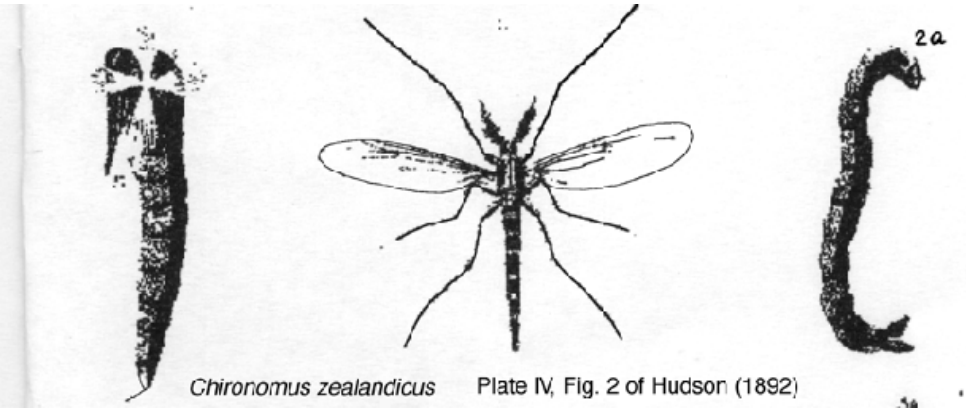


Chironomus zealandicus Plate IV, Fig. 2 of Hudson (1892)

NEW ZEALAND *CHIRONOMUS* SPECIES

Integration of data of Jon Martin[1] and Don Forsyth[2]

[1] Genetics, Genomics and Development, School of Biosciences, The University of Melbourne, Parkville 3010, Australia

[2] Deceased

When Freeman (1959) revised the New Zealand Chironomidae he recognized two species of the genus *Chironomus* (s.s.): *C. zealandicus* and *C. analis*. However, even at this stage it was known that adults of *C. zealandicus* could be produced from two distinct larval types, a salinarius-type (lacking ventral tubules) or a so-called thummi-type (with ventral tubules) (Forsyth, 1971), although in fact the latter are a bathophilus-type. (see below for current classification scheme).

Analysis of the polytene chromosomes further indicated that there were different chromosome number forms of both the salinarius- and the bathophilus-type larvae (Lentzios *et al*., 1980), which appeared to be distinct species. With the integration of the morphological and ecological analyses of Don Forsyth, the karyotypic studies of Jon Martin, and DNA studies with associated larvae from Ian Hogg and Sofia Ibarrarán, we have concluded that there are at least fourteen species of *Chironomus* in New Zealand (Note that this only includes one of the two species described by Sublette & Wirth (1980) from the subantarctic islands) and includes an Australian species that may be a recent migrant. DNA studies are suggesting some of these species are groups of closely related species as is common in other parts of the world. Where possible a link to the relevant Bin in the BOLD Database (http://www.boldsystems.org/index.php) is given.

Seven of the currently recognised species have a salinarius-type larva, and seven others are bathophilus-type, although two are polymorphic for ventral tubule development with some having only slight development of the posterior pair of ventral tubules (halophilus-type). The larva of the fourteenth species is unknown.

For convenience, some Pacific island species are also included (see below).

In general, the morphological terminology used in this document follows Sæther (1980), Webb & Scholl (1985) and Vallenduuk & Moller Pillot (1997).

Abbreviations

AR – Antennal ratio. In larvae it is A1/A2-A5, measured only from the sclerotized parts of each segment as the soft tissue between each segment can stretch to different extents during slide mounting.

ASA - distance between antennal bases
AT – Anal tubules
BOLD - Barcoding of Life Database (http://www.boldsystems.org/index.php)
BR - Balbiani ring
COI - Cytochrome oxidase subunit I
CS – sensilla chaetica
Cyt B - Cytochrome b
FC - Frontoclypeus
FT – Frontal tubercles
Gb2B - Globin II Beta
Gb9 - Globin IX
GC - Gonocoxite IX
GP – Gonopopheses VIII
GS – Gonostylus
H setae – Found only in the adult female. Usualy included in the dorsocentrals (sometimes with a note that these begin more anteriorly in females than males), but since they are anterior to the parapsidal suture they are humerals and their arrangement has some taxonomic usefulness (e.g. linear, in a cluster, or a mixture).
HR – ratio of length to width of pupal respiratory base
IPD – see VPA
IVo – Inferior volsella
LR – Leg Ratio (Ta1/Ti, usually of fore leg)
MD – male determining (gene)
Mdt-Mat – distance from the tip of dorsal tooth to the tip of apical tooth of the mandible.
Mt – Mitochondrial
MTR – Mdt-Mat divided by mandible length
MW - Mentum width
N – Nucleolus (i.e. the sac produced by an active NOR)PSB
NOR – Nucleolar Organizing Region (i.e. the chromosomal locus capable of producing a nucleolus)
PE - Pecten epipharyngis
TLt – posterolateral tubules

PMa – Pecten mandibularis
PreM – Premandible
PSA – Pedes spurii A
PSB- Pedes spurii B
RO - Ring Organ – of larval antenna and dorsal head
S4A – distance between larval S4 setae
SCf - Sensilla campaniformia (on brachiolum)
SCh - Sensilla Chaetica
SVo - Superior volsella
VHL - Ventral head length
VM – Ventromentum
VML – length of VM
VMR - ratio of the width of the marginal region of ventromentum (usually seen as a granular band under light microscopy) to the distance from the anterior margin to the base of the striae (see figure below)
VPA (also IPD) – distance between the inner margins of the two VM.
VR – Venarum ratio. It should be noted that there are two ways in which this may be calculated, one usually giving a value above 1, the other a value below 1 – these are reciprocals of each other. The value used here is that given in Sæther (1981): length of crossvein to length of M-vein.
VT - Ventral tubules
¿ - presence at locality not confirmed.

One aim in these studies has been to evaluate as many characters of adults, pupae and larvae as possible in order to evaluate which ones might prove useful for separating the species that can only be recognized at present by the banding patterns of the larval polytene chromosomes.

Provisional Key to Adult Males

(based on supplemented data of D.J. Forsyth)

1. Anal point stout . . . . . *C. analis*
   Anal point narrower 2

2. Abdominal tergites with dark saddle spots 5
   Abdominal tergites with bands or patches covering most of the segment 3

3. Anterior tergites with a band over only about two thirds of the segment 4
   Anterior tergites with band over most of the segment . . . . . .*C.* 'thermarum'

4. Pigmentation of the anterior tergites narrowing to the posterior edge . . . . . *C.* 'castaneum'
   Pigmentation of anterior segments covering whole width of segment 7

5. Anterior LR generally above 1.5; only short sparse beard . . . . . *C. forsythi* (part)
   Anterior LR below 1.5; may or may not have beard 6

6. Lacking a beard . . . . . *C.* nr. 'castaneum'
   Dense short beard and sparse long beard . . . . . *C. zealandicus*

7 Anterior LR generally above 1.5; only short sparse beard (BR <3) . . . . . *C. forsythi* (part)
   Anterior LR probably just below 1.5, at least some longer beard (BR 3-7) 8
   **C. nr. antipodensis* would also fit here, but LR not known.

8. Dense short beard and sparse longer beard (BR 4-7) . . . . . *C. novaezelandiae*
   Moderate beard (BR 3-4) (based on only 1 specimen) . . . . . *C.* sp. NZ12

Note that the adults of some species are unknown.
The adults of *C.* 'spilleri' and sp. NZ12 are assumed to be similar to those of *C. novaezelandiae* since Don Forsyth included them all under that name.
The Australian species C. 'pseudoppositus' has been recognized in New Zealand on the basis of mtCOI sequence, but the morphology has not been compared with that of Australian specimens.

Pacific species have not been included in the above key, but the following species are considered:
Chironomus bicoloris Tokunaga, 1964
Chironomus circumdatus (Kieffer, 1916)
Chironomus crassiforceps Kieffer, 1916, as *Tendipes*
Chironomus hawaiiensis Grimshaw, 1901
Chironomus pallidinubeculosis Tokunaga 1964
Chironomus preapicalis Tokunaga 1964
Chironomus vitellinus Freeman, 1961
Chironomus sp. Fiji1 ("C. harrisi")

In the adult descriptions reference is made to the types of superior volsella shape as recognized by Strenzke (1959). This is a helpful initial classification, but experience has shown that the types are not discrete but are part of a continuum. The three categories as described by Strenzke are:

S-type: The SVo is shoe shaped, i.e. it is drawn out distal-medially into a broad, rounded lobe (Fig. a-c, below) (Strenzke's figure suggests the most distal point will be at the toe of the shoe),
D-type: The SVo is ribbon-like: distally it may have a weakly thickened shoulder (Fig. d, below) (most distal point is not at the internal margin), or bent in a shallow sickle-shape (Fig. e-f, below).
E-type: The SVo has the form of an elephant's tusk; distally it is sharply graded to a point, or with an expanded knob (Fig. g-i, below) (line from base to most distal point goes outside the limits of the SV).

Abb. 4. Grundformen der Claspette des *Chironomus*-Hypopygs (♂). a—c S-Typ (a *halophilus*, b *thummi thummi*, c *luridus*), d—f D-Typ (d, e *dorsalis*, f *striatus*), g—i E-Typ (g *cingulatus*, h *salinarius*, i *annularius*).

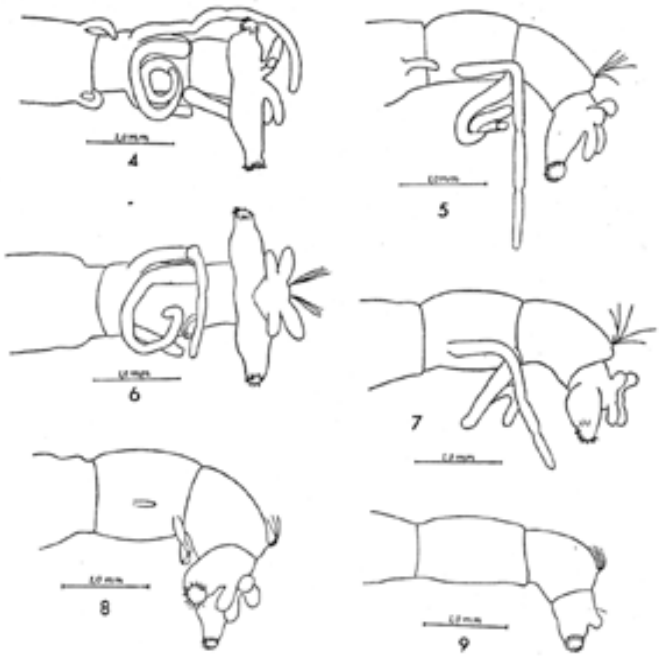
—

In the following key and descriptions, reference is made to the larval type. The scheme used here is the revision of older classifications as proposed by Proulx *et al*. (2013), who recognize 9 categories.
The categories are:
salinarius - lacking posterolateral (TLt) and ventral tubules (VT)

Lacking TLt:
halophilus - anterior VT very short or absent, posterior VT short
bathophilus – moderate to long, essentially straight VT.
fluviatilis - VT slightly curved and coming to a point at ends. (often hard to distinguish from bathophilus-type, particularly in some fixed material)
thummi – long, anterior VT with 'elbows', posterior VT coiled

Possessing TLt:
reductus – lacking ventral tubules.
semireductus – short straight or slightly curved VT.
melanotus – moderate to long, essentially straight VT.
plumosus – long, anterior VT with 'elbows', posterior VT coiled.

13

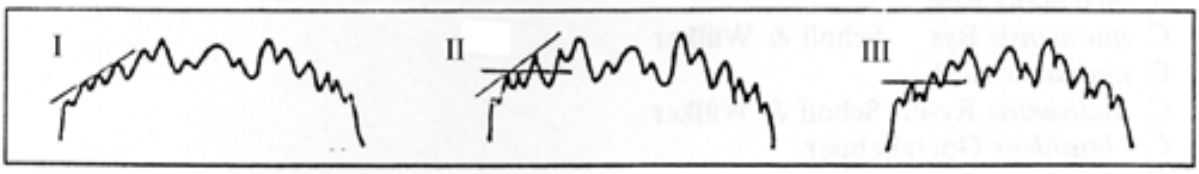


Figs. 4—9. Hind parts of larvae.
4. plumosus type (total length 15 cm; loc. 12; 13.VII.1943); ventral view; right tubuli cut off.
5. as 4, but seen from the left; left tubuli only drawn.
6. thummi type (total length 17 cm; loc. 1; 5.VII.1944) ventral view; right tubuli cut off.
7. as 6, but seen from the left; left tubuli only drawn.
8. halophilus type (total length 12 cm; the fjord; 27.IV.1942); seen from the left, slightly from the ventral side.
9. salinarius type (total length 15 cm; the fjord; 27.IV.1942); seen from the left.

Note that only about three of these categories, lacking lateral tubules, have been found in New Zealand.

Reference is also made to a number of larval characters including the mentum and mandible types originally devised by Webb & Scholl (1985), Vallenduuk & Moller Pillot (1997) and Proulx *et al*. (2013). These classifications were made for relatively small numbers of species, but with the much larger number of species, such as in the North American fauna, they do not cover all the variability seen in these characters and so further modification has been necessary.

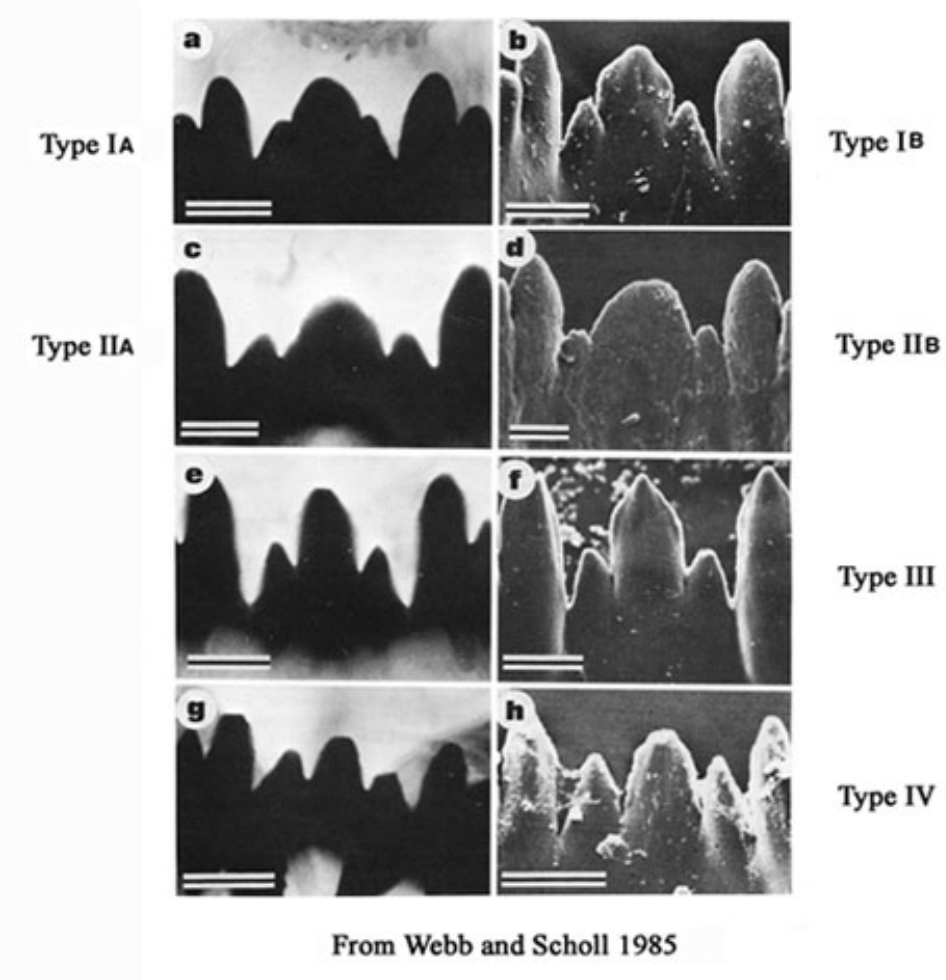
The mentum type is defined only by the degree of development of the 4th lateral teeth:
Type I - height in same line as the rest of the lateral teeth;
Type II - 4th laterals reduced, height about equal to that of the 5th laterals;
Type III - 4th laterals further reduced, height less than that of the 5th laterals.



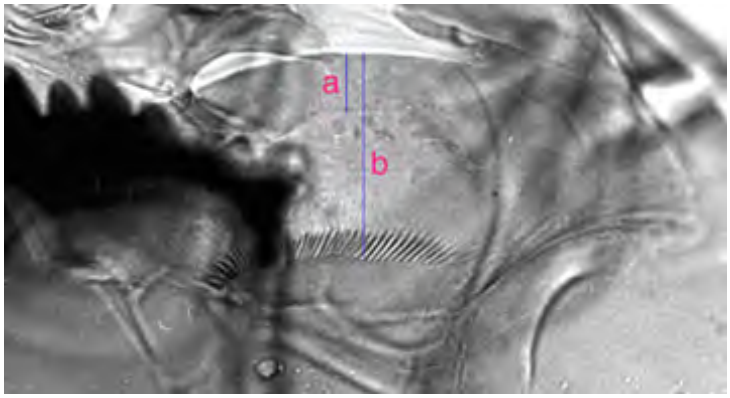
From Vallenduuk and Moller Pillot 1997

The mentum may be further classified by the characters of the central trifid tooth:
Type IA - c2 teeth only partially separate from c1, i.e. as shoulders on c1. (figure a)

Type IB – c2 teeth slightly more separated (figure b)
Type IIA - c1 broad, c2 teeth distinctly separated (figure c) (there is also a variant with a narrower c1).
Type IIB – c1 very broad, c2 less separated (figure d).
Type III - c1 tooth relatively narrow and much higher than the separated c2 teeth (figs e and f).
Type IV - c2 teeth well separated, not much lower than the relatively narrow c1 tooth (figs g and h)

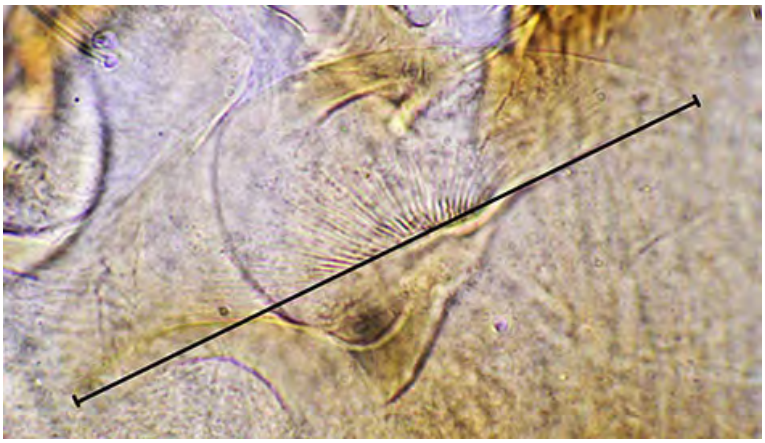


Ventromentum



VMR = a/b

b also serves as a measure of the depth of the Vm for the ratio of length to depth of the VM plates.
VM length (VML) is measured directly from inner margin to outer margin:



<u>Pecten epipharyngis</u>
Proulx *et al.* (2013) recognised 4 types of PE in North American species. These are useful if the teeth are not worn down as they often are in older larvae. Type D does not occur in any known Australian species.
Type A – fine sharp rather uniform teeth.

