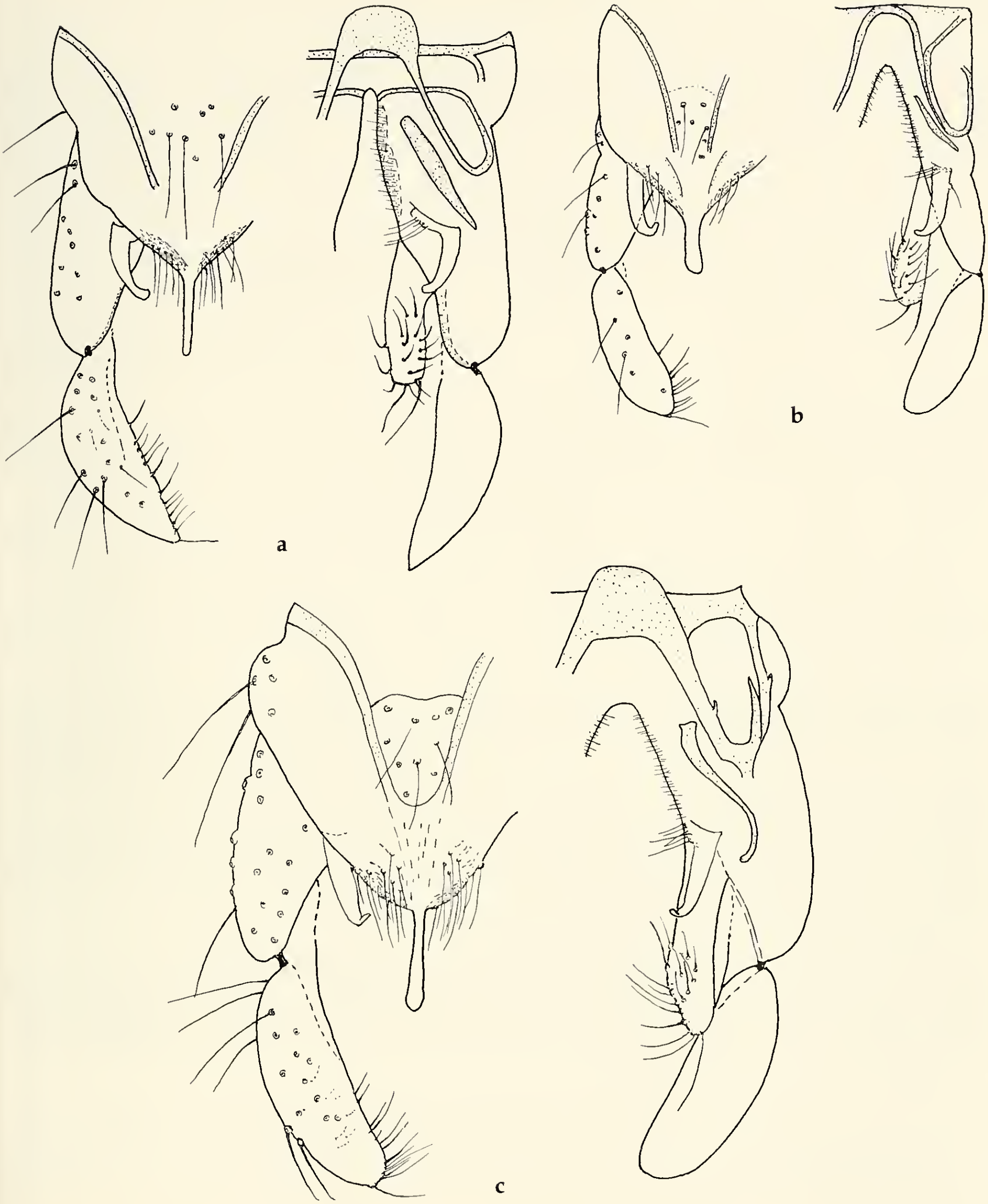

Fig. 4. Male hypopygia of **a.** *Sergentia baueri* (Black Forest); **b.** *S. prima* (Material Brundin); **c.** *S. coracina* (Titisee). Dorsal view, left side: upper parts, right side: lower parts.

Chromosome IV: One end with large heterochromatic block, other end fan shaped (if paired). Balbiani rings in about the middle of the chromosome and another not far from the non-heterochromatinized end.

Larva (based on Proviz & Proviz 1997, p. 633 and fig.1). See also Berg & Petersen 1956, fig. 82, p. 196. Length IVth larval instar 8-12 mm. Head of a yellow grey colour, brown in the region of submentum,

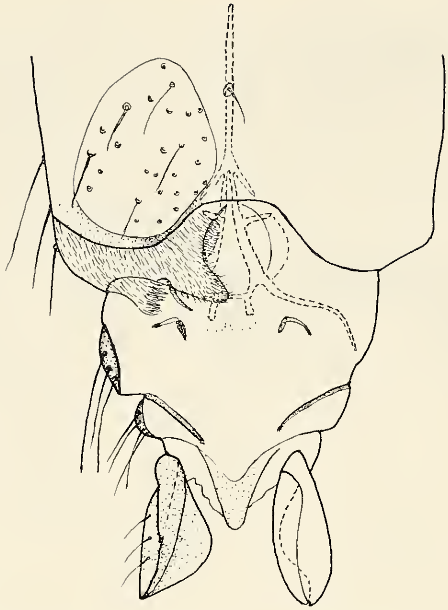

Fig. 5. Female adult of *Sergentia baueri*, posterior part of abdomen, ventral side.

width 430-480 µm. Frontoclypeal apotome light brown with a barely distinct reticular pattern in the clypeal region. Eyes round, irregular in shape, upper and lower eye of almost equal size (40 × 60 µm). Antennae with 5 segments. Basal segment 3.5-3.8 times longer than wide, ring organ situated at a distance of 15-20 µm from its base. The long ramus of sensilla longer than length of segments 2-5. The short ramus of sensilla 5-6 µm long. Lauterborn organs small, rod-shaped, not extending to the top of 3rd segment. Length of antennal segments in µm: 98 (95-105), 31(30-33), 9(7-10), 8(7-10), 4(4-5). AR=1.5-1.9. Width of 1st antennal segment at the level of ring organ (W1) 27 (25-30) µm. L1/L2 ratio 3.1, L1/W1=3.6, L2/W1=1.2.

Premandible with two teeth and a long dense barb.

Mandible 200-220 µm long, dark yellow, black on top. Distal tooth brown, inner teeth black, last inner tooth same color as the remaining ones. Apical tooth large, almost as long as the total width of the bases of the two subsequent inner teeth. Seta subdentalis thick with split top, extending to the top of the 3rd inner tooth. Internal seta split into 4 rami, of which 3 are shrub-like and 1 pectinate. Carina of mandible composed of 10-11 chaetoids.

Mentum with 4 median and 6 pairs of lateral teeth of a black-brown colour. Median teeth larger than the remaining ones, outer median teeth higher than the remaining ones, first lateral tooth lower than 2nd. Total width of central and 1st lateral teeth (M) 60-76 µm.

Ventromental lamellae large, approximately as long as the width of the basis of mentum. Anterior margin smooth. Striae most distinct at internal angles (sinuous lines), less distinct in middle part (short parallel lines), absent in distal part.

Pupa (Langton, pers.comm.). Median points of tergites III and IV very small (almost invisible under low power), contrasting with the much larger points of the anterior transverse band. Pale exuviae with combs of segment VIII golden-yellow. Length 6.4-7.8 mm (m=7.2 mm, n=14). 45-68 anal lobe taeniae (m=59.4, n=14).

Adult male (Fig.4b). Morphometric values tab.1. Clearly different from *S. coracina*, more difficult to distinguish from *S. baueri*. Diagnostic is the short spatulate anal point. Noteworthy is the briste sometimes present on the upper volsella (Fig. 4b) which was already shown in Berg & Petersen 1956 (Fig. 84)

Sergentia coracina, Zetterstedt

Zetterstedt 1824, *Chironomus coracinus*, original description.
Andersen 1937, *Pentapedilum* , adult male (drawing hypopygium), larva.
Lenz 1927, *Sergentia longiventris*, larva, pupa. Identical with Lenz 1941, *Sergentia profundorum.*
Edwards 1929, *Polypedilum (Sergentia) coracina*, adult male.
Goetghebuer 1937, *Sergentia coracina*, adult.
Bauer 1945, *Sergentia coracina*, chromosomes.
Townes 1945, *Sergentia coracina*, adult male (drawing hypopygium).
Wülker 1961, *Sergentia coracina*, larva, pupa, adult male.
Hofmann 1971, *Sergentia coracina*, mentum of larva.
Stahl 1966, *Sergentia coracina*, larva.
Saether 1977, *Phaenopsectra coracina*, adult female.
Pankratova 1983, *Sergentia coracina*, larva, pupa.
Pinder & Reiss 1983, *Sergentia coracina*, larva.
Kiknadze et al. 1991, *Sergentia coracina*, chromosomes, larva.