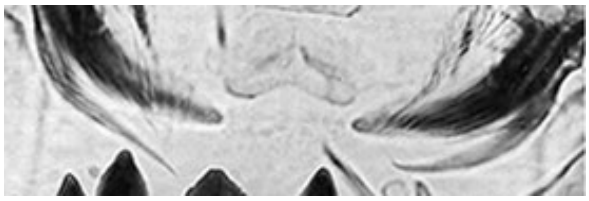
Type B – teeth broader but still sharp. Sometimes with one or two fine smaller teeth interspersed.

Type C - rounded and usually short. Worn type B teeth may be mistaken for this type.

Type D - rounded teeth with smaller teeth interspersed (generally found in the subgenera *Lobochironomus* or *Chaetolabis* which have not been found in New Zealand).

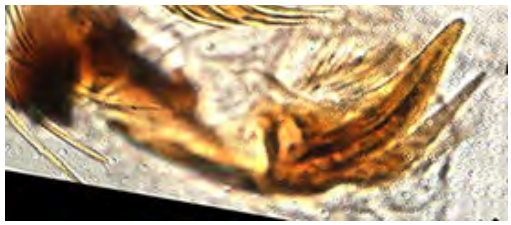
<u>Premandible</u>

Type A: Both teeth narrow and coming to a fine point.



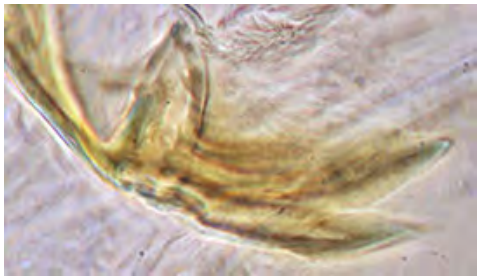
Type B: inner tooth moderately broad, about 3-5 times wider than, outer tooth. This can be split into 2 subgroups:

B1 – both teeth come to relatively fine points.

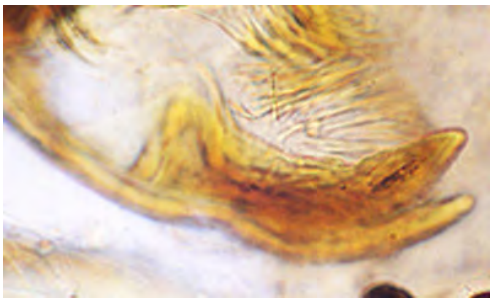


B2 – the inner tooth comes to a relatively broad point.

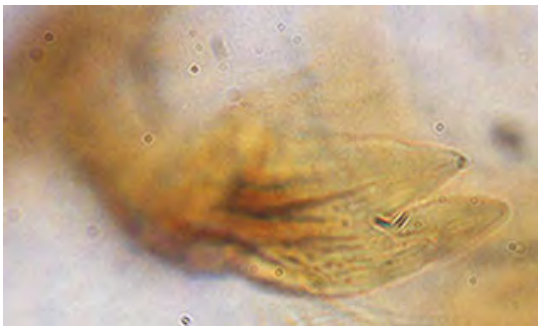
Type C: Both teeth are moderately broad, coming to relatively broad points.



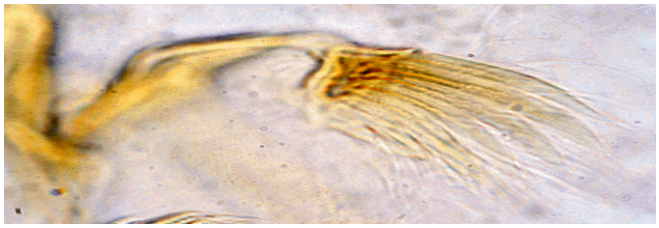
Type D: Inner tooth very broad, outer tooth moderately broad.



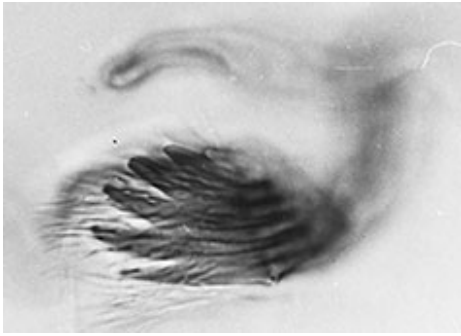
Type E: Both teeth very broad and often quite short.



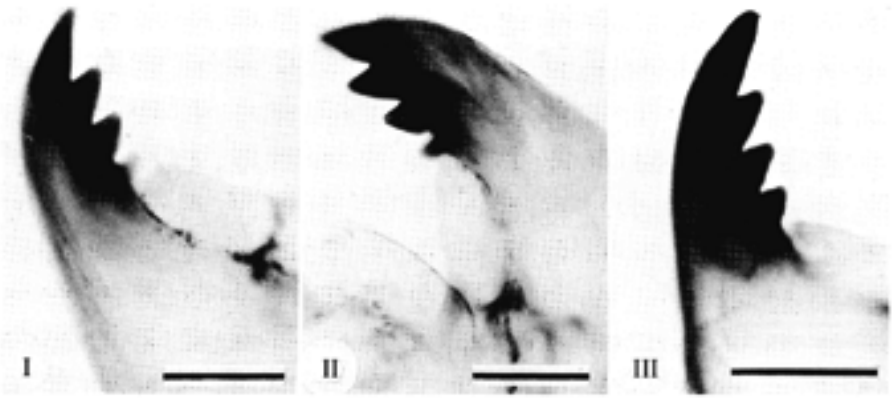
Type F: A five (sometimes 6) toothed premandible



Species of *Kiefferulus* also have a five-toothed premandible, but it is broader



The mandible type is defined by the degree of darkening and separation of the 3rd inner tooth.
It appears preferable to consider these as separate characters:
Separation
Type I - almost completely fused on lower margin;
Type II - tooth partly free on lower margin;
Type III - 3rd tooth completely separate.
Colour
Type A – pale
Type B – slightly darkened
Type C – as dark as other teeth



From Webb and Scholl 1985.
These would represent IA, IIB, and IIIC respectively

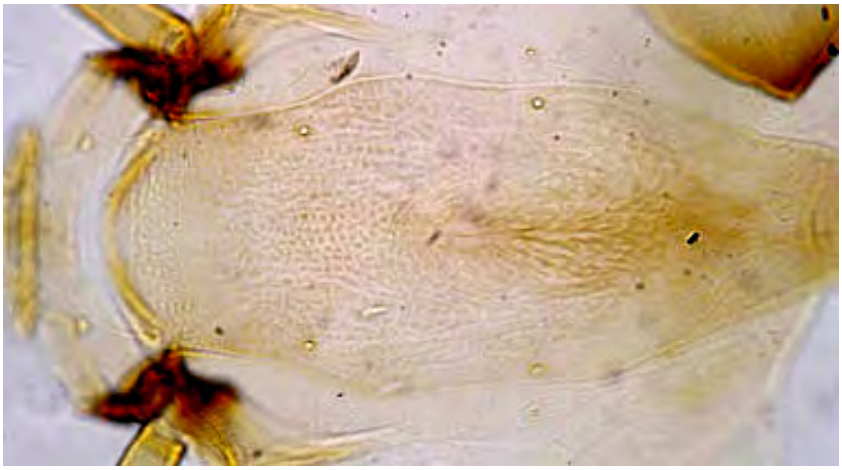
Mandible length and Mdt-Mat:
Mandible length is measured from the heel to the tip of the apical tooth.

Hirvenoja and Michailova (1998) illustrated that the distance between the tip of the dorsal tooth and the apical tooth could differ between related species (Mdt-Mat) (blue line in figure below).

However for different sized species it may be preferable to divide this value by the length of the mandible (black line in figure above) to obtain the MTR.

Relationship on the FC of the distance between antennal bases and distance between S4 setae

This character gives some indication of the shape of the anterior region of the FC: the amount and extent of the narrowing at the anterior end near the antennal bases, and where the S4 setae are in relation to the broadening of the clypeus (see figure below). This relationship can be further characterized by the distance of the S4 setae from the edge of the FC – most easily expressed by the fraction of the FC width between the two S4 setae. This has two components: how far the setae are from the FC margin, and how close they are to the widest point of the FC.



Frontoclypeus with approximately equal distance between antennal bases and S4 setae
Note also the barely visible 'ring organ' of Yamamoto *et al*. (2015), (more obvious at top) immediately opposite the S5 setae. This is a characteristic of species of *Chironomus*.

Salivary reservoir:
This can sometimes be a useful character for separating species, but can be quite variable, probably due to squashing during slide mounting. Therefore theose specimens with the widest opening are the most appropriate to use.

One aim in these studies has been to evaluate as many characters of adults, pupae and larvae as possible in order to evaluate which ones might prove useful for separating the species that can only be recognized at present by the banding patterns of the larval polytene chromosomes.

It should be noted that many of the larval characters referred to in the following descriptions can be quite variable. General size and ventral, lateral and anal tubules can be affected by environmental conditions, as well as by genetic variability. Appearance of mouth parts is also affected by wear, for example a worn type III central trifid tooth can appear to be type II. Genetic variation can also apply to these characters. Consequently, identification may need to be based on agreement of the majority of characters, particularly those that are least variable. This is why identification of larvae on the basis of morphological characters is so difficult.

Provisional Key to Fourth Instar Larvae

1. Larva a salinarius-type. 2
   Larva with at least some development of VTs 8

2. More than 60 striations on VM . . . . . *C. zealandicus* (= *C.* species a)
   Less than 60 striations on VM 3

3. Anal tubules rel. long sometimes with sl. constriction near middle . . *C. forsythi* (in part)
   Anal tubules relatively short, pointed or rounded. 4

4. FC region of head pale or only slightly darkened 5
   FC region very dark 6

5. c1 tooth of mentum broad (IIA). sp.NZ9

   c1 tooth of mentum generally narrower (IIA). . . . . *C.* 'thermarum' (in part)

6. c1 tooth of mentum broad (type IIA) . . . . . .*C.* ‘castaneum’ group . 7

   c1 tooth of mentum generally narrower.(narrow type IIA) . . . . . *C. analis*

7. Mandible of ty. IIB or C (occasionally IIIC), with about 15- 25 furrows . . . . . *C. ‘castaneum’* group
   Mandible of ty IIIC, with about 26 furrows . . . . . .*C.* sp.14

8. Slight development of posterior ventral tubules only. . . . . *C.* '*thermarum*'
   In thermal waters (but *C. zealandicus, . novaezelandiae* and sp. 12 can be also)
   Two pairs of ventral tubules present. 9

9. Anal tubules relatively long, as in *C. forsythi* 10
   Anal tubules shorter and rounded. 11

10. Anal tubules all about equal & 2.5x longer than wide (3 polytene chromosomes) . *C.* sp.8
    Anal tubules about 2.5-4.2 times longer than wide, dorsal pair often longer. . . . . *C. ‘pseudoppositus’*

11. Head somewhat narrower, ratio mentum width/VHL less than 0.65, ventral tubules sometimes longer than 1.0 mm, post pair longer . . . . . *C. novae-zealandiae* group . . . 12
    (Note: with frontoclypeus generally darkened but sometimes pale or only slightly darkened (as in known specimens of *C.* sp.8))
    Head broader, ratio mentum/VHL above 0.65 with darkened frontoclypeus. . . . . *C.* sp.7
    Not in North Island.

Chironomus zealandicus Hudson, 1892

There have been several attempts to relate *C. zealandicus* to one of the cytologically known species, and it has been suggested at different times that it was either species 1 (Forsyth,1978 and Martin,1998) or C. species a (Martin,1996).
However, species 1 can be ruled out because there is an entry in Hudson's journal that he reared the specimens of *C. zealandicus* from larvae without ventral tubules. Forsyth therefore thinks that *C.* species a is the species that corresponds to Hudson's *C. zealandicus*. This is supported further by the fact that *C.* species a is the largest of the reared species, about the size of Hudson's *C. zealandicus* specimens.

The name is therefore used in this sense in this work.

The chromosomal banding patterns were originally defined using the Australian standard of Martin (1969) but are now in the process of being transferred to the more universally used (although more difficult for defining a specific band) standards of Keyl (1962) and Devai *et al*. (1989).

Species descriptions:

1. *Chironomus novaezelandiae* Kieffer, 1921
   Although originally allocated the name *Chironomus novae-zelandiae*, such names are no longer acceptable under the Code, and it should now be *Chironomus novaezelandiae.*
   The identification of this material as *C. novaezelandiae* is based on the similarity to the specimens in the type series, plus the broad distribution of the species.

   In BOLD Bin: BOLD AAJ0168 and BOLD ABZ5458
   BOLD ABZ5458 is the nearest neighbor-Bin to BOLD AAJ0168 (Bin for *C.* spNZ12) and the reason for the separation is possibly the presence of polymorphic sites in *C. novaezelandiae* in which one base is identical to the fixed base in *C.* spNZ12 (see below).
   C. 'thermarum' is also a member of this species group and is also in Bin BOLD AAJ0168.

   CHIRONOMUS NOVÆ-ZELANDIÆ ~ n sp. ♂ Yellowish. Frontal lobes very small. Antennae and plumes brown, black scape, twelfth segment very long, four times as long as 2-11 combined, 3-11 very broad. Metanotum, three shortened bands of mesonotum and mesosternum brownish red and dull. Halteres white. Wing hyaline, lobe at right angles, transversal black, cubitus a half longer than the radius, and nearer to the tip of the wing than the discoidal;

cross-vein under the transversal. Legs yellowish, fourth and fifth segments of the tarsae a dark brown, anterior metatarsus a third longer than tibia, its distal third and the second segment setae long, 2-4 gradually shorter, pulvilli large, the two spurs of the posterior tibia short. Abdomen brown black, hind margin of tergites whitish. Claspers brown black; terminal parts very long, nearly twice as long as the basal, slightly curved and slightly thinned in their distal half, median part bearing, before the extremity, a row of six rigid bristles, almost twice as long as the width of the segment; superior appendage red, exceeding the basal segment, strongly curved, equally wide to the extremity, which is rounded; inferior appendage twice as long as the superior, exceeding the basal third of the terminal segment, with numerous long, curved, dorsal hairs; anal point moderately long. L. 8 m/m.
(i.e. AR about 4; LR about 1.3)
♀. Antennae brown, second segment has neck a little longer then wide; 3-5 a neck shorter than the base, the sixth half longer than the fifth. L. 7 m/m.
New Zealand, 7♂ 1♀

Translation of Kieffer's original 1921 description

Adult:

There are 5 males, including the lectotype from Wellington, and two females (so Kieffer may have only examined one of them) of the type series, collected by Osten-Sacken, in the DEI near Berlin, Germany. These specimens are lacking many leg segments, and the abdomen in one case. These specimens were examined in 1997.

Males:

AR about 3.23-3.6 (Kieffer gives 4.0); Clypeal setae about 22-37. Thoracic setae could not be clarified.

Wing length could not be measured, but VR about 1, as noted by Kieffer.

Legs: Anterior tarsi with a beard of dense shorter setae (BR 1.6-4.3) and sparse longer setae (BR about 3-7) i.e. about twice the length of the shorter setae.

Leg segments (relative lengths only):

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	285	265	377	200	140	-	-	1.34-1.45	0.96-1.09	2-4, 3-7
PII	290	275	160	100	-	-	-	0.58-0.60	1.02-1.08	
PIII	370	390	254	154	-	-	-	0.60-0.69	0.89-1.0	

BR – there is a double beard, mainly short (2.1-4.3) and sparse longer (3.15-7.15)

Abdominal segments generally with a dark band and a narrow pale posterior stripe.

One specimen (labelled only 'New Zealand') has a narrower dark band and has green on the abdomen as well - since this specimen has only a shorter beard (BR 3.15), it may be a different species.

Data from other specimens: The identification of the current material as *C. novae-zelandiae* is based on the similarity to the specimens in the type series, plus the broad distribution of the species.

Male of *C. novaezelandiae* from BOLD database (NZINS-83)

Wing length about 4.06-4.88 mm; width about 0.88-0.96 mm, VR about 0.98. AR about 3.2-3.22; small FT about 10-15 µm long and 7.5 µm wide; 15-23 setae on clypeus.
Palpal segments (micron): 58 : 60 : 250 : 249 : 354; P5/P4 1.01-1.42; P5/P3 1.39-1.41.
Thoracic setae: Acrostichal - not seen; Dorsolateral - 12-17; Prealar - 5-6; Scutellar in roughly two rows, 4-10 anterior and 11-12 posterior (total 15-22).
Anterior tibiae and tarsus bearded, with mainly shorter setae (BR about 3) and sparse longer setae (i.e. essentially a sparse long beard).
Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1435	1290	1790	1060	775	640	295	1.38-1.43	1.12	2.7-3.9
PII	1505	1400	830	525	370	255	178	0.57-0.61	1.06-1.08	
PIII	1700	1725	1178	728	519	345	203	0.65-0.69	0.93-0.99	

BR – double beard only measured from one specimen: short 3.3, sparse long 4.5

Abdominal tergites with brown bands covering the basal 2/3 of TII-VI, wider in midline than at edges, and about 4/5 of tergites VII and VIII. 3-6 setae in individual patches on tergite IX.

Male terminalia (left), and Anal point (right)

Hypopygium: SVo hooked, E(h)-type of Strenzke (1959); IVo reaching almost to the end of the long and relatively narrow anal point (about midpoint of gonostyle) with more-basal setae of IVo ramose. Gonostylus only moderately swollen and reduces relatively sharply over distal third.

Females:
Osten-Sacken female – just labelled 'New Zealand'
Few metrics able to be ascertained;
Antenna (relative lengths: 100 : 200 : 175 : 180 : 265. AR 0.41-0.42;
Most leg segments missing:
Leg segments (relative lengths only):

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T
PI	225	235	-	-	-	-	-	-	0.94
PII	205	215	-	-	-	-	-	-	0.95
PIII	370	390	255	-	-	-	-	0.63	1.0

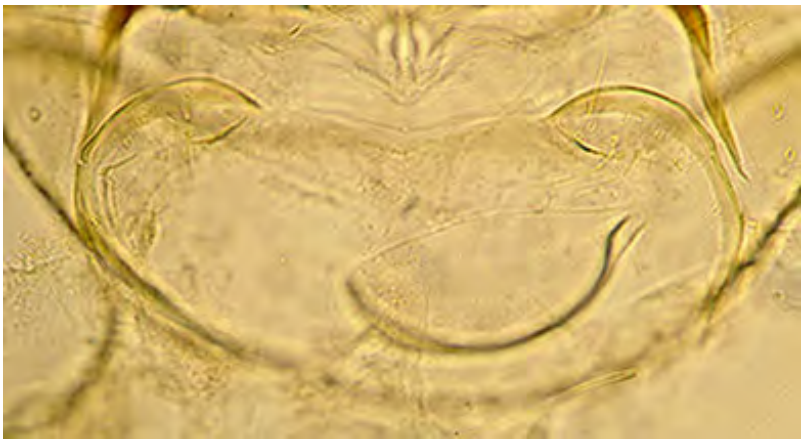
Other females:
Wing length 4.46 (3.96-4.88) mm, width 0.96-1.40 mm; VR 0.81-0.98, about 3-4 Scf on brachiolum, and about 25 setae in squamal fringe.
Head: Antennal proportions (micron)(propn of neck in brackets): 181-220 (0.31); 116-138 (0.42); 130-155 (0.33): 131-150 (0.43): 215-251. AR 0.39 (0.38-0.41); A5/A1 1.16 (1.14-1.22).
FT about 23-35 µm and 3-3.6 times longer than wide; palpal segments (µm) 100 : 64 : 226 : 259 : 387: P5/P4 1.34-1.53; P5/P3 1.41-1.91.
Clypeal width about 1.6 times the diameter of the antennal pedicel; 41-51 setae.
Thoracic setae: Acrostichal – 13-19; Humeral about 3-5 linear sometimes incl. perhaps 3 small setae, Dorsolateral – 19-30 (Humeral+ Dorsolateral 22-33); Prealar – 5-9; Supra alar - 1; Scutellar – anterior row 15-27, posterior row 16-20 (total 22-47).

Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1467	1320	1860	1027	767	620	327	1.38-1.44	1.11	0.45-0.50
PII	1520	1480	833	493	360	333	207	0.56-0.57	1.00-1.06	
PIII	1787	1853	1240	760	580	353	233	0.64-0.69	0.94-0.99	

BR 1.63-2.21

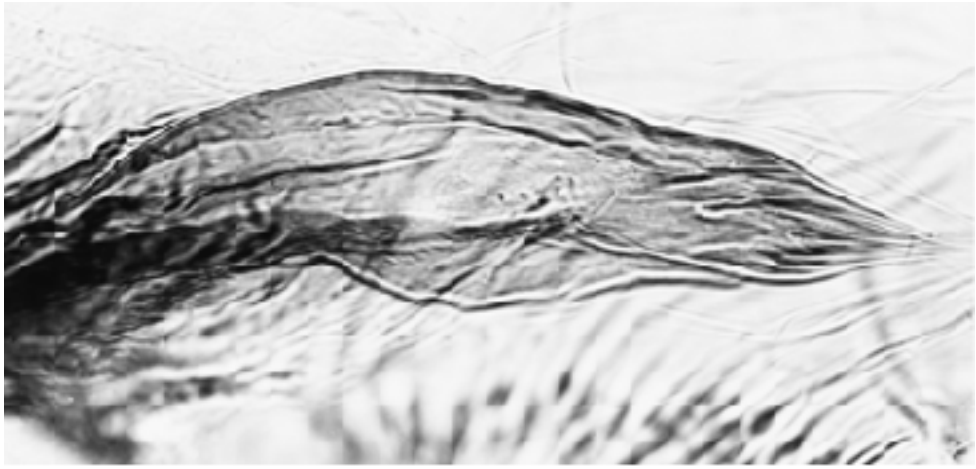
Abdominal tergites with darkened bands, at anterior of TII to TIV then more extensive.



Terminal region of female showing the narrow semicircular segment X, and the rounded posterior margin of the cercus

Segment X a narrow semicircle about 210 x 34 µm (6 times longer than widest point); cerci also appear to be essentially semicircular.

Pupa: about 9.8-10.2 mm long (South Island females); cephalic tubercles about 100 µm long, subapical seta about 90µm. Thorax and muscle scars pale yellow brown, abdomen relatively pale; shagreen largely in mid-line - on post half of segment II, post 2/3 of segment III and wider on segments IV-VI; none apparent on segments VII-IX.
Basal respiratory ring about 205 µm long, HR about 2.4, with the respiratory bases markedly narrowed in the middle.
About 80 recurved hooks at posterior of segment II, covering about 70% of the segment width.
Pedes spurii B at posterior of segments II and III; a large pedes spurii A on segment IV, about 230-260 µm long and 95-109 µm wide, about 0.27-0.32 of the segment length.
Caudolateral spurs of segment VIII sometimes with numerous appressed spines (c.f. *C. zealandicus*); about 6.3 (5-9) longer spines and possibly a small one near the base. In some populations with paler larval heads there are only two or three spines but it is probable that some of these would be *C.* 'thermarum'.



About 132 taeniae on the swim fin, in up to three rows in some places.

Fourth instar larva: Usually a bathophilus-type larva, but variable with habitat. Size also variable depending upon habitat and South Island specimens tend to be larger. Length from 9.3-20.8 (fem 12.3-20.8; male 12.3-16.2) mm. Ventral tubules also variable, from 0.4-1.5 mm., anterior and posterior pair essentially equal size but varying between individuals. Anal tubules again variable in length but dorsal pair generally slightly shorter (165-500 vs 195-555 µm) but often slightly wider than the ventral pair (90-320 vs 100-240 µm), length/width about the same (1.4-3.8).

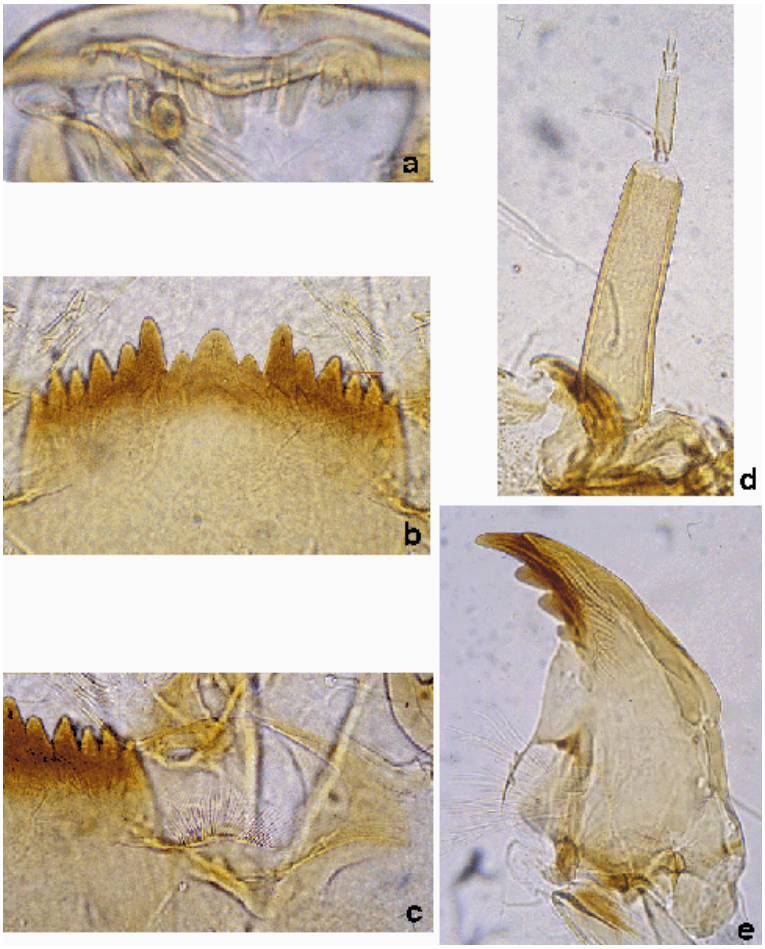
Head capsule normally very dark in gular and frontoclypeal regions. However some individuals have the gular region only slightly darkened and almost no darkening of the frontoclypeus - may be polymorphic in some North Island populations and fixed in some South Island populations (Martin, 1998). These latter may include other species (including C. 'thermarum') but they seem to have very similar cytological features.

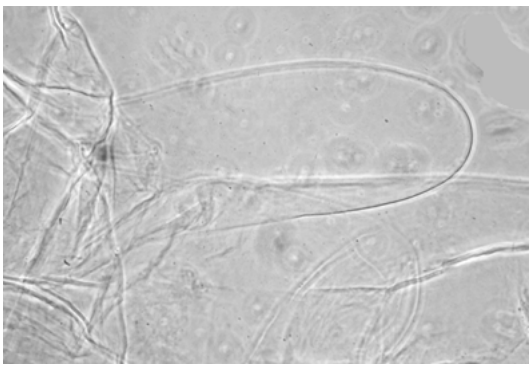
Head relatively narrow, mentum width less than 0.65 of the VHL. Mentum (b, below) of type II, i.e. 4th laterals reduced almost to level of 5th laterals, with centre teeth of normal type IIA (c2 teeth relatively more distinct than those of *C.* 'thermarum').

VM (c, below) about 194-240 µm wide and 3.2-3.9 times wider than deep; with about 35-56 striae (lower in smaller specimens); IPD 0.27-0.44 of MW; VMR 0.30-0.31. PE (a, below) with about 9-18 often irregular teeth.

Antenna (d, below) with basal segment relatively long and narrow, about 3 to 4 times as long as wide; AR about 1.9-2.6; antennal segment proportions (micron) 157 : 33 : 9 : 13 : 7 . Distance between antennal bases overall about the same as that between the S4 setae, i.e. S4 setae, which occupy 0.76-0.94 of the FC width, as likely to be more separated as to be less separated than the antennal bases.

Mandible (e, below) mostly of type IIB, but may be only IB; 11 to 27 furrows on outer surface near base; 10-15 taeniae in PecM (again reflecting variation in size); Mdt-Mat abt 34, MTR about 0.32.



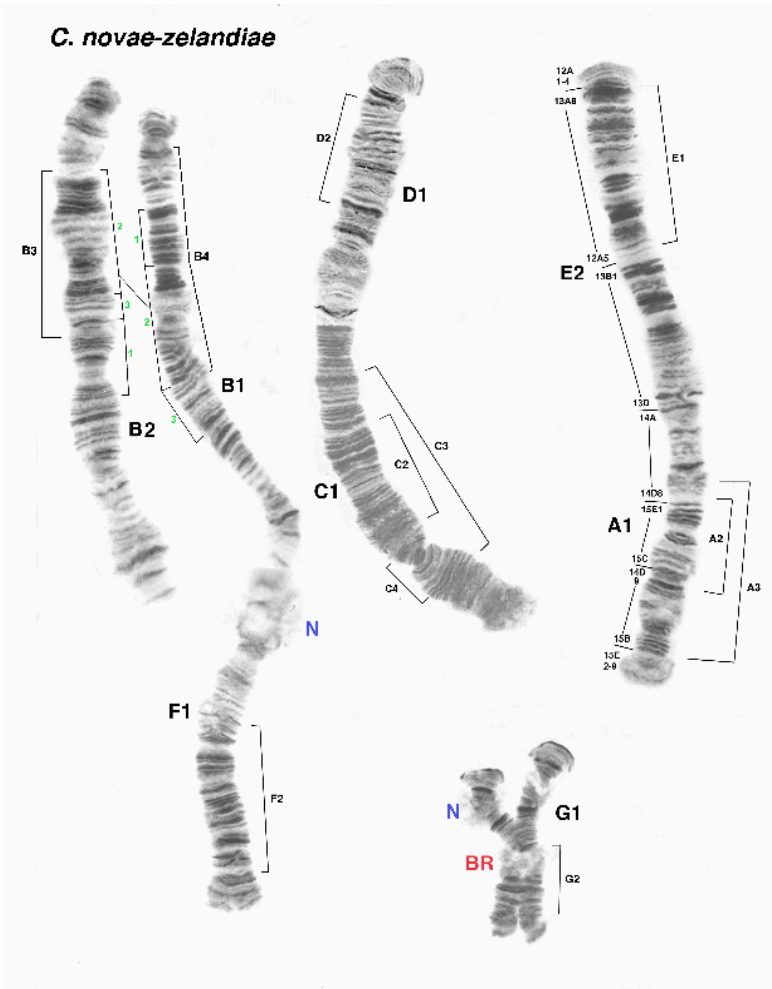


Third instar larva: A single larva was available, length unknown; anterior VT 0.64 µm, posterior 0.68 µm, ventral head length (281 µm) within the range of the 4th instars, but mentum width only 185 µm. Dorsal AT 165µm and ventral AT 195µm in length and both about 1.7-1.8 times longer than wide. Gula darkened over posterior 2/3; FC also darkened. Ventromental plates separated by 0.37 of the mentum width; with 28-30 striae; VMR 0.31-0.38. PE with 13 teeth.

Distance between antennal bases (about 138 µm) about the same as that between the S4 setae (about 137 µm). The relationships of A1 to the VHL about the same as in the smallest 4th instars; distance of RO up from base of segment very different (0.32 & 0.47), A1 2.5 times longer than wide; AR 2.31; relative length of segments (µm) 95 : 19 : 6 : 11: 5.

Mandible about 240 µm long, of type IIIC; with 13-14 furrows and 10 taeniae in the PecM.

Cytology: 4 polytene chromosomes with the pseudothummi-cytocomplex arm combination (BF, CD, AE, G). Centromeres of metacentric chromosomes thin but distinctly heterochromatic, most strongly developed on the CD chromosome. Main nucleolus proximal in arm F (Lentzios & Stocker 1979 (see below)).
Arm G often with a small nucleolus (see figure), although this may be hard to distinguish from a BR unless the nuclear envelope can be seen, and some individuals have been heterozygous for a BR and a nucleolus. Usually another obvious BR, which may be either terminal or medial as the result of an inversion. Specimens without the nucleolus and with a large BR in this region, may be a different species (perhaps *C.* sp.NZ12).
Arm A with sequence oppA4 of Australian species and two other sequences; arm C with one sequence apparently as *C. tepperi* C1; arm D with one sequence as *C. australis*; arm E with one sequence as oppE1 of Australian species, as well as an additional sequence. One of the sequences of arm F appears identical to oppF3 and ausF1.
Polymorphic in all arms. Sequences A3 and C4 known only as homozygotes in sample C from Waikato area. Analysis of an egg mass from Auckland indicates that the MD is not on arm A.
Lentzios *et al*. (1980) give some information on the number and location of C-bands.



nzlA1: 1a-e, 11 - 10, 2c - 1f, 3e - 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 - 19 as oppA4, anlA1, forA1

nzlA2: 1a-e, 11 - 10, 2c - 1f, 3e - 2e, 7 - 4, 12a-c, 3i-f, 9 - 8, 2d, 13 - 19

nzlA3: 1a-e, 13a-f, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 2e - 3e, 1f - 2c, 10 - 11, 14 - 19

nzlB1: Large puff (group 7) with distal dark bands, near middle of arm.

nzlB2: Possibly the result of overlapping inversions. Puff with reduced dark bands nearer distal end of arm.

nzlB3: Derived from B2 by a short inversion of the region with the puff, so that the reduced dark bands are now proximal. may be only in sp. NZ12.

nzlC1: Characteristic band groups 3-4, with 5 distal, near distal end as tepC1

nzlC2: small median inversion, just proximal to groups 3-4.

nzlC3: inversion of most of arm

nzlC4T: Small inversion at distal end of the arm, from group 3-4.

nzlD1: 1 - 2, 16 - 10d, 3a-d, 9 - 3e, 10a-c, 17 - 24 as *australis* D1

nzlD2: 1 - 2, 16c-a, 17e-a, 10c-a, 3e - 9, 3d-a, 10d -15, 18 - 24

nzlD3 1 -2, 16 - 11, 4c - 9, 3d-a, 4ba - 3e, 10a-c, 17 - 24

nzlE1: 1 - 3e, 10b - 3f, 10c - 13 as *oppositus* E1, *analis, forsythi*

nzlE2: 1a-c, 5 - 10b, 3e - 1d, 4 - 3f, 10c - 13

nzlE3: 1a-c, 5 - 7c, 10g-c, 3f - 4, 1d - 3e, 10b - 7d, 11 – 13 may be only in sp. NZ12

nzlF1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 ie. as *oppositus* F3, *analis, forsythi*

nzlF2: 1a-e, 12 - 15c, 2c - 10, 2a, 11i-a, 2b, 15d - 23

nzlG1: Subterminal BR and median BR (often just a pale space).

nzlG2: Inversion of region from median BR to near distal end of arm.

nzlG3: Subterminal nucleolus and adjacent BR, or no visible BR.

It is still likely that this is a mixture of at least two species, as there seem to be two types of arm G: one no apparent nucleolus and with a large subterminal and a medial BR (G1) (the latter moved distally in G2), and another with a subterminal nucleolus and often without an obvious BR (G3), or with a BR very close to the nucleolus – but other than the presence or absence of the nucleolus or BR, the sequence appears identical.
Mt*COI* data suggests a common variable species and a possible second less common form. This seems to represent the difference between the sequence of *C. novaezeandiae* (common & variable) and *C.* spNZ12. These two species differ at a number of sites in the barcode sequence, with somewhat more differences from *C.* 'thermarum' (see below).

DNA analysis:

Mt *COI* – a number of sequences in the BOLD database. These sequences are for 3 species spread across 2 BOLD Bins. There are however distinct differences at a number of sites, as shown below. The increased polymorphism in *C. novaezelandiae* reflects its broader distribution.

C. novaezelandiae

T	G/A	C	T	T	A	T	A/G	T	C	A	T	A/G	T/C	T	C	T	T	A	T	C/T	C/T	A	T	G/A	G/A	T/C	A	C	A	T/	T/C	T/C	T	G	T/C

C. sp.NZ12

T/G	A/T	C	G/T	T	A	A	G	T	C	A	T	A	C	T	C	T	T	A	T	C	C	A	C	G	A	T	C	C/G	C	T	T	T	A	A	T

C.'thermarum'

T	A	T	T	A	T	A	G	A	T	C	A	A	T	A	T	C	C	T	C	T	T	G	C/T	G/A	A	T	C	C	C	T	T	T	A	A	T

Mt *cytB* - GenBank (AF192178.1)

Occurs in a wide variety of habitats, from lakes to pools, including thermal waters, and fresh to brackish. While there may be more than one species still included, the available DNA data is consistent with this wide habitat tolerance.

Localities

North Island:

Auckland, North Auckland (D.J.Forsyth) (NZ.8.2)1965; & (A. & R. Mesa) (NZ.8.1) 25-i-1969

Puarenga Stream, Whakarewarewa, South Auckland (NZ.20.1) (Jon Martin & D.J. Forsyth) 8-xii-1973 – "G3"

Kerosene Creek (37.94°S, 175.56°E), South Auckland (NZ.78.1) (Sofia Ibarrarán) 5.ii.2007 (rare)

Lake Ngahewa, South Auckland (NZ.76.1) (Sofia Ibarrarán) 29.viii.2007

Lake Ngapouri, Waiotapu, South Auckland (NZ.9.1) (D.J. Forsyth) 15-ii-1972; and (NZ.9.3) Jon Martin and D.J. Forsyth) 5-xii-1973.

Lake Okaro, (NZ.10.9), 10 Km s. Rotorua (NZ.10.9) (Sofia Ibarrarán) 5.ii.2007

Lake Rotoiti, about 16 Km north east of Rotorua, South Auckland (NZ.19.3) (Sofia Ibarrarán) 29-viii-2007

Lake Rotowhero area (38.30°S, 176.40°E), South Auckland (NZ.11.6) (Sofia Ibarrarán) 5.ii.2007

Ornamental pool, Rotorua (NZ.26.3) (D.J.Forsyth & Jon Martin) 12-xii-1973

Oruanui Link Road, north Taupo (NZ.71.1) (D.J. Forsyth) 18-ix-1990 – "G3"

Potting shed pond, Taita (NZ.14.1) (D.J.Forsyth) 13-x-1972; and (NZ.14.2) (D.J.Forsyth) 26-i-1973 (rare)

Potting shed pond, Taita Soil Bureau, Wellington (NZ.14.3) (Jon Martin & D.J.Forsyth) 22-xii-1973

Queen Elizabeth Park (NZ.80.1) South Auckland (NZ.80.1) (Sofia Ibarrarán) 5.ii.2007

Artist's Palette, Waitapu thermal area (NZ.21.1) (D.J.Forsyth & Jon Martin) 9-xii-1973

Sulphur Point, South Auckland 37.94°S, 175.56°E) (Sofia Ibarrarán) 5.ii.2007

Trentham Sewage Plant, Upper Hutt (NZ.13-1) (D.J.Forsyth) Tank G 5-xii-1972.