Karyotype (Fig.2) 2n=6. Centromeres heterochromatinized. Nucleoli in arms IL, IR and IIL. Inversion polymorphism in IIR, IIL and IV (American populations). European and American populations differ by fixed inversions in arms IR, IIR, IIIR and IV.

Chromosome I: Nucleolus IR around group 24, in European populations very distal, in American populations in proximal half. Typical puff of group 22 near middle of the arm (Europ.pop.). Nucleolus arm IL is around group 12 (about ⅓ from centromere)

Chromosome II: Distal part of IIR as in *S. prima*, but other part more complicated, especially in European populations. Arm IIL as in *S. baueri* of Far East population but area around nucleolus in group 7 somewhat obscured.

Chromosome III and IV are joint in *S. coracina*. A good marker can be found in groups 10-11 of IIIR which are adjacent to centromere in *S. baueri* and not far from centromere in American populations of *S. coracina* but inverted and near the terminal end of the arm in European populations. Other groups difficult to localize, also in IIIL. Chromosome IV has a thick heterochromatic cap in one end and at least 2 Balbiani rings at equal distances.

Larva. Length up to 18mm. Head yellow, only hind margin dark brown, hind part of gula sometimes brownish. Width about 480 µm, length 440 µm. Eyes separated at about half of eye diameter. Antenna with 5 segments, length of segments in µm: 86-114, 30-32, 14,14,6. Blade long, sometimes longer than segments 2-5. Distance of ring organ from basis L1 18-28 µm. Width of segment 1 at the level of ring organ (W1) 28 µm. Premandible with 2 teeth, extended brush. Mandible with large apical and 4 inner teeth, all dark coloured. Seta subdentalis simple, slender and long, curved distally. Mentum with 4 median teeth (the outer ones a bit higher) and 6 scarcely differing lateral teeth in a slightly bent row. Ventromental lamellae curved, anterior margin smooth. Striae in anterior part straight, more irregular towards posterior and lacking completely in distal area. Connections between anterior and posterior part of striae barely visible.

Tab. 1. Comparison of morphological data (male adults) of the 3 species.

Character	*S. baueri* (n=40) Black Forest, Material Nevers	*S. prima* (n=12) Sweden and Denmark Material Brundin and Lindegaard	*S. coracina* (n=12) Black Forest, Titisee, Material Wülker
Antennal ratio	2.26(1.95-2.42)	2.49(2.21-2.88)	3.48(3.31-3.75)
Bristle ratio	7.69(6.33-8.83)	7.0(6.0-8.0)	5.88(5.0-8.12)
Leg ratio L1	1.10(1.03-1.21)	1.06(1.05-1.1)	0.95(0.92-0.97)
Dorsocentral setae	27.3(15-34)	23(20-25)	40.25(26-49)
Acrostichal setae	18.3(13-23)	14(11-17)	11.82(9-14)
Prealar setae	9.5(6-14)	6.5(6-8)	10(7-14)
Scutellar setae	28.1	45.5(26-65)	59(50-83)
Setae on tergite IX (am-setae)	9.9(6-16)	7.66(6-9)	12.18(10-19)
Wing length (mm)	3.83(3.53-4.08)	3.82(3.7-4.0)	4.61(4.4-4.85)

Pupa (Langton, pers.comm.). Armament of tergites III-V: points of anterior transverse band larger than points of median patch; median patch more narrow towards anterior but generally quite broadly attached to the anterior band; anterior band points gradually decreasing in size towards posterior to median point size. Lateral shagreen of sternites III and IV of spinules directed laterad and arranged in irregular longitudinal rows (a good confirmatory character, although the spinules are sometimes irregularly dispersed and occasionally missing altogether.) Large exuviae (7.4-10.6 mm, m=8.9 mm, n=44. Anal lobes with many taeniae (54-103, m=72.7, n=43).

Adult male (Fig. 4c). The value 4 for the antennal ratio to be found in most descriptions is a rough estimation. Average values are approximately 3.5 (Tab. 1). Remarkably low leg ratio. The morphometric measurements , most of which are size dependent, exhibit distinct differences from those of the other species (Tab. 1). The previous drawings of the hypopygium are more or less superficial. Therefore we provide a new one (Fig. 4c).

Diagnoses

The main differences between the three species can be made clear by a simple key.

Chromosomes

1. Chromosomes 2n=6, nucleoli in arms IL, IIL and IR, heterochromatin at centromeres *S. coracina*
– Chromosomes 2n=8 .... 2.

2. Nucleoli in arms IL and IIR, heterochromatin at centromeres and telomere arm G .... *S. prima*
– Nucleolus in IIIR, only slight amount of heterochromatin at centromeres ...... *S. baueri*, spec. nov.

Larvae

1. Larvae large (up to 18 mm),head capsule yellow (only hind margin brown), head width/length 480/440 µm .... *S. coracina*
– Larvae smaller (up to 12 mm), head capsule with large darker areas .... 2.

2. Premandible with 2 teeth, head width small (480/420 µm) .... *S. prima*
– Premandible with 4 teeth, head width/length 530/480 µm (Fig. 3) .... *S. baueri*

Pupae (based on data of P. Langton)

1. Large exuviae (7.4-10.6 mm), anal lobes with many taeniae (54-103) crowded posteriorly in more than one rank .... *S. coracina*
– Smaller exuviae (5.6-9.8 mm), anal lobes with fewer taeniae (28-68) usually in a single row ...... 2.

2. Median points of tergites III and IV very small, contrasting with the much larger points of the anterior transverse band .... *S. prima*
– Anterior and median points of tergites III and IV of similar size .... *S. baueri*

Adult males

1. Antennal ratio >3, leg ratio L1 <1. Anal point spatulate .... *S. coracina*
– Antennal ratio < 3, leg ratio L1 >1 .... 2.

2. Anal point spatulate (Fig. 4b), upper volsella sometimes with a single bristle .... *S. prima*
– Anal point with parallel edges (Fig. 4a), no bristle on upper volsella .... *S. baueri*

Ecology, distribution

Sergentia baueri prefers (at least in Europe) shallow pools or ponds, sometimes with strong current (Löschteich Falkau, forest pool St. Märgen, Lunzer Mittersee) or with a certain degree of eutrophication (meadow pool St. Peter).

The few places in which the cytologically defined species *S. prima* has been found in Europe are small, not very deep lakes, but with humous to polyhumous conditions.

S. coracina is known as northern stenothermal form in rather deep lakes (Brundin 1949). In the arctic-subarctic region it also occurs in the litoral area. Therefore a common occurrence with *S. prima* is possible. However in Central Europe, the species is confined to the profundal area, with maximal abundance mostly at 15-20 m.

S. baueri extends from West Europe (Black Forest, Alps) to the Far East of Russia. For the intermediate region, some reports of *S. "longiventris"* are present (Altai, leg. Rusanova, pers.comm. of I. I. Kiknadze; vicinity of Irkutsk, papers of Linevich et coll., Proviz et al. 1991). However, the *"longiventris"* in Linevich et al. 1991 has a larval premandible with 2 teeth and can thus hardly correspond to *S. baueri*. It appears to belong to *S. electa* (V. Proviz, pers.comm.).

S. prima has only been described for Scandinavia and Siberia (this paper).

The distribution of *S. coracina* is clearly holarctic, with a possible intermediate step in Japan. In Russia it has been reported in the area of Kaliningrad (Lake Wischnetzkoye), Scherbina 1988, Lake Glubokoye near Moscow (Sokolova & Izvekova 1996) and in the vicinity of Lake Baikal (Linevich 1964) but with no cytological evidence. In Western Europe the distribution is arctoalpine with some reports in high mountains in the intermediate region (summary see Wülker 1961). In the USA, Indiana is regarded as the southern limit for the species (Stahl 1959).

Discussion

The older literature about the genus *Sergentia* is summarized in Brundin (1949), Thienemann (1954) and Wülker (1961). The present investigation is based primarily on cytotaxonomic results. With the help of this evidence we were able to clarify the systematic situation of the existing species. We are convinced that four *Sergentia* species exist in Western Europe: *S. coracina*, the new species *S. prima* and *S. baueri* (both replacing *S. "longiventris"*) and the taxon called *"S. psiloptera"* in Brundin 1949 and Wülker 1961, which has not been characterized cytotaxonomically and may also require a new name (see Introduction). The replacement of *S. "longiventris"* by *S. prima* and *S. baueri* makes previous opinions on the ecological relevance of *S. "longiventris"* doubtful. Bauer (1945) concluded that "als eigentliche Leitform (for the "*Sergentia*-Lake", comment of authors) nur *S. longiventris* vom Typus Tjernosen und Mittersee kennzeichnend ist". In view of the present paper, however, it is most probable that Tjernosen and Lunzer Mittersee contain different *Sergentia*-species. Therefore the usefulness of *Sergentia* for lake typology must be questioned (see discussion in Brundin 1949).