Waikato area (J. Kanapathipillai) (Sample C) 26-iv-1996. (both with & without nucleolus)

Waikato (39.79°S, 175.32°E), South Auckland (Melissa Hill) 26-ix-2012.

Waikato area (37.802°S, 175.334°E) (I. Hogg) 16.vii.2012 and (E.Doyle & N. Binks) 12.xi.2013.

Wellington (Osten-Sacken) Lectotype male

South Island:

Belfast, c. 10 km n. Christchurch (NZ.54.1) (D. Matthews) 7-1-1974

Bromley, Christchurch, Canterbury (NZ.15.1) (D.J.Forsyth) 22-ii-1973

Bromley Sewage Works, Christchurch, Canterbury (NZ.7.3) (Jon Martin) 28-xii- 1973 (Region 4-6 of Robb's samples); and (NZ.7.6) (Jon Martin) 11-i-1974
Christchurch, Canterbury (NZ.7.1) (A.E.Lambden) Jan.Feb.1969
Horseshoe Lake, Canterbury (NZ.72.1) (C.A.Woodward) 15-i-2004
Fairfield Sewage Works, Taieri County Council. Otago (NZ.37.1) (Jon & C.J.Martin, T.Dodgshun) 3-i-1974
Haast junction, Westland (NZ.67.1) (Jon Martin) Egg masses #2.
Haast junction, Westland (NZ.67.1 and NZ.67.2) (Jon Martin & C.J. Martin) 25 & 26-i-1978
Lake Hayes, c.13km n.e. Queenstown, Westland (NZ.47.1) (Jon Martin) 7-i-1974
Lake Ianthe, c. 18 km n. Harihari, Westland (NZ.51.1) (Jon Martin) 9-i-1974
Lake Lochie, on Te Anau-Milford Road, Southland (NZ.45.1) (Jon Martin) 6-i-1974; and (NZ.45.3) (Jon Martin) 19-i-1978
Lake Horseshoe (42.358ºS, 172.52ºE), Waiau River Valley, Canterbury (NZ.68.1) (B.V.Timms) 9-vii-1979; & (C.Woodward) 15-i-2004)
?Lake Pukaki, Canterbury (NZ.33.1) (Jon Martin) 31-xii-1973
Lake Te Anau, Te Anau, Southland (NZ.46.2) (Jon Martin) 7-i-1974 (1 larva)
Long Point, nr. Tahakopa (46.52ºS, 169.38ºE), South Otago (NZ.5.2) (J.S.Pillai) 25-iv-1968
Long Point, nr. Tahakopa (46.52ºS, 169.38ºE), South Otago (NZ.5.4) (Jon Martin) 4-i-1974 (in different BOLD Bin)
Mirror Lake, 58km n.w. Te Anau,Southland (NZ.44.1) (Jon & C.J.Martin) 6-i-1974
12.5 km Hermitage, Mount Cook, Canterbury (NZ.34.1) (Jon Martin) 31-xii-1973
Otago (Osten-Sacken) in type series.
Owaka River, South Otago (46.42ºS, 169.60ºE (D. Dodgshun & J.S.Pillai) 14-iii-1974
Purakaunui Bay (46.55ºS, 169.62ºE), Southland (NZ.42.1) (T.Dodgshun & C.J.Martin) 4-i-1974 (no nucleolus)
Tahakopa South Otago
Waikouaiti River, Otago (NZ.35.1) (Jon Martin) 31-xii-1973
Winton, Westland (NZ.43.1) (Jon Martin) 4-i-1974

This appears to have been the "thummi-type" studied by Robb (1966). It was studied by Lentzios and Stocker (1979) and Lentzios *et al*. (1980) as *C. zealandicus* Type I. Lentzios and Stocker (1979) report a nucleolus only in arm F. They received most of their material from Long Point.

2. *Chironomus zealandicus*, Hudson 1892
Redescribed by Hutton 1902.
C. species a (Forsyth 1978)

In BOLD Bin: BOLD AAS1265

Adult:

Male:

Hutton's description, aside from a detailed colour description, provides the information that length is 6-8 mm, wing length about 5.5 mm, and LR about 1.3.

Additional specimens:

AR about 3.0-4.0.

Wing length 5.04 (4.63-5.50) mm; width 1.05 (0.96-1.16) mm.; VR 0.94 (0.94-0.98); abt 3.9 (3-5) SCf on brachiolum; 9.8 (9-12) setae in squamal fringe.

FT present, 23-35 micron, abt. 2.5x longer than wide. Clypeus about 0.8-0.9x width of antennal pedicel; palp proportions (µm) 70 : 67 : 276 : 270 : 359.

Setae: 16-33 Clypeal; 11-16 Acrostichal; 16-20 Dorsocentrals; abt 6 prealars; 1-2 supra-alars; 17-29 Scutellar, sometimes in two rows (posterior row larger) sometimes in multiple rows, in which case the anterior rows more numerous (5-11) than posterior row (12-18).

LR 1.3 - 1.44; Anterior tarsi with a short dense beard (BR about 3 - 6) and sparse longer hairs (BR about 6 - 9).

Leg lengths (microns) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1600	1540	1980	1230	870	700	350	1.29-1.44	1.03-1.08	5.4-6.5
PII	1710	1720	960	650	480	320	230	0.55-0.59	0.96-1.08	
PIII	2110	2200	1430	940	700	460	270	0.65-0.70	0.94-1.00	

Abdominal tergites with a broad dark band covering most of the surface, leaving only a narrow pale band at the posterior edge.

Anal point narrow at base, remaining relatively narrow, SVo of E-type (between h and i) of Strenzke (1959); IVo reaching almost to end of anal point, with simple setae. About 8-15 setae in a single pale patch on TIX. GS moderately swollen, narrowing over posterior third, sometimes relatively sharply.

Female

Based on one specimen.

Wing length 4..4 mm; width 1.2 mm; VR 1.06; 4 SCf on brachiolum; 17-20 setae in squamal fringe.

AR 0.35; A5/A1 1.05; antennal proportions (micron) 211 : 136 : 141 : 146 : 221.

FT present 33 µm. About 41 clypeal setae. Palpal proportions (segs 2-5) (micron) 80 : 231 : 291 : 432.

Setae: 18-19 Acrostichal; 22 Dorsocentrals; 6 Prealars; 1 Supra-alar; 33 Scutellar in two rows (18 in anterior row, 15 larger setae in posterior row.

LR 1.36; BR 1.35. Leg lengths and proportions (micron)

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1635	1445	1960	1040	785	610	315	1.38	1.13	0.31
PII	1645	1570	885	495	365	255	190	0.56	1.05	
PIII	1875	1875	1230	735	570	470	230	0.66	1.00	

Abdomen generally brown.

Pupa: Length about 10.2–12.5 mm, inner margin of wing case about 2-2.45 mm (males). Cephalic tubercle about 134-160 x 75 micron, with sub-apical seta about 78-88 micron; and slight indication of a secondary tubercle. Respiratory base about 158 micron long, HR 2.55, base of respiratory filaments almost divided in middle. Muscle scars on abdominal tergites slightly darkened; about 65-100 recurved hooks on abdominal segment II, occupying about 65% of segment width. Caudolateral spur of segment VIII with numerous spines (18-22) spreading out like a hand with the fingers spread (below), sometimes with small spines at the outer edge. About 107-115 taeniae on each side of the anal lobe, mostly in a single row.

Fourth instar larva: salinarius-type larva. Largest NZ species, length about 15.3 - 21.5 mm (female), 15.3 - 18.7 mm (male). Head capsule with frontoclypeus and most of the gular region very dark. Anal tubules short and pointed. Most distinctive feature is the high number of striae (75-99) on the ventromental plate.
Mentum of type II (i.e 4th laterals reduced at least to the level of 5th laterals), with central trifid tooth of Type II, although sometimes the c2 teeth are less separated from the c1 tooth. PE with about 14-15 relatively sharp teeth, some reduced. Premandible with the usual two blades, inner blade about twice the width of the outer (2.1).
Antennal segments in proportions (micron) 163 : 37 : 8 : 15 : 8 ; AR 2.0 - 2.3; basal segment of antenna relatively long and narrow, about 3.1 - 3.7 times as long as wide.
Mandible with 3rd inner tooth darkened and often fully separate (i.e. Type IIIC); about 17 - 22 furrows on the outer surface near the base.

Cytology: 3 polytene chromosomes, modified pseudothummi-complex arm combination (BF, CD, GEA). Three nucleoli, one in arm G, one proximal and another medial in arm F. The medial nucleolus may not always be developed, as it was not detected by Lentzios & Stocker (1979). zeaA1 differs from *oppositus* A4 sequence by a simple inversion11-2e; arm E pattern not typical but zeaE1 appears to differ by a small inversion 5c-7 from *oppositus* E1. Arm F differs from that of *novaezelandiae*, etc., by inversion of the region 11-7. Considerable polymorphism in arms A, B,C, E, and G(?); sex determiner (MD) in arm C, probably near the

centromere (Martin & Lee, 1984). A spontaneous whole arm translocation (GEA/BF to GEB/AF) was found in a male larva from a laboratory stock.

zeaA1: 1a-e, 2e - 3e, 1f - 2c, 10 - 11, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 - 19

hypothetical 1a-e, 2g - 3a, 4a, 12a-c, 3i-f, 9 - 8, 2d-f, 11 - 10, 2e - 1f, 3e-b, 4b - 7, 13 - 19

zeaA2: 1a-e, 10 - 11, 2f-d, 8 - 9, 3f-i, 12c-a, 4a, 3a - 2g, 1e-d, 2e - 1f, 3e-b, 4b - 7, 13 - 19

zeaB1: Puff, with proximal dark bands (groups 7 and 8), in proximal third of arm.

zeaB2: Inversion of distal end of arm, distal to large puff.

zeaC1:

zeaC2: Inversion of about 2/3 of arm.

zeaD1:

zeaE1: (approx) 1?- 3e, 10b - 8, 5c - 7, 5b - 3f, 10c - 13

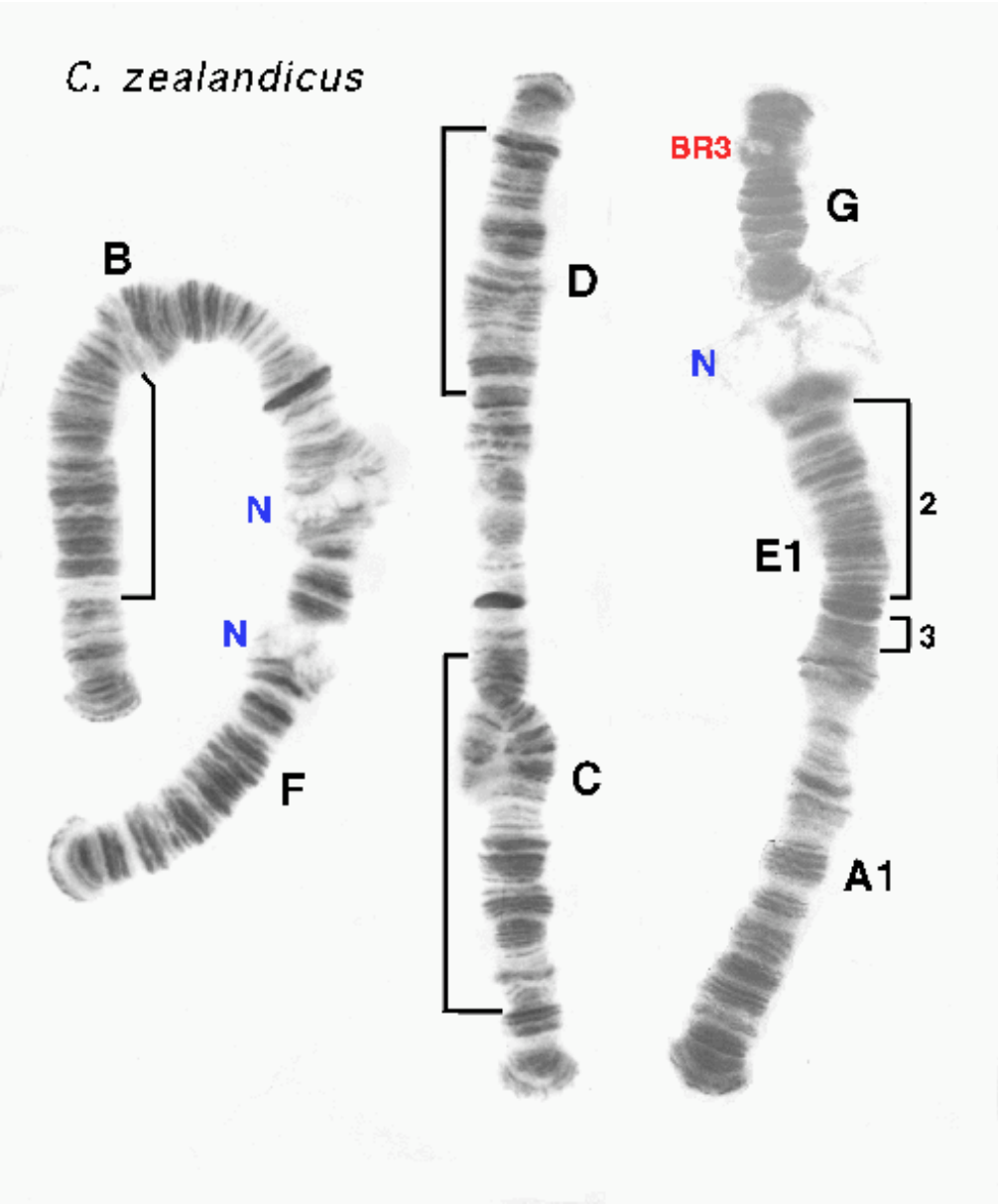
zeaE2: (approx) 1?-f, 4b - 5b, 7 - 5c, 8 - 10b, 3e - 2, 4a - 3f, 10c - 13

zeaE3: (approx) 1?- 3e, 10b - 8, 5c - 7, 5b - 3f, 10c-g, 12 -11, 13

zeaF1: 1 - 2a, 10 - 8, 11 - 15c, 2c - 7, 2b, 15d – 23 (In7 - 11 from oppositus F3)

zeaG1: fused to arm E.

zeaG2: possible inversion



Molecular:
Mt COI - GenBank (AF192209.1), also BOLD
Gb2B - GenBank (AJ003813)
Gb9 - GenBank (AJ003814.1)

Localities:
North Island:

Tank I & N, Lake Okaro, Rotorua area (D.J.Forsyth) 8-xi-1972
Lake Okaro, Rotorua area (NZ.10.7) 14-ix-1982
Ornamental pool, Rotorua (NZ.26.3) (Jon Martin & D.J.Forsyth) E. mass 2S.
Lake Ngaroto, South Auckland (NZ.75.1) (Sofia Ibarraran) 29-viii-2007
Waikato area, South Auckland (J. Kanapathipillai) (Sample B) 26-iv-1996
1km west Waimangu (NZ.27.1) (D.J.Forsyth & Jon Martin) Egg mass 1S. Coll:13-xii-1973

South Island:

Belfast, Canterbury, (NZ.54.1) (D. Matthews) 7-1-1974 (Oxidation ponds).
Bromley Sewage Works, Christchurch, Canterbury (NZ.7.1) (A.E.Lambden) Jan.Feb.1969 (Oxidation Ponds)
Glen Lake, Canterbury (43.02°S, 172.787°E) (NZ.73.1) (C.A.Woodward) 15-i-2004
Lake Ellesmere, Kaituna, Canterbury (NZ.30.1 & 2) (Jon Martin) 29-xii-1973 & 12-i-1974.

3. *Chironomus analis* Freeman, 1959.

Likely to be in BOLD Bin BOLD:AAL7011 and BOLD ACG0887
(these are nearest neighbour bins and at one locality both are found)

Chironomus (Chironomus) analis sp. n.

This species is very similar to *zealandicus* in general appearance, but the male anal point is much heavier and stouter (Text-fig. 3, *c*). In colour it tends to be rather paler and the male abdomen is green with a saddle-shaped dark mark placed in the basal two-thirds of each of segments 2–5. In other structural features the two species are identical.

Holotype male NELSON: Blackball, v.1920 (*J. W. Campbell*). WELLINGTON: Ohakune, 1 ♂, 3 ♀ (*J. W. Campbell* and *T. R. Harris*). WESTLAND: W. Coast, 1 ♂, ii.1925 (*T. R. Harris*). OTAGO: Queenstown, 1 ♂, xii.1919 (*T. R. Harris*). All specimens are in the British Museum.

Description of C. analis from Freeman 1959

Adult:

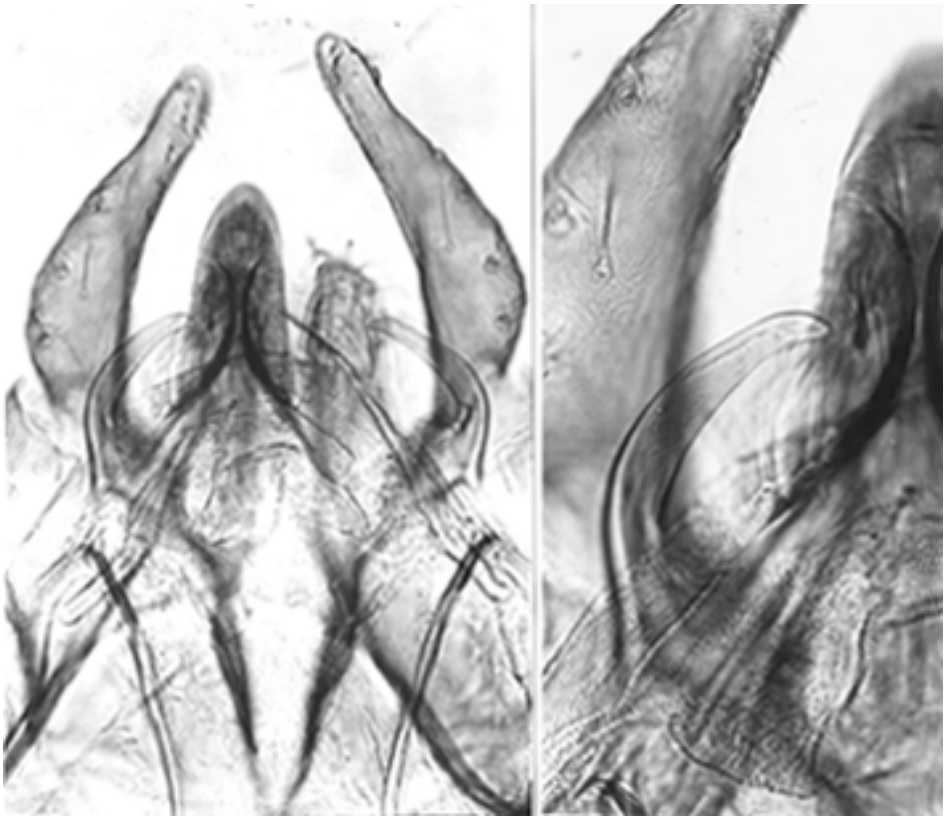
Male: (From two available specimens):

AR about 3.3-3.4. FT about 26-38 µm long and 15-16 µm wide. Palpal proportions (µm): 63 : 63 : 268 : 273 : 245+ (broken). About 25-26 clypeal setae.
Thoracic setae: acrostichal - at least 9-15; dorsocentrals - 17-18; prealars 6-7; scutellars in two rows - about 9 anterior, about 13 posterior.
Leg lengths (microns) and proportions as follows:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1630	1540	2210	1260	920	780	370	1.39-1.50	1.02-1.10	4.8-5.6
PII	1740	1660	1020	635	460	310	213	0.61-0.62	1.04-1.06	
PIII	2025	2105	1465	900	645	425	245	0.68-0.72	0.96-0.97	

Ant Ta5/Ti about 0.23-0.25. Abt 34 sens.chaet on midTa1, abt 30 on hindTa1.