Moreover, the thorough cytotaxonomic investigations of *Sergentia* species in Lake Baikal (summarizing discussion Proviz et al. 1994) casts new light on the ecological importance of the genus *Sergentia*.

Acknowledgements

We thank O. A. Schnell and his group (Bergen/Norway) for collecting and sending *Sergentia* larvae from Norvegian lakes. Merete Farstad and Jarle Harvardstun spent some cool and wet nights there collecting nocturnal planctonic *Sergentia*. P. Jonasson and C. Lindegaard provided material from lake Gribso/Denmark, E. A. Makarchenko (Vladivostok) collected in the Far East. V. J. Proviz (Irkustk) visited the first author for exchange of results. P. Langton (Huntingdon) kindly treated the pupae. In the USA, help in collecting and preparing was provided by Dr. Wm. Brooks, Ripon, Wisc., Dr. M. Daniels and Tom Nevers, South Band, Ind., and Mr. O'Neill, Oshkosh, Wisc. In Germany, T. Franz and R. Rössler provided important technical help. Financial support to P. Nevers came from the Fulbright Commission and Deutscher Akademischer Austauschdienst.

References

Andersen, F. S. 1937. Über die Metamorphose der Ceratopogoniden und Chironomiden Nordost-Grönlands.- Medd. Grönland **116:** 1-95

Bauer, H. 1945. Chromosomen und Systematik bei Chironomiden. – Arch. Hydrobiol. **40:** 994-1008

Berg, K. & I. C. Petersen 1956. Studies on the humic acid lake Gribsø. – Folia limnol. Scand. **8:** 1-273

Brehm, V. 1942. Nochmals die Biocönosen der Lunzer Gewässer. – Int. Rev. ges. Hydrobiol. Hydrogr. **42:** 289-316

Brundin, L. 1949. Chironomiden und andere Bodentiere der südschwedischen Urgebirgsseen. Ein Beitrag zur Kenntnis der bodenfaunistischen Charakterzüge schwedischer oligotropher Seen. – Rep. Inst. Freshwat. Res. Drottningholm **30:** 1-914

Edwards, F. W. 1929. British non biting midges (Chironomidae). – Trans.entomol.Soc. London 77: 279-430

– – 1935. Diptera from Bear Island. – Ann. Mag. nat. hist. Ser. **10:** 531-543

Goetghebuer, M. 1937-1954. Tendipedidae (Chironomidae). B) Subfamilie Tendipedinae (Chironominae). A. Die Imagines. – In: Lindner, E. (ed.): Die Fliegen der palaearktischen Region **13c:** 1-138

Hofmann, W. 1971. Zur Taxonomie und Palökologie subfossiler Chironomiden. – Arch. Hydrobiol. Beih. **6:** 1-50

Johannsen, O. A. 1934. New species of North American Ceratopogonidae and Chironomidae. – J. N. Y. ent. Soc. **42:** 344-352

Keyl, H. G. & I. Keyl 1959. Die cytologische Diagnostik der Chironomiden. I. Bestimmungstabellen für die Gattung *Chironomus* auf Grund der Speicheldrüsen-Chromosomen. – Arch Hydrobiol. **56:** 43-57

Kiknadze, I. I., Shilova, A. I., Kerkis, I. E., Schobanov, N. A., Selenov, N. I., Grebenuk, L. P. Istomina, A. G. & B. A. Prasolov 1991. Karyotypen und Morphologie der Larven des Tribus Chironomini (In Russian). – Novosibirsk: Idatelstvo Nauka, Sibirskoye Otdeleniye 1-160

Lenz, F. 1925. Chironomiden und Seetypenlehre. – Naturwiss. **13:** 5-10

– – 1927. Chironomiden aus norwegischen Hochgebirgsseen. Zugleich ein Beitrag zur Seetypenlehre. – Nytt. Mag. Naturvid. **66:** 11-192

– – 1941. Die Jugendstadien der Sectio Chironomariae (Tendipedini) connectentes (Subfamilie Chironominae=Tendipedinae). – Arch. Hydrobiol. **38:** 1-69

Linevich, A. A. (1964) Tendipedids (Chironomids) from Pribaikal and West Zabaikal regions (In Russian).- Autoreferat Dissertation Leningrad

– – 1981 Chironomids from Baikal and surroundings (In Russian). – Novosibirsk: Idatelstvo Nauka, Sibirskoye Otdeleniye 1-152

– – , Samburova, V. E. & V. N. Alexandrov 1991. Towards investigation of metamorphosis of Baikal chironomids. – In: Morphology und Evolution of Invertebrates (In Russian). – Novosibirsk: Idatelstvo Nauka, Sibirskoye Otdeleniye 211-266

Lundbeck, J. 1951. Zur Kenntnis der Lebensverhältnisse in sauren Binnengewässern. – Arch. Hydrobiol. Suppl. **20:** 18-117

Nevers, P. 1972. Beiträge zur Cytotaxionomie, Morphologie, Systematik und Biologie der Gattung *Sergentia* Kieff. (Dipt., Chironomidae). – Staatsexamensarbeit Univ. Freiburg

Pankratova, V. Y. 1983. Larvae and nymphae of the midges of the Chironominae subfamily of the Fauna USSR (Diptera, Chironomidae = Tendipedidae) (in Russian). – "Nauka" Leningrad Otd, 296 pp.

Pinder, L. C. V. & F. Reiss 1983. The larvae of Chironominae (Diptera, Chironomidae) of the Holarctic region-keys and diagnoses. – Ent. scand. Suppl. **19:** 293-435

Proviz, V. J. & L. I. Proviz 1992. Structure and evolution of karyotype in group of endemic Chironomid species of the genus *Sergentia* Kieffer (Diptera, Chironomidae) in Baikal lake. – Zool. Zh. **71:** 60-70

– – & – – 1997 A new chironomid species of genus *Sergentia* (Diptera, Chironomidae) from the Irkutsk water reservoir. – Zool. Zh. **76:** 633-636

Proviz, V. J., Ivanova, L. V., Proviz, L. I., Slobodyanuk, S. Y. & E. T. Taeveskaye 1991. Investigations on karyotypes and elektrophoretic spectres of hemoglobins in 6 chironomid species (Diptera, Chironomidae) (In Russian). – Tsitologiya **33:** 122-128

– – , Goddeeris, B. R. & V. Belkov 1994. Speciation in Baikal Chironomidae (Diptera): An introduction.- Arch. Hydrobiol. Beih. Ergebn. Limnol. **44:** 327-334

Saether, O. A. 1977. Female genitalia in Chironomidae and other Nematocera. Morphology, phylogenies, keys. – Bull. Fish. Res. Board Canada: 1-210

– – 1980. Glossary of chironomid morphology terminology. – Ent Scand. Suppl. **14:** 1-51

Scherbina, G. S. 1988. Produktion von *Sergentia coracina* (Zett.) im See Wischtnetzkoye (Diptera, Chironomidae) (In Russian). – Biology of Inland Waters, Information Bulletin **79:** 59-64

Sokolova, N. Y. & E. T. Izvekova 1986. Benthos of Lake Glubokoe. – Hydrobiologia **141:** 89-93

Stahl, J. B. 1959. The development history of the chironomid and *Chaoborus* faunas of Myers Lake. – Invest. Indiana Lakes and Streams **5:** 47-102

– – 1966. Characteristics of a North American *Sergentia*-lake.- Gew. Abwässer (Krefeld) **41/42:** 95-122

Thienemann, A. 1943. Chironomiden aus dem Lunzer Seengebiet. VIII. Neue Metamorphosen. – Zool. Anz. **142:** 192-199

– – 1954. *Chironomus*. Leben, Verbreitung und wirtschaftliche Bedeutung der Chironomiden. – Binnengewässer **20:** 1-834

Townes, H. K. 1945. The nearctic species of Tendipedini (Diptera; Tendipedidae=Chironomidae). – Am. Midl. Nat. **34:** 1-206

Tschernovskij, H. A. 1949. Bestimmungsbuch für Larven der Chironomiden.(In Russian) Bestimmungsbücher zur Fauna der UdSSR 3, Moskau und Leningrad

Wülker, W. 1961. Studien zur Morphologie., Biologie und Verbreitung der Gattung *Sergentia* Kieff. (Dipt., Chironomidae). – Arch. Hydrobiol. Suppl. **25:** 307-331

– – , Maier, W. & P. Bertau 1969. Untersuchungen über die Haemolymphproteine der Chironomiden (Diptera). – Z. Naturforsch. **24b**: 110-116

Zetterstedt, J. W. 1838: Insecta lapponica. – Lipsiae