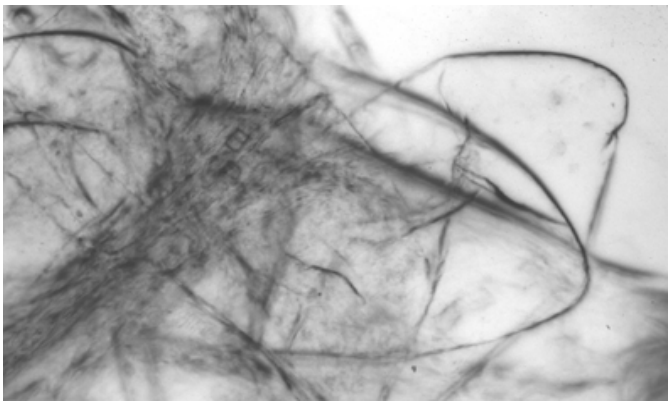
Abdomen: Segments 2-5 greenish with dark saddle spots in the basal region of the segment. 9-11 setae in individual (?) pale areas on tergite IX.



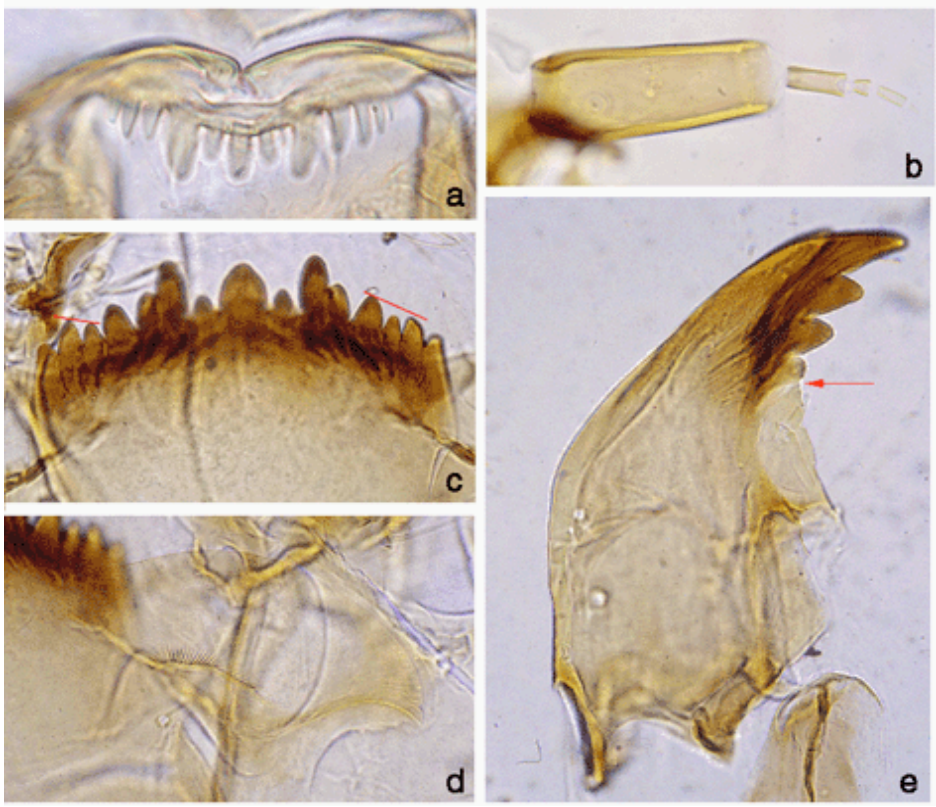
Anal point broad and stout, wider at base, SVo curved, D(g)-E(h)-type of Strenzke (1959). IVo with simple setae, not reaching the end of the anal point and to about the middle of the GS which is markedly swollen and reducing over posterior 1/3.

Pupa: From notes by Don Forsyth, the pupa has a dark exuvia, with dark muscle scars, and a very dark lateral spur on segment VIII with multiple appressed spines.

Fourth instar larva: A salinarius-type larva. Head capsule coloration similar to that of *C. zealandicus*, but a smaller species, length about 11.4 -19.0 mm (female), 10.7 - 16.0 (male). Anal tubules (below) short and rounded or pointed, less than 3 times longer than wide.



Mentum (c, below) generally type II; centre tooth with c2 teeth well separated (i.e. type narr. IIA); 6th laterals slightly turned out.
Ventromental plate (d, below) with only about 30-42 striae; VMR 0.28-0.31. PE (a, below) with about 8-16 teeth, some reduced (type C, but teeth sharp).
Basal segment of antenna (b, below) not as long and narrow as in other NZ species such as *C. zealanicus*, and about 2.8-3.5 times as long as wide (similar to *C.* species 6). Antennal proportions (microns) 132 : 32 : 7 : 15 : 7 ; AR 1.88 – 2.3.
Distance between the S4 setae greater than that between the antennal bases.
Mandible (e, below) type IIB, with about 13-25 furrows on outer surface near the base.



Cytology: 4 polytene chromosomes, pseudothummi-complex arm combination (BF, CD, AE, G). Two nucleoli; a large one in arm F and a small one in arm G, often difficult to distinguish from a BR. Two Brs towards the other end of the arm. Arm G usually only partially paired, sometimes more so than others. Arm A as sequence A4 in Australian species; arm E with sequence E1 as Australian species; anlF1 as F3 in Australian species. Polymorphism at least in arms B, C and F.

anlA1: 1a-e, 11 - 10, 2c - 1f, 3e - 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 - 19 ie. as oppA4, forA1, nzlA1.

anlB1: Puff (group 7) in proximal third of arm, separated from usual associated dark bands. as *forsythi* B1

anlB2: inversion of distal half of arm, seen as heterozygote at Lake Ngapouri.

anlC1: as *oppositus* C4?

anlC2: as *oppositus* C3? seen at Lake Ngapouri.

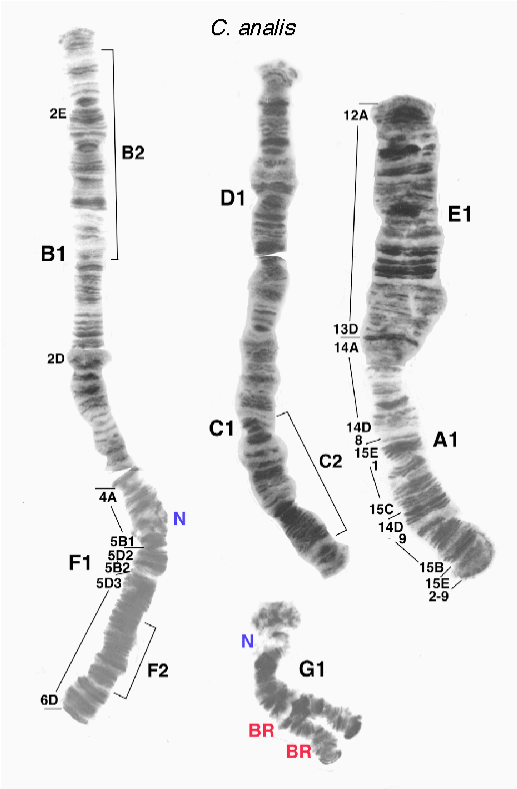
anlD1: 1-2, 16 - 13, 8- 3e, 9, 3d-a, 10d - 12, 10a-c, 17 – 24

anlE1: 1 - 3e, 10b - 3f, 10c - 13 ie. as *forsythi* E1, etc.

anlF1: (approx.) 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 ie. as *oppositus* F3, *forsythi, novaezelandiae*

anlF2: 1 – 2a, 10 – 9c, 2c – 9b, 15c – 11, 2b, 15d – 23.

anlG1: essentially as *C. novaezelandiae*?



Found in lakes

Localities:

North Island:

Lake Karapiro, South Auckland (NZ.77.1) (Sofia Ibarrarán) 15-ii-2007
Lake Karapiro, South Auckland (NZ.77.2) (Sofia Ibarrarán) 29-viii-2007
Lake Ngapouri, Waiotapu (38.00ºS, 176.50ºE) (NZ.9.1 & 2) (D.J.Forsyth) 15-ii-and 8-xi-1972; 5-xii-1973
Lake Okaro, Rotorua area (38.30ºS, 176.40ºE) (NZ.10.1 & 8) (D.J.Forsyth) 19-ix-1972 and 14-ix-1982
Lake Okaro, Rotorua area (38.30ºS, 176.40ºE) (NZ.10.1 & 8) (NZ.10.9) (Sofia Ibarrarán) 14-ii-2007
Ngapuna, Rotorua area (38.15ºS, 176.27ºE) (NZ.17.1) (Jon Martin & D.J. Forsyth) 7-xii-1973
Ohakune, Wellington (Freeman 1959)
Waikato area (Doyle & Binks)(BOLD database BOLD ACG0887) (37.202ºS, 175.502ºE)

South Island:

Blackball, Nelson (Freeman 1959) (Holotype)
Lake Brunner, Mitchell, Westland (NZ.52.2) (Jon Martin) 10-i-1974
East Cove, Lake Te Anau (45.17ºS, 167.83ºE), Southland (NZ.46.5) (Jon & H.I.Martin) 23-i-1978 (?)
Owaka River (46.42ºS, 169.60ºE), South Otago (NZ.56.1) (D. Dodgshun & J.S. Pillai) 14-iii-1974
Queenstown, Otago (Freeman (1959)
West Coast, Westland (Freeman 1959)

(These require further checking, as some may be *C. forsythi*. Many collections assumed to be *C. zealandicus*, e.g. material studied by Robb, seem to be identical with the larval material identified as *C. analis* by Forsyth.)

4. *Chironomus forsythi* Martin, 1998.

In BOLD Bin:

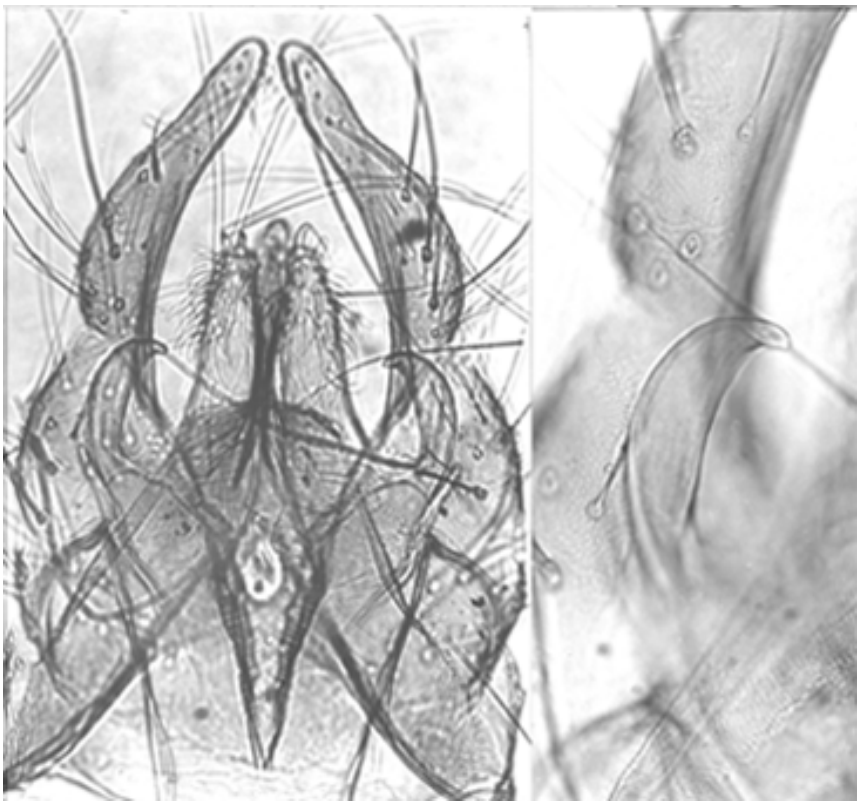
Adult:

Male:
Wing length: 3.6-5.3 mm; width 1.1-1.3 mm; VR 0.98-1.04.
AR: 3.6-4.4
Palpal segments 2 -5 (micron): 80 : 280 : 260 : 330. Clypeal setae about 28–38.
At least 12–18 acrostichal setae; 16-24 dorsocentrals; 5-7 prealars; scutellars in two approximate rows - anterior row about 6-23, posterior row about 15-18 setae.
Fore LR: 1.52-1.56 may be diagnostic. Legs pale, unbanded, with only a short sparse beard.

Leg proportions (micron):

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1660	1510	2240	1280	890	700	330	1.52-1.56	1.06-1.11	1.7-2.09
PII	1700	1620	940	620	430	285	215	0.57-0.59	1.05	
PIII	1980	2040	1410	880	620	390	245	0.68-0.73	0.96-0.98	

Abdominal tergites 2-5 with dark brown patches across about two thirds of the segment, although sometimes reducing towards the basal margin to a more triangular appearance.

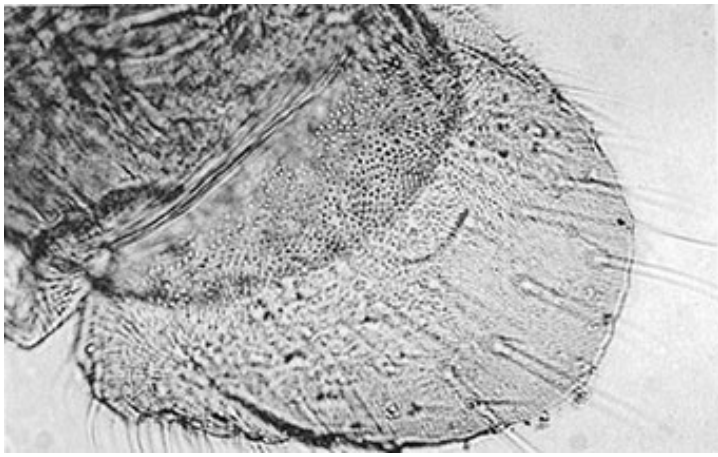


Anal point relatively narrow, wider at tip; 4-11 setae in a single pale area at centre of tergite IX.
SVo curved, essentially D(e)-type of Strenzke 1959); IVo reaching about to end of the anal point or middle of gonostylus with forked setae. GS relatively swollen, reducing significantly on distal third.

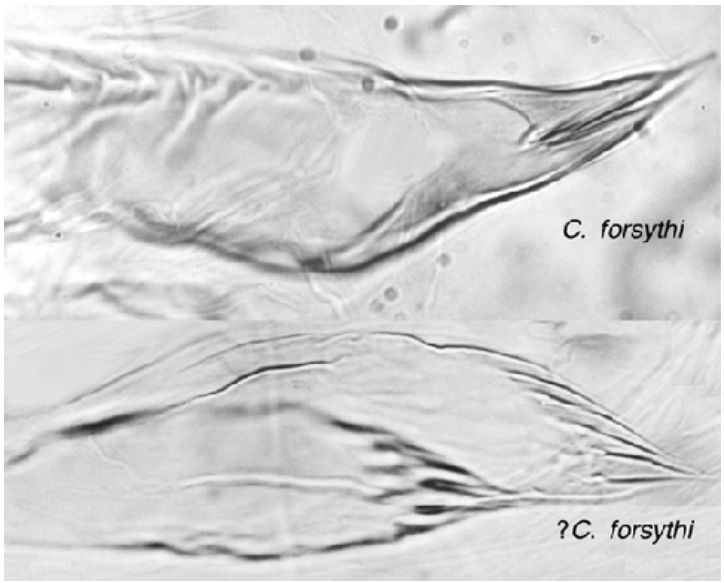
Female:
Wing length: 3.4-5.9 mm; wing width: 0.9-1.7 mm; VR 0.93-0.97
AR: 0 32-0.49; flagella length (micron): 190 : 140 : 135 : 130 : 210
Palpal segments 2-5 (micron): 70 : 230 : 250 : 385. Clypeal setae about 26–56.
About 15 acrostichal setae; 18-38 dorsocentrals (incl. humerals); 6-8 prealars; scutellars in two approximate rows - anterior row about 5-23, posterior row about 6-30 setae.
LR slightly lower than that of males, about 1.47–1.48 (2).
Leg proportions (micron):

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1550	1410	1990	940	785	650	270	1.47-1.48	1.08-1.11	0.46
PII	1580	1595	830	470	350	245	195	0.55-0.57	0.97-1.00	
PIII	1860	1940	1300	780	600	320	220	0.63-0.72	0.96-0.97	

Cercus (below) with rounded outline but with a relatively large bulge on the ventral base.



Pupa: Length of exuvia about 11.3-11.8 mm (female) and 6.8-10.5 mm (male); inner margin of wing case about 2.15 mm. Cephalic tubercles about 110-160 micron, with sub-apical seta about 45-65 micron. About 76-112 recurved hooks on segment II; muscle scars on tergites pale or slightly pigmented; caudolateral spurs of segment VIII with only two to three spines at the type locality (Haast) and in most North Island populations, but about 6-11 spines are found in some, mostly South Island, specimens tentatively assigned to this species. About 135-157 (female) and 56-131 (male) multiple ranked taeniae on each side of the anal lobe.

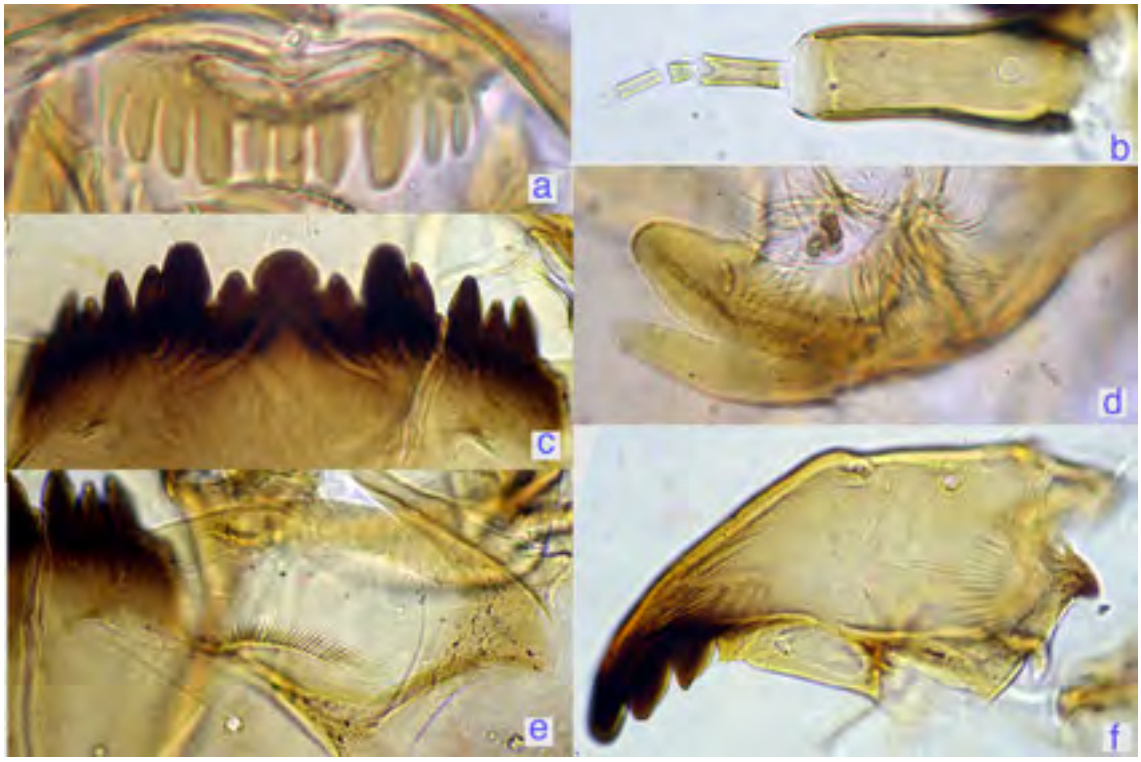


Pupal spurs of *C. forsythi*
Both islands (above, from Haast egg mass #6) and South Island only (below)

Fourth instar larva: A salinarius-type larva. Length about 12.0-20.5 mm (female), 12.2 - 20.0 (male) (larger specimens may be a further new species). Anal tubules elongated and rounded, from 2-3 times as long as wide and often constricted in the middle, in some populations, but short with no constriction in others.

Anal tubules of a larva from nr. Haast, egg mass #6

Head capsule with posterior third of gula dark, FC slightly dark to dark, and in some larvae dark triangular marks on the posterior margin either side of the FC.
Mentum (Fig. c, below) with 4th laterals reduced almost or beyond the level of the 5th laterals (type II); central trifid tooth with c1 tooth relatively broad and c2 teeth separated (type IIA).
Ventromental plate (Fig. e, below) with about 30-43 striae; VMR about 0.30. PE with about 8-16 usually relatively broad even teeth.
Premandible (Fig. d, below) of type D, probably with outer tooth about the same length or slightly shorter than the inner tooth, which is about twice as wide as the outer tooth.
Antenna with a moderately broad basal segment about 2.6-3.4 times longer than wide; RO about 1/3 to ½ up from base of segment; AR 1.8-2.5; antennal proportions (microns) 133 : 29 : 8 : 14 : 7.
Mandible (Fig. f, below) generally type IIA, although 3rd inner tooth somewhat variable in pigmentation and degree of separation; about 13-23 furrows on outer surface near base.



Mouthparts of a larva from the same egg mass as the Holotype.

Cytology: 4 polytene chromosomes, pseudothummi-complex arm combination (BF, CD, AE, G). Probably only one nucleolus, proximal in arm F, another subterminal in arm G, is not always apparent and may not be present in true *C. forsythi* (see below). Arm G closely paired in some populations, paired only in the middle in others, with a median BR and a smaller one towards the opposite end from the nucleolus.
Arm A of some individuals with sequence oppA4 of Australian species; forD1 as nzlD2; forE1 as oppE1 of Australian species.
Polymorphism in arms A to F; some South Island populations polymorphic in all these arms, including at least 3 sequences each in arms A, B, and F, others with limited polymorphism in arms A and B. This may indicate that 2 species are present in these populations.

forA1: 1a-e, 11-10, 2c-1f, 3e-2d, 8-9, 3f-i, 12c-a, 4-7, 13-19 ie. as oppA4, anlA1, nzlA1.

forA2: 1a-e, <u>2e - 3e, 1f - 2c, 10 - 11</u>, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 – 19 (from forA1)

forA3: 1a-e, <u>10d-a, 2c - 1f, 3 - 2e</u>, 10e-11e, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 – 19 (from forA2)

forA4: large inversion of forA1?

forB1: Puff (group 7) with proximal dark bands (group 8) about middle of arm.

forB2 Inversion of centre half of arm, reversed puff and dark bands (groups 7 & 8).

forB3: From B2 by inversion which reverses puff (group 7) again and moves it near the distal end.

forC1: as C1 of *oppositus* and. *australis.*

forC2: large inversion taking typical groups 3 – 4 to near the centromere as *analis* C1

forC3: a smaller inversion of forC2, not including the typical groups 3 - 4.

forD1: 1 - 2, 16c-a,17e-a, 10c-a, 3e - 9, 3d-a, 10d -15, 18 - 24 as nzlD2

forD2: 1 - 2, 16c-a, 17e-a, 10c-a, 3e-g, 18, 15 - 10d, 3a-d, 9 - 4, 19 – 24 (from forD1)

forD3: approx. 1 - 2, 16c-a, 10c-a, 3e - 5, 19 - 18, 15 - 10d, 3a-d, 9 - 6, 20 – 24 (from forD1)

forE1: 1 - 3e, 10b - 3f, 10c - 13 i.e. as *oppositus* E1*, analis, novaezelandiae*

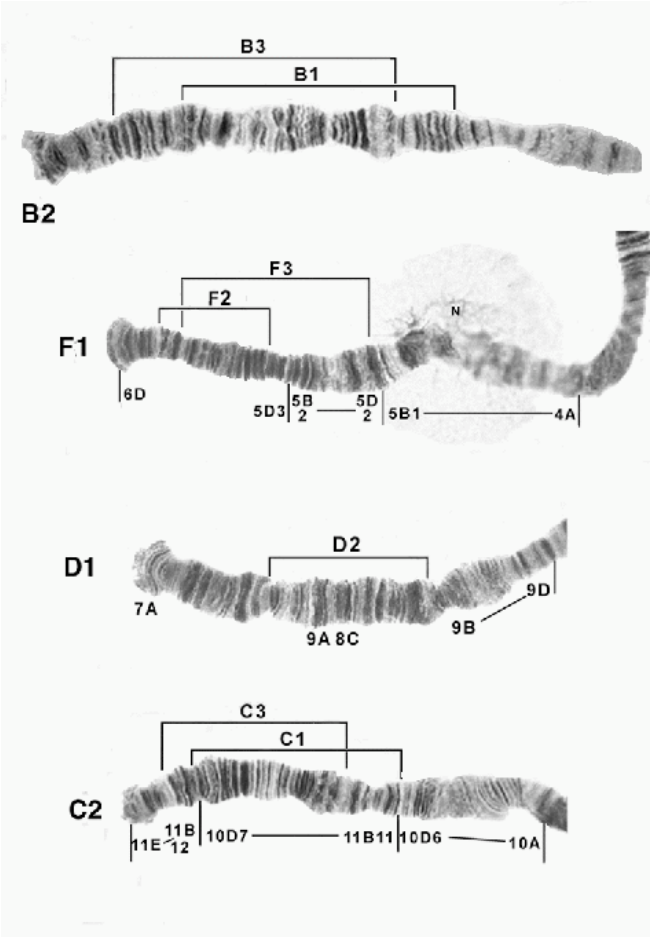
forE2: 1a-i, 3f - 10b, 3e - 2a, 10c – 13

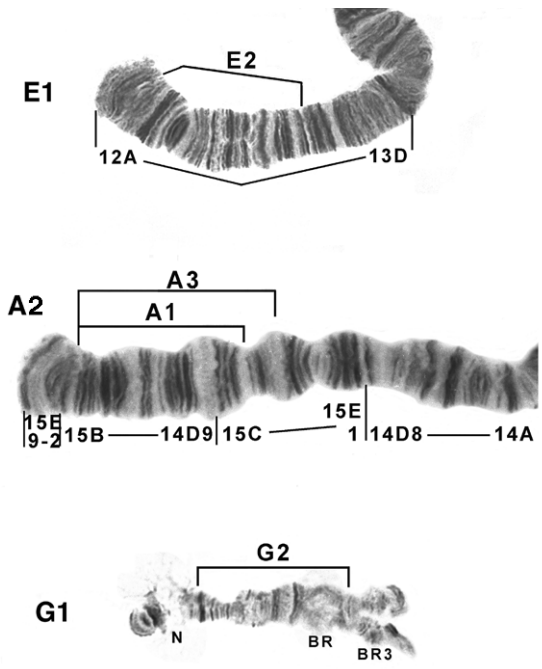
forF1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 i.e. as *oppositus* F3, *australis, analis, novaezelandiae*

forF2: (approx.) 1 – 2a, 10 – 9c, 4 – 9b, 3 – 2c, 15c – 11, 2b, 15d – 23 (found on both islands)

forF3: (approx.) 1 - 2a, 10 - 7d, 11 - 15c, 2c - 7c, 2b, 15d - 23 in Sth Is. specimens

forG1: no BR near the subterminal nucleolus.





DNA analyses:

Mt *COI* - see BOLD

COI data for larvae from the same egg mass (NZ.67.1 Emass #6) as the holotype larva, are different from that of other specimens. One possibility is that the female parent was of hybrid descent from a female of a different species; alternatively it reflects the presence of multiple species under this name.

Morphology and cytology given by Martin (1998), but some details were incorrect. Both arms A and F show a different sequence to that stated, and the limits of some inversions on these arms were incorrect. (corrected above).

Based on the banding sequence of arm F, there could be three species included under this name, because the three sequences identified usually occur only as homozygotes (see below). If this proves to be true, the type specimen of *C. forsythi* is associated with sequence F1. Larvae with F2 are more common in the South Island, but a single larva from Lake Ngaroto, Sth Auckland, was heterozygous for F1.2. Larvae with F3 have been found at only three localities in the South Island: Bealey, Ross Creek Dam and Lake Wakitipu, although a larva from Sullivans Dam was heterozygous F1.3.

Material associated with the Holotype and Allotype:

To help resolve this matter, the description of material from NZ.67.1 egg mass#6 is given: The holotype is a polytene chromosome squash with associated larval body mounted on the same slide.

Adult:

No adult male associated with the Holotype larva or Allotype female is known.

Allotype female:

Wing length: 4.23 mm; wing width: 1.18 mm; VR 0.92

AR: 0.49; flagella length (micron): 181 : 126 : 141 : 131 : 251
Palpal segments 2 - 5 (micron): 60 : 201 : 201 : 417. Clypeal setae about 37.
About 15 acrostichal setae; 27 dorsocentrals; 6 prealars; scutellars in two approximate rows - anterior row about 23, posterior row about 17 setae.
Leg proportions (micron):

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1420	1220	1820	1040	740	600	300	1.47	1.15	0.49
PII	1500	1400	800	440	320	220	180	0.57	1.07	0.13
PIII	1680	1740	1160	680	520	300	200	0.67	0.97	0.11

Pupa: (based on male exuvia and a female prepupa) Length of exuvia about 6.8 mm. Cephalic tubercles about 120 micron, with sub-apical seta about 46 micron. About 76-78 recurved hooks on segment II, occupying about 60% of width of segment; muscle scars on tergites pale or slightly pigmented; line of fine spines on conjunctive V/VI, and patch on conjunctive VI/VII; caudolateral spurs of segment VIII with three or four spines (in case of four spines there were three large and one small). About 56-58 multiple ranked setae on each side of the anal lobe.

Fourth instar larva: Length about 12 mm (probably small because laboratory reared); anal tubules about 3 times as long as wide (see figure above). Gula dark to very dark over posterior 2/3, FC darkened with a triangular dark patch on each side at the posterior margin of the head.
Mentum with rounded teeth, 4th laterals reduced below level of 5th laterals (type III); central trifid tooth with c1 tooth relatively broad and c2 teeth separated (type II).
Ventromental plates separated by about 1/3 of mentum width, about 42 - 43 striae. PE with about 12 broad teeth, narrowing towards the edges.
Premandible probably with outer tooth longer than inner tooth, which is about twice as wide as the outer tooth.
Antenna with basal segment about three times longer than wide, ring organ about a third of the way up from the base of the segment; AR about 1.74; proportions of segments (µm) 110 : 26 : 6 : 14 : 5.
Mandible with third inner tooth relatively dark, but only partly separated (type II); about 12 - 13 bristles in the PMan, 15-16 furrows on the outer surface at the base.
(see figures of mouthparts above)

Cytology at type locality: Sequences recorded are: forA3, forB2, forC1, forD1, for E1, forF1, and forG1 (apparently without a nucleolus).

Localities:
North Island:

Lake Ngaroto, South Auckland (NZ-75-1) (S. Ibarraran) 27-viii-2007 (-37.96ºS, 175.29ºE) – probable hybrid (het 5 arms)

Lake Rotoaira, South Auckland (NZ.82.1) (Sofia Ibarrarán) 14-ii-2007 (-39.06ºS, 175.71ºE)
Potting shed pond, Taita Soil Bureau, Wellington (NZ.14.1) (D.J.Forsyth) 13-x-1972 (-41.18ºS, 174.95ºE)
Potting shed pond, Taita Soil Bureau, Wellington (NZ.14.2) (D.J.Forsyth) 26-i-1973 (-41.18ºS, 174.95ºE)
Potting shed pond, Taita Soil Bureau, Wellington (NZ.14.3) (Jon Martin & D.J.Forsyth) 23-xii-1973 (-41.18ºS, 174.95ºE)

South Island

Bealey, 11 Km east of Arthurs Pass, (NZ.3.1) (J.A. & M.M.Thomson) 1-ii-1968 (-43.04ºS, 171.64ºE) – could be F3.3
Belfast (north of Christchurch), Canterbury (NZ.54.1) (D.Matthews) 7-i-1974
Botanic Gardens, Christchurch, Canterbury (NZ.2.1) (J.A. & M.M.Thomson) 31-i-1968 (-43.55ºS, 172.67ºE)
Dunedin, Otago (NZ-6-1) (J.S.Pillai) 12-iii-1968 (-45.80ºS, 170.87ºE) (shorter anal tubules)
Haast junction, Westland (NZ.67.1) (Jon Martin) (-43.88ºS, 169.05ºE) Egg masses #6, #10 (long anal tubules) (Type locality)
Haast junction, Westland (NZ.67.2) (Jon Martin) 26-i-1978 (-43.88ºS, 169.05ºE)
Lake Hawea, Otago (NZ.48.1) (Jon & C.J. Martin) 7-i-1948 (-44.50ºS, 169.28ºE)
Lake Lochie, 87km n.w. Te Anau, Fiordland (NZ.45.1) (Jon Martin) 6-i-1974
Lake Pukaki, Canterbury (NZ.33.1) (Jon Martin) 31-xii-1973
c.1 m in Lake Te Anau, Te Anau, Southland (NZ.46.2) (Jon Martin) 7-i-1974
Lake Wakatipu, Kingston, Southland (NZ.62.1) (Jon & C.J.Martin) 21-i-1978 – could be F3.3 (shorter anal tubules)
Mirror Lake, 6 Km Knob Flat on Milford Road, Southland (NZ.44.1) (Jon & C.J.Martin) 6-i-1974
Owaka River, South Otago (NZ.56.1) (T.Dodgshun & J.S.Pillai) 14-iii-1974
Sullivans Dam, Dunedin City Council Water Dept., Otago (NZ.36.1) (Jon & C.J.Martin & T.Dodgshun) 3-i-1974

Possible new species:

Bromley Sewage Works, Christchurch, Canterbury (NZ.7.3) (Jon Martin) 28-xii-1973 (Region 4-6 of Robb's samples) – homozygous F2.2 (shorter anal tubules)
Pond 3, Bromley Sewage Works, Christchurch, Canterbury (NZ.7.6) (Jon Martin) 11-i-1974 – homozygous F2.2
Bromley, Christchurch, Canterbury (NZ.15.1) (D.J.Forsyth) 22-ii-1973 – homozygous F2.2
Lake Brunner, Mitchell, Westland (NZ.52.2) (Jon Martin) 10-i-1974 – homozygous F2.2
Long Point, nr. Tahakopa, Otago (NZ.5.4) (Jon Martin) 4-i-1974 – homozygous F2.2
Ross Creek Dam, Dunedin City Council Water Dept., Otago (NZ.39.1) (Jon Martin & T.Dodgshun) 3-i-1974 – homozygous F3.3

5. *Chironomus* 'thermarum' (ms name of D.J. Forsyth).

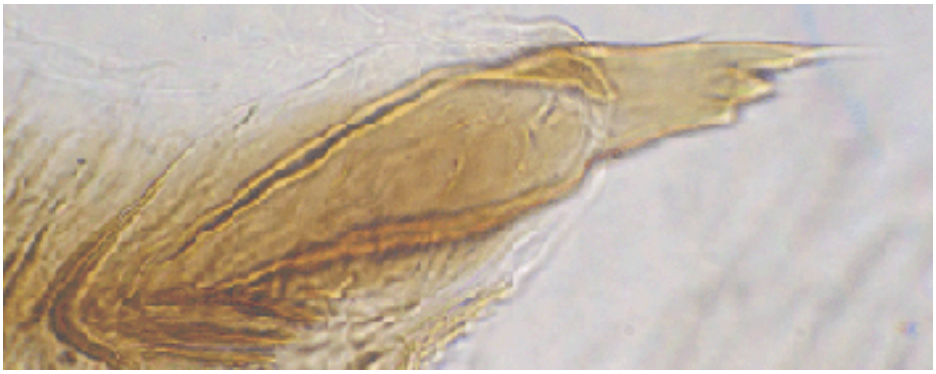
This is a morphologically variable species in regards to larval type.

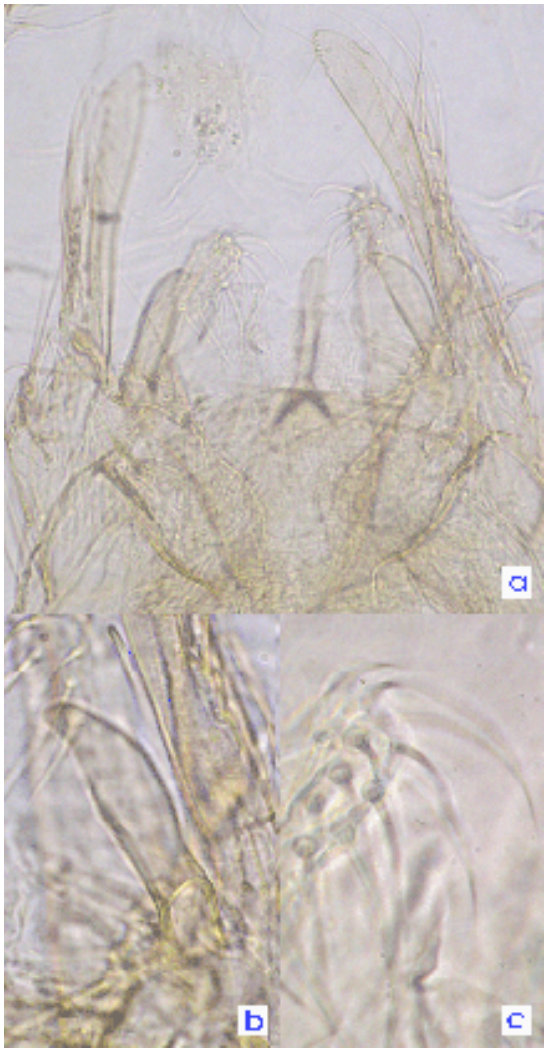
In Bold Bin: BOLD:AAJ0168 or BOLD:ABZ5458

Adult:

Male: Forsyth describes the abdominal tergites as largely dark with only a narrow pale posterior margin of segments II to VI and on four fifths of segments VII and VIII.
A pupa with a pharate male is available, from which the following characters could be determined:
Tergite IX with 5 setae in individual pale areas. Anal point (a, above) narrow at base, but appears turned down at the end which is broader; SVo (b, above) with just a small hook at the tip (D(e)-type of Strenzke 1959); IVo (a, above) extending to about middle of gonostylus with setae simple (c, above). Gonostylus (a, above) moderately broad but narrowing only slightly at distal end, about 4+1 setae at tip.

Pupa: about 6.9 mm (1 male)-8.3 mm (1 female) long; inner margin of wing case about 1.44-1.66 mm. Cephalic tubercle about 85-114 µm long. Basal ring about 115-145 µm long and 57-65 µm wide, HR 1.77-2.56. Thorax and muscle scars yellow-brown, otherwise pale. Shagreen on posterior half of segment II, increasing to whole of segments IV-VI, little on segments VII & VIII. Hook row with 70-92 hooks, occupying about 0.6-0.8 of segment width. PSB on segs II and III; PSA of segment IV large (202-218 µm long, 101-145 µm wide) and about 0.26-0.28 length of segment. Caudolateral spur of segment VIII with about 2 or 3 spines, at least 1 small. 68-93 taeniae on each side of anal lobe, mostly in a single row, but some double at posterior end.





Fourth instar larva: A bathophilus, with both short anterior and posterior VT (over 0.32 mm in length) to halophilus with only poster pair up to about 0.12 mm) to salinarius-type. Generally smaller due to growing at higher temperature (but larger when reared in the lab at lower temperatures), length about 10-14 mm (fem. 10.3-14.0; male 9.2-14.0 mm). Where present ventral tubules approximately equal in length, anterior 0.63 (0.44-0.96) mm and posterior 0.64 (0.32-1.01) mm. Anal tubules from 1.5-2.1 times longer than wide.

Head capsule with FC generally pale or slightly darkened, gula darkened and can be broader than the mentum width. Head relatively narrow, mentum width about 0.54-0.60 of ventral head length

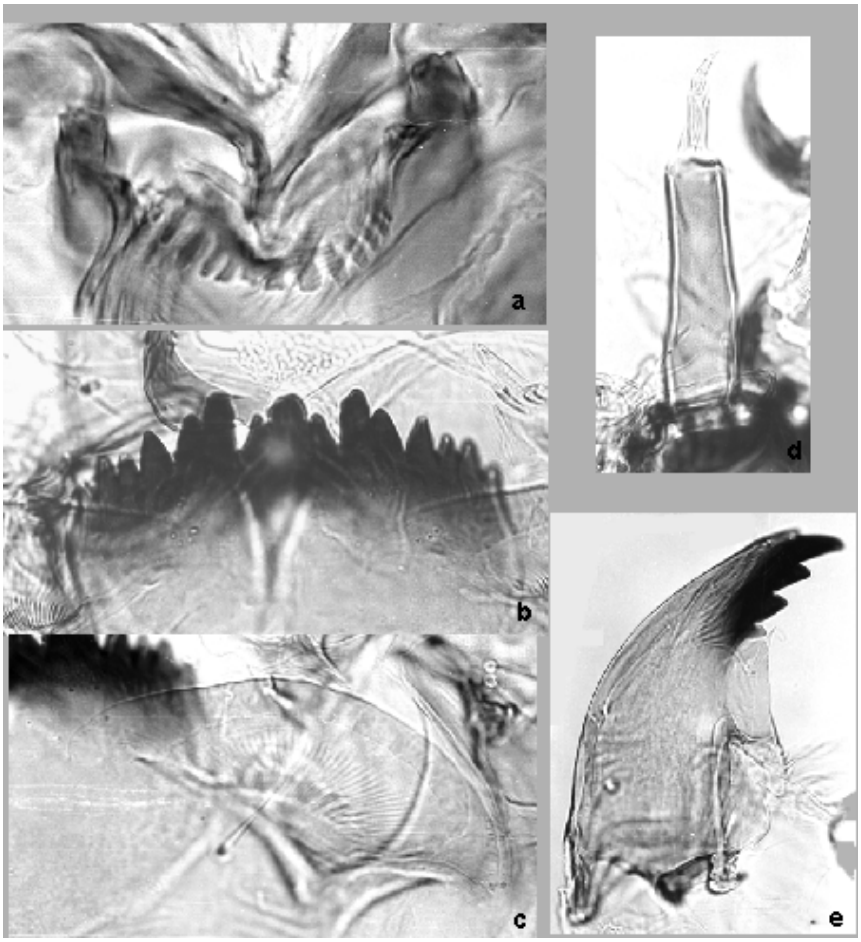
Mentum (Fig. b, below) with 4th laterals reduced about to level of 5th lateral, or sometimes lower (type II-III); centre tooth relatively narrow, with c2 teeth only partly separated on its shoulders (i.e. type IB or occasionally III); 6th laterals arising from a lower level.

VM (Fig. c, below) about 182-205 µm wide and 3.04-3.86 times wider than deep, and 1.0-1.1 time wider than the mentum, with about 37.9 (33-41) striae; IPD 0.28-0.35; VMR 0.24-0.35. Pecten epipharyngis (Fig. a, below) with about 11-16 sometimes uneven teeth (type B), with about 45-55 striae; VMR about 0.29-0.32. PE with about 11-16 sometimes irregular teeth. Premandible with teeth usually about equal length, inner tooth about 2+-5 times the width of the outer tooth, both coming to a broad, or occasionally a narrow, point.

Antenna (Fig. d, below) with basal segment about 3-4 times longer than wide; RO about 0.29 (0.24-0.38) up from base of segment; A4 relatively short, only about 20% longer than segment 3; A5 about as long as A3 (0.73-1.08 times as long); AR 2.27 (2.00-2.44); segment proportions (micron) 119 ; 27 : 7.5 : 10 : 6.5.

Distance between the S4 setae (150.7 (126-162) µm) basically similar to that between the antennal bases (148.2 (129-167) µm).

Mandible (Fig. e, below) about 220-252 µm long (heel to Mdt) of type II, with about 13-15 furrows on outer surface near base; 11-13 taeniae in Pecten mandibularis; Mdt-Mat 22-30 µm; MTR 0.30-0.43.



Mouth parts of the larva of *Chironomus* 'thermarum'
a. Pecten epipharyngis; b. Mentum; c. Ventromentum; d. Antenna; e. Mandible.

Cytology: 4 polytene chromosomes, pseudothummi-complex arm combination (BF,CD,EA,G). Arm G normally closely paired with a large subterminal BR, and a smaller one medially. Nucleolus on arm F at about group 19. Arm A with sequence A4 as found in Australian species; arm E with sequence E1 of Australian species.

thmA1: 1a-e, 11 - 10, 2c - 1f, 3e - 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 - 19 ie. as oppA4, anlA1, forA1, nzlA1.

thmB1: Puff (group 7) often hardly developed, with proximal dark bands (group 8) near distal end as nzlB4.

thmB2: possibly as *oppositus* B1- possibly in non-thermal habitats

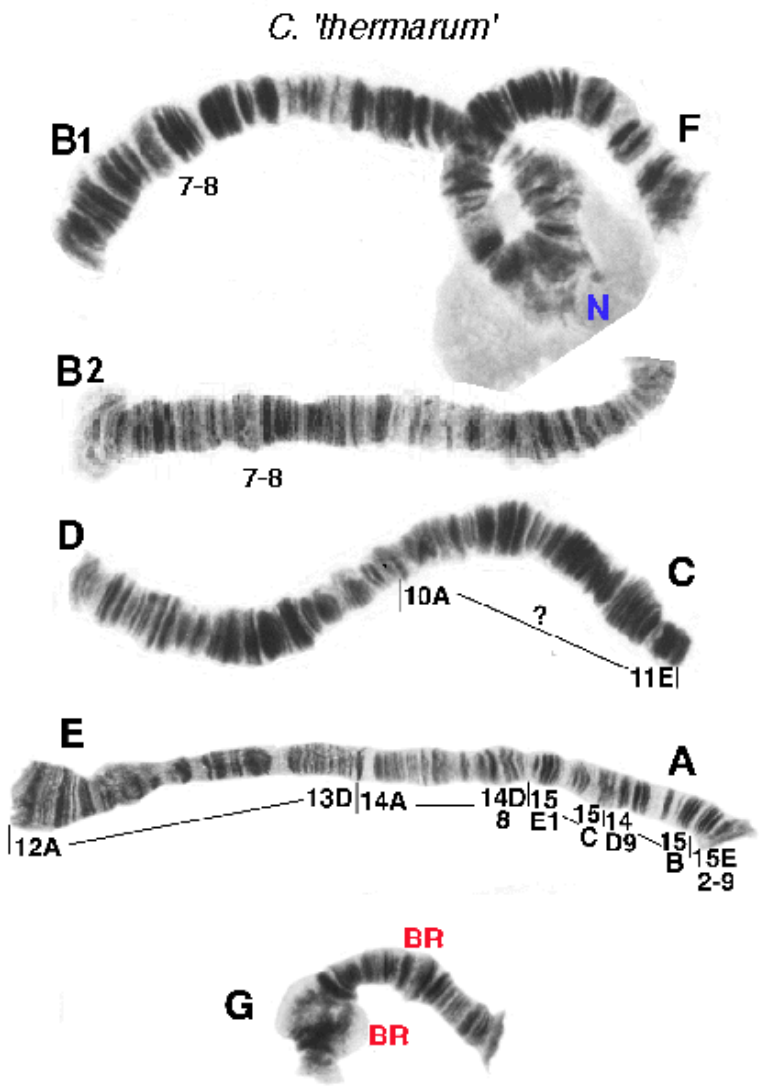
thmC1: As nzlC1, forC1, and *oppositus*?

thmD1: 1 - 2, 16c-a,17e-a, 10c-a, 3e - 9, 3d-a, 10d -15, 18 - 24 as forD1

thmE1: 1 - 3e, 10b - 3f, 10c - 13 ie. as *oppositus* E1*, analis, forsythi.*

thmF1: appears to be 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 i.e. as oppF3, nzlF1, etc.

thmG1: large subterminal BR and median BR.



Molecular:

Mt *COI*: *COI* sequence suggests that *C*. 'thermarium' may be an ecologically plastic species that can live in thermal habitats as well as habitats with lower water temperatures. At normal temperatures the larvae are a bathophilus type, with the VT, particularly the anterior pair, reducing in size with higher temperatures (see below).

Localities:

North Island:

Kerosene Creek (thermal), South Auckland (39.94ºS, 176.56ºE) (NZ.78.1) (S. Ibarraran) 27-viii-2007

Lake Ngahewa (38.31ºS, 176.37ºE), South Auckland (NZ.76.1) (S. Ibarraran) 28-viii-2007.

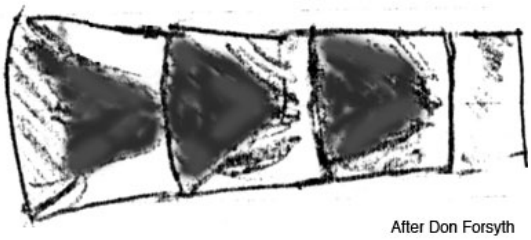
Lake Rotowhero, South Auckland (38.30ºS, 176.40ºE) (NZ.11.3) (D.J. Forsyth and Jon Martin) 23-xii-1973; (NZ.11.6) (S. Ibarraran) abt 15-ii-2007

Queen Elizabeth Park (37.94ºS,175.56ºE), South Auckland (NZ.80.1) (S. Ibarraran) abt 15-ii-2007.
Waiotapu Stream (thermal) South Auckland (38.38ºS, 176.35ºE) (NZ.69.1) (D.J.Forsyth) 14-vi-1983
Waiotapu Stream (thermal) South Auckland (38.38ºS, 176.35ºE) (NZ.69.2) (D.J.Forsyth) 25-iii-1998

6a. *Chironomus* 'castaneum'. (ms name of D.J. Forsyth)

In BOLD Bin: BOLD:AAL7010
Along with *C.* 'campano' and C. sp. NZ9. (see under *C.* sp.NZ9 for further detail)

This manuscript name was allocated by D.J. Forsyth for specimens from Poutu Canal, Lake Rotoaira, South Auckland. His associated adults were not available for study.
Don described the adult abdomen as having somewhat triangular brown markings on the tergites that became progressively wider on successive segments.


After Don Forsyth

DNA and cytological data indicated that there was more than one taxon initially included under this name.

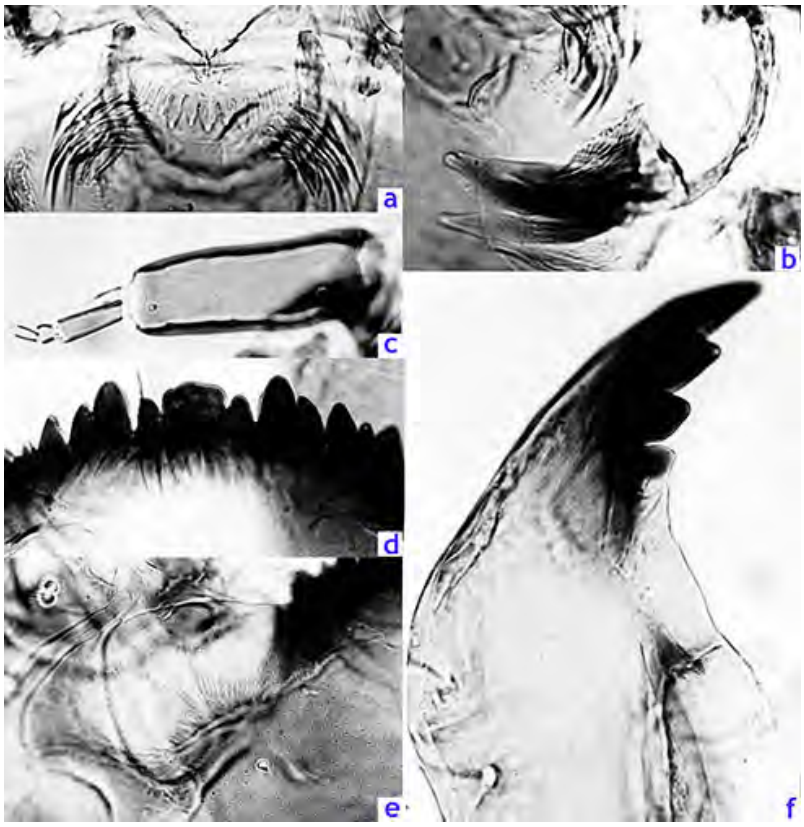
Adult:

Male: Abdomen with somewhat triangular brown markings, narrowing towards the posterior margin, on the tergites that become progressively wider on successive segments.

Pupa: Spur with 3-5 spines.

Fourth instar larva: A salinarius-type larva. Length about 16.23 (15.2-16.8) mm (female); 14.1 (12.8-14.8) mm (male). Anal tubules short and normally rounded, usually about the same length although the ventral pair may be longer and narrower; only about 2x as long as wide – occasionally pointed and about the same width as the length.
FC and posterior half to two thirds of gula, dark to very dark, sometimes with some slight darkening at posterior of head capsule. Salivary reservoir relatively deep: 78 µm long and 4.4 times longer than deep.
Mentum (Fig. d, below) width about 0.68 to 0.77 of VHL; with 4th lateral reduced to about the level of the 5th laterals (type II), c1 tooth broad (broad IIA), 6th laterals turned out.

VM (Fig. e, below) about 245 µm long and 2.95-3.23 wider than deep; about 1.03 times the mentum width and separated by about 0.4-0.5 of its width; with about 45.0 (39-55) striae, which appear to extend almost to anterior margin, particularly at the outer edges; VMR about 0.27. PE (Fig. a, below) with about 11.6 (10-14) teeth, mostly worn but narrowing towards the edges. Premandible (Fig. b, below) of type B2, with outer tooth about 3-5x the width of the outer tooth and coming to a broad point.
Distance between antennal bases (167.7) less than the distance between the S4 setae (183). Antennae (Fig. c, below) with basal segment relatively short (0.35-0.43 of VHL) and only about 2.2-3.1 times longer than wide, AR about 2.10-2.14; RO about 0.36 (0.27-0.45) up from base of segment 1; relative length of segments (µm) 122 : 31 : 9 : 13 : 7 ; A3 shorter than A4, but longer than A5.
Mandible (Fig. f, below) about 249-326 µm long, of type IIB or occasionally IIC, and with about 18.2 (11-24) furrows on outer surface near base; 12.5 (10-15) taeniae in PecM; Mdt-Mat about 25, MTR about 0.27.



Third instar larva: A single larva was available, about 8.7 mm long; dorsal and ventral AT equal size: 160 µm long and twice as long as wide. Gula slightly darkened over posterior 1/3 to 1/2; FC pale. Mentum width about 0.4 of VHL. Ventromental plates separated by about 0.4 of the mentum width; with 28-30 striae; VMR 0.31-0.38. Premandible with inner tooth about 2.5 times wider than the outer tooth. PE with 11 teeth.
Distance between antennal bases about 0.85 of that between the S4 setae. The relationships of A1 to the VHL about the same as in the 4th instar; RO further up from base of segment (0.41-0.53); relative length of segments (µm) 75 : 24 : 8 : 13: 8.

Mandible about 175 µm long, of type IIB; with 22 furrows and 9 taeniae in the PecM.

Cytology: 4 polytene chromosomes, with pseudothummi group arm combination (BF, CD, EA, G).
Distinguished by two nucleoli in chromosome 1 (one proximal in B and 1 proximal in F).
Arm A with a sequence differing from oppA4 by a simple inversion which is also found in *C. forsythi* and other species; arm E commonly differs from E1 of Australian species by a large inversion, although that E1 is still present. Arm F appears identical to that of *C. oppositus* F3 and *C. australis*F1. Arm G often partly unpaired.
Polymorphic in all arms except arm F.

casA1: 1a-e, 2e - 3e, 1f - 2c, 10 - 11, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 – 19 i.e. as forA2

casA3: 1a-e, 12a-c, 3i-f, 9 – 8, 2d, 11 -10, 2c – 1f, 3 – 2e, 4 - 7, 13 – 19 from casA1
(Poutu & also Winton as camA3)

casB1: Nucleolus just distal to 4 characteristic bands (groups 24 – 26), and puff with proximal dark bands (groups 8-7) near distal end i.e. by small inversion from forB2

casB2: Inversion of distal third of arm taking the puff and distal dark bands (groups 7-8) close to the telomere, from casB1.

casC1: groups 4-3 about 1/3 from distal end, with groups 6-5 distal to them. as nzlC1

casD1: as forD1

casD2: as forD2

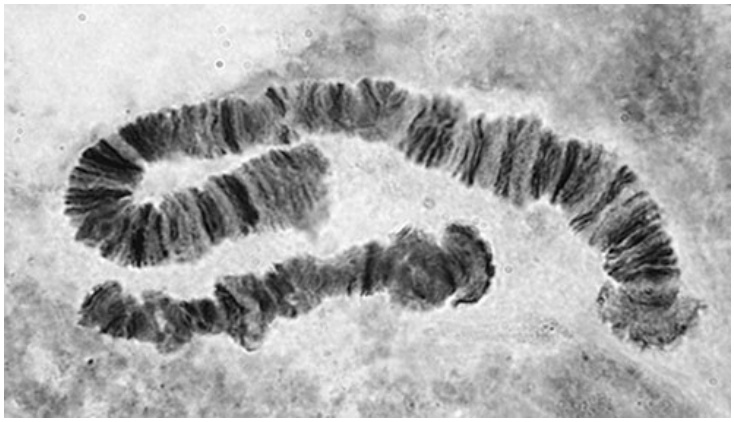
casD3: small proximal inversion from casD1, just proximal to breakpoint of D2.

casE1: 1 - 3e, 10b - 3f, 10c - 13 i.e. as oppE1, anlE1, forE1, nzlE1

casE2: 1a-e, 3f - 10b, 3e - 2a, 10c - 13 i.e. as forE2

casF1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 i.e. as oppF3, forF1, anlF1, nzlF1

casG1: with subterminal nucleolus. Differs from forG1 by an inversion around the median BR.



Arms A1E1 and G1 of *C.* sp. 'castaneum'

Localities:
North Island:

Lake Karapiro, South Auckland (NZ.77.1) (Sofia Ibarrarán) 27-viii-2007
Lake Okaro, South Auckland (NZ.10.9) (Sofia Ibarrarán) 14-ii-2007
Lake Okareka Wellington District (NZ.82.1) (Sofia Ibarrarán) 29-viii-2007
Poutu Canal (39.07ºS, 175.75ºE), Lake Rotoaira (NZ.70.1) (D.J.Forsyth) 8-x-1990 (Forsyth's type locality)
Lake Rotoaira (39.056ºS, 175.705ºE), South Auckland (NZ.70.2) (Sofia Ibarrarán) 14-ii-2007
Lake Rotoaira (39.056ºS, 175.705ºE), South Auckland (NZ.70.3) (Sofia Ibarrarán) 27-viii-2007

South Island

Haast junction, 3 km w Haast (43.88ºS, 169.05ºE), Westland (NZ.67.1) (Jon Martin) 25-i-1978
Winton (46.10ºS, 168.20ºE), Southland (NZ.43.1) (Jon Martin) 5-i-1974

The evidence for the presence of more than one species comes from both the cytology and the mt*COI* sequence. At the type locality there is A1 and A2; B1 and B2; C1; mainly D2 with D1 and D3; E1 and E2; F1; and G1.

Mt*COI* sequence: Some sequence is in the BOLD database.

6b. *Chironomus* 'campana' (nr. 'castaneum')
This species is recognized as close to *C.* 'castaneum' on the basis of the cytology and mt*COI* sequences, and also close to C. sp.NZ9.

In BOLD Bin: BOLD:AAL7010
Along with *C.* 'castaneum' and *C.* sp. NZ9. (see under *C.* sp.NZ9 for further detail)

Adult:

Two males, one a somewhat incomplete reared male, were available for study.
The adult male from Lake Hawea, Otago, South Island NZ.48.1 male 1 (7.I.1974) has been chosen as type since there is also DNA barcode data for this specimen: Colouration not recorded before DNA extraction and slide mounting.

AR about 3.8; Wing length 5.37 mm, width 0.86 mm.; VR 0.92; LR 1.33; anterior tarsi without a beard, BR 1.7.
FT present 30-40 µm long and 1.7-2.5 time longer than wide.
Palpal proportions (micron): 78 : 56 : 280, 278 : 420; P5/P4 about 1.51, P5/P3 about 1.38. Clypeus 1.15 times wider than the antennal pedicel; 26 clypeal setae.

Thoracic setae: at least 10 acrostichal; 22 dorsolateral; 6-7 prealar; 1 supraalar; 27 scutellar (10 in anterior row, 17 in posterior row).
Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta5/Ti
PI	1700	1680	2240	1320	1000	820	340	1.33	1.01	0.15
PII	1820	1810	1030	630	440	290	230	0.57	1.01	0.22
PIII	2120	2260	1540	940	680	420	250	0.68	0.94	0.11

Abdomen somewhat triangular (Don Forsyth referred to them as 'bell shaped') patches on segments II-IV, then covering most of the tergites. TIX with 9 setae in a single pale area.

Hypopygium of the proposed type male.

Anal point narrow at base and widening a little at the distal end. SVo closest to the E(h) type of Strenzke (1959); IVo reaching about to the end of the anal point or a quarter to a third along the gonostylus, with simple setae. GS moderately swollen and narrows markedly from about the distal third to half; about 6+1, 7+1 setae at tip.

Additional data from the other male: AR about 3.7. Wings damaged LR about 1.33-1.52, anterior tarsi without a beard (BR about 1.7).
FT present, length about 69 µm; for palp only P2 (50 µm) and P3 (241 µm) could be measured. about 22 clypeal setae.
Thoracic setae – acrostichals – at least 10; dorsocentrals - about 22; supra-alars 1; scutellar in two rows - 10 anterior, 17 posterior.
Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1392	1316	2000	1139	810	633	304	1.52	1.06	1.67
PII	1544	1468	873	557	380	266	203	0.59	1.05	
PIII	1797	1835	1342	835	557	354	228	0.73	0.98	

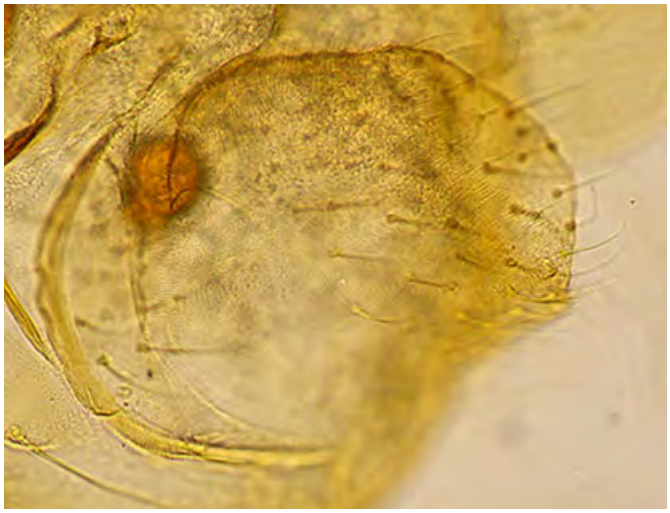
Fore Ta5/Ti about 0.23. Sensilla chaetica difficult to see, perhaps 4 mTa1, 7 hTa1.

Female: There is data for a female collected at the same time and from the same site as the proposed type male. It is included here although there is no proof that it belongs to this species (*C. forsythi* was also present at the location, but the leg ratios are more similar to those of the type male than to those of *C. forsythi* females).

Wing length: 5.37 mm; wing width: 1.14 mm; VR 0.91
AR: 0 35; flagella length (micron): 225 : 130 : 155 : 140 : 230, A5/A1 1.02.
Palpal segments (micron): - : - : 105 : 275 : 301; P5/P4 1.35; P5/P3 2.86. Clypeal width 1.8 times antennal pedicel; 37 setae.
Thoracic setae: About 16 acrostichal; 4-5 humeral; 25-29 dorsolateral (30-33 dl+humls); 8 prealars; scutellars in two approximate rows - anterior row about 15, posterior row about 19 (34 total) setae.
Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1620	1560	2100	1080	780	680	340	1.35	1.04	0.45
PII	1620	1700	930	500	360	260	200	0.55	0.95	
PIII	1900	2140	1400	820	610	360	220	0.65	0.89	

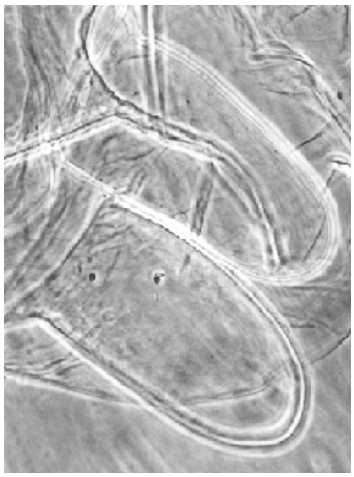
BR about 1.46. Sensilla chaetica 14 mTa1, 16 hTa1.
Colour of abdominal tergites undetermined but apparently over most of the segment.
GcIX with 3 setae; segment X appressed to cercus, crescent shaped, about 280 µm long and 5.9 times longer than its greatest width, with 16 setae. Cercus (below) with rounded outline; ventral margin longer.



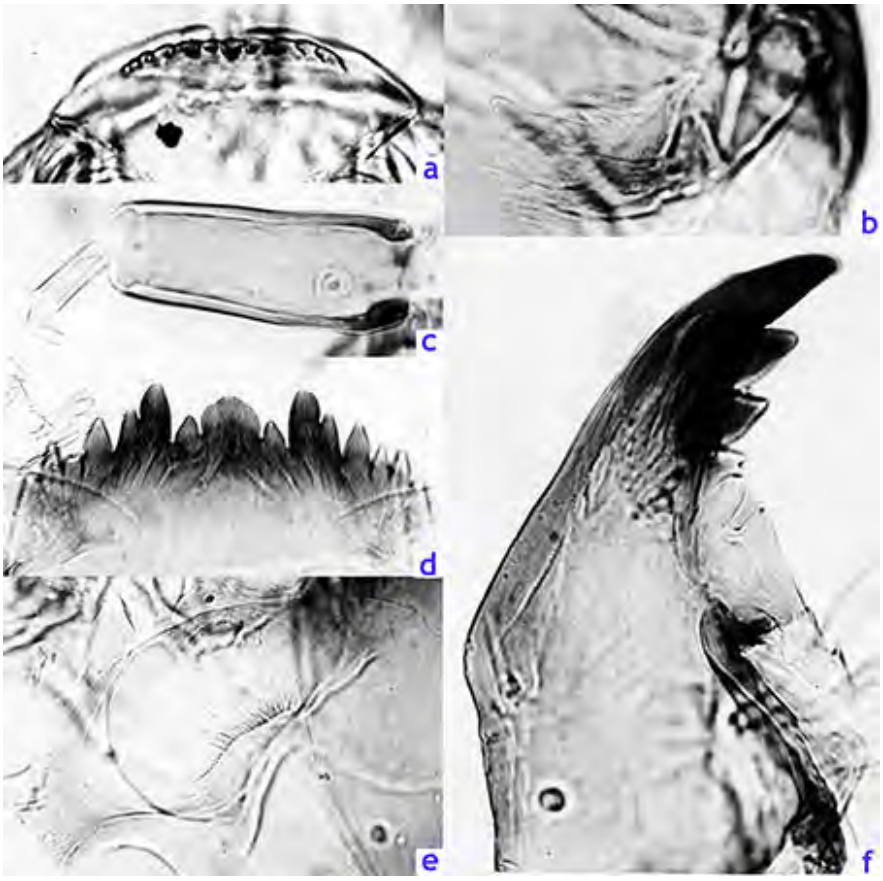
Cercus with closely applied segment X (at left)

Pupa: Length about 9.4 mm. Pedes spurii B developed on segment II, and about 55 hooks on posterior margin. Pedes spurii A well developed on segment IV.
Caudolateral spur of segment VIII with about 3-6 appressed spines.
Anal lobe with a hair fringe of about 132 taeniae (on each side).

Fourth instar larva: A salinarius-type larva, length 12.7-17.2 mm (female); 12.3-14.8 mm (male).
A larva from Winton showed a small bump for the posterior VT (about 0.06mm).
Anal tubules (below) short, about 200-400 µm long and 2-3x (1.8-3.2) longer than wide.



Frontoclypeus and posterior half to two thirds of gula, dark to very dark, sometimes with some slight darkening at posterior of head capsule.
Mentum (Fig. c, below) of type II, c1 tooth of mentum broad (broad IIA), 6th laterals turned out.
Ventromentum (Fig. d, below) about 223.5 (190-248) µm wide and 3.26-3.7 times wider than deep; with about 37.4 (35-40) striae, which reach almost to the anterior margin, particularly at the lateral edges; VMR 0.36 (0.30-0.39).
Pecten epipharyngis (Fig. a, below) with about 10-14 teeth narrowing towards the edges.
Premandible (Fig. b, below) with broad teeth, inner tooth about 3-5x the width of the outer tooth and coming to a broad point.
Distance between antennal bases, 164.9 (157-184.5) µm, less than the distance between the S4 setae, 181.3 (164-195) µm.
Antennae (Fig. c, below) with basal segment about 40% of the VHL and 2.81 (2.61-3.21) times longer than wide, AR 1.84 (1.59 - 2.07); RO about one third (0.29-0.36) up from base of segment; proportions (µm) 125 : 35 ; 10 : 15 : 7 ; A3 shorter than A4, but longer than A5.
Mandible (Fig. f, below) about 297.75 (245-328) µm long; generally type IIB, but sometimes 3rd inner tooth darker and more distinct (IIC), and with about 22.5 (18-26) furrows on outer surface near base; 12.4 (11-14) taeniae in PecM; Mdt-Mat 22.5-40.5, MTR 0.26-0.36.



Cytology: Four polytene chromosomes with the pseudothummi arm combination AE, BF, CD, G. There may be a smaller nucleolus in arm G, but otherwise basic sequences as in *C. castaneum,* with a nucleolus in both arms B and F. Polymorphic in all arms, some unique to this species. Arm G often partly unpaired.

camA1: 1a-e, 2e - 3e, 1f - 2c, 10 - 11, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 – 19 i.e. as casA1

camA2: 1a-e, 2e - 3, 1f - 2c, 10 - 11, 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 - 19 i.e. as casA2

camA3: 1a-e, 12a-c, 3i-f, 9 – 8, 2d, 11 -10, 2c – 1f, 3 – 2e, 4 - 7, 13 – 19 from camA1

(Winton, & also Poutu as casA3)

camB1: Nucleolus just distal to 4 characteristic bands (groups 24 – 26), and puff with proximal dark bands (groups 8-7) near distal end i.e. as casB1

camB2: Inversion of distal third of arm, as nzlB3, taking the puff and proximal dark bands (groups 7-8) close to the telomere i.e. as casB2.

camB3: Inversion of region of the nucleolus, from camB1 (different breakpoints to the difference of camB1 to forB2).

camC1: groups 4-3 about 1/3 from distal end, with groups 6-5 distal to it. i.e. as casC1

camC2: simple inversion of distal third from camC1. (in NZ.67.1Em#1)

camD1: as casD1

camD2: as casD2

camE1: 1 - 3e, 10b - 3f, 10c - 13 i.e. as oppE1, etc., casE1

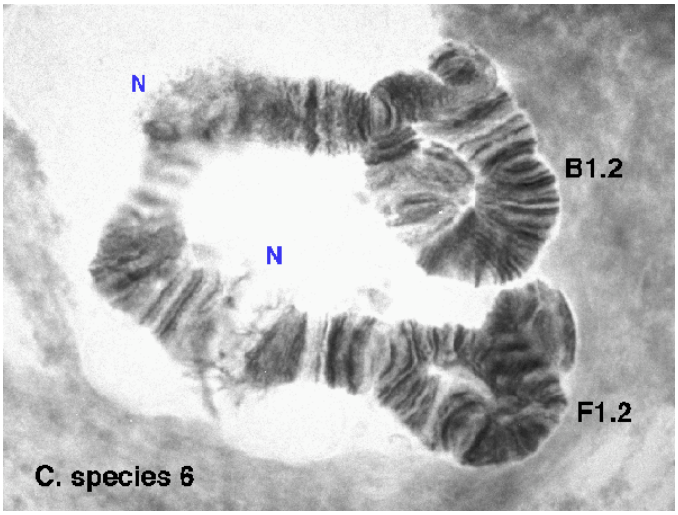
camE2: 1a-e, 3f - 10b, 3e - 2a, 10c - 13 i.e. as casE2

camF1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 i.e. as oppF3, forF1, casF1

camF2: (approx.) 1 – 2a, 10 – 9c, 4 – 9b, 3 – 2c, 15c – 11, 2b, 15d – 23 as forF2

camG1: with small subterminal nucleolus.

camG2: from camG1 by a smaller inversion around the median BR than that differentiating camG1 from forG1. (NZ.67.1 Em#1)



Chromosome BF of a larva from Winton, South Island, showing the two nucleoli.
Also heterozygous for an inversion in both arms.

North Island

Lake Karapiro (37.94ºS, 175.56ºE), South Auckland (NZ.77.1) (Sofia Ibarrarán) 27-viii-2007

Lake Okaro (38.30ºS, 176.40ºE), South Auckland (NZ.10.9) (Sofia Ibarrarán) 14-ii-2007

Lake Rotoaira (39.056ºS, 175.705ºE), nr. Turangi, South Auckland (NZ.70.2) (Sofia Ibarrarán) 14-ii-2007.

South Island:

abt.1 m in Lake Te Anau (45.17ºS, 167.50ºE), Te Anau, Southland (NZ.46.2) (Jon Martin) 7-i-1974

Lake Hawea (44.50ºS, 169.17ºE), Otago (NZ.48.1) (Jon & C.J. Martin) 7-i-1974

Owaka River (46.42ºS, 169.60ºE), South Otago (NZ.56.1) (T.Dodgshun & J.S.Pillai) 14-iii-1974

Creek at Winton (46.10ºS, 168.20ºE), Westland (NZ.43.1) (Jon Martin) 5-i-1974

Mt*COI*: There is sequence in BOLD.

The evidence for this species comes from the cytology and the Mt*COI* sequence.
The species is apparently also close to *C. analis* and may hybridize with it, since at least one larva has been found with the *C.* nr. *castaneum* cytology, but the *C. analis COI* sequence.

7. *Chironomus* n.sp. NZ7

Adult: not known.

Pupa: not known.

Fourth instar larva: A bathophilus-type larva, although ventral tubules shorter than *C. novaezelandiae* (ant. abt. 0.48-0.88 mm; post abt. 0.52-1.0 mm). Medium size species, about size of *C. forsythi, C. analis*, and larger *C. novaezelandiae*, length about 14.2–19.2 mm.
Head capsule relatively broad, width of mentum at least 2/3 of VHL; generally with gular region dark, a darkened FC and sometimes in surrounding regions.
Mentum with 4th laterals slightly reduced, sometimes higher than 5th laterals (i.e between type I & II), c1 tooth relatively broad, c2 teeth usually separated, but occasionally still partially on shoulders of c1 (i.e. usually type IIA, but sometimes type III).
VM with about 34-46 striae; VMR about 0.32-0.47. Distance between VMs about 0.31-0.46 of mentum width.. PE with 11-17 teeth, some of which are reduced in size.
Antennae with basal segment at least 3.5 to 4.4 times as long as wide; AR about 1.7-2.3; A2 about 0.28 length of A1; ratio of segments (micron): 168 : 40 : 11 : 16 : 8.
Distance between antennal bases generally smaller than distance between S4 setae, but may be about equal or even greater (1 of 6 larvae).
Mandible of type I-IIB, with about 23-27 furrows on outer surface near the base; 12–14 taeniae in PMa.

Cytology: 4 polytene chromosomes with unique chromosome arm combination BG, CD, EA, F. One large nucleolus proximal on arm G. Arm E as E1 of Australian species; arm F as *oppositus* F3, *australis,* etc.

Arm A1: (approx) 1a-e, 11 - 10, 2c - 1f, 6 - 4,12a-c, 8 - 9, 2d - 3,17 - 13, 7d-a, 18 - 19

Arm B1: Puff (group 7) with proximal dark bands (group 8) near middle of arm.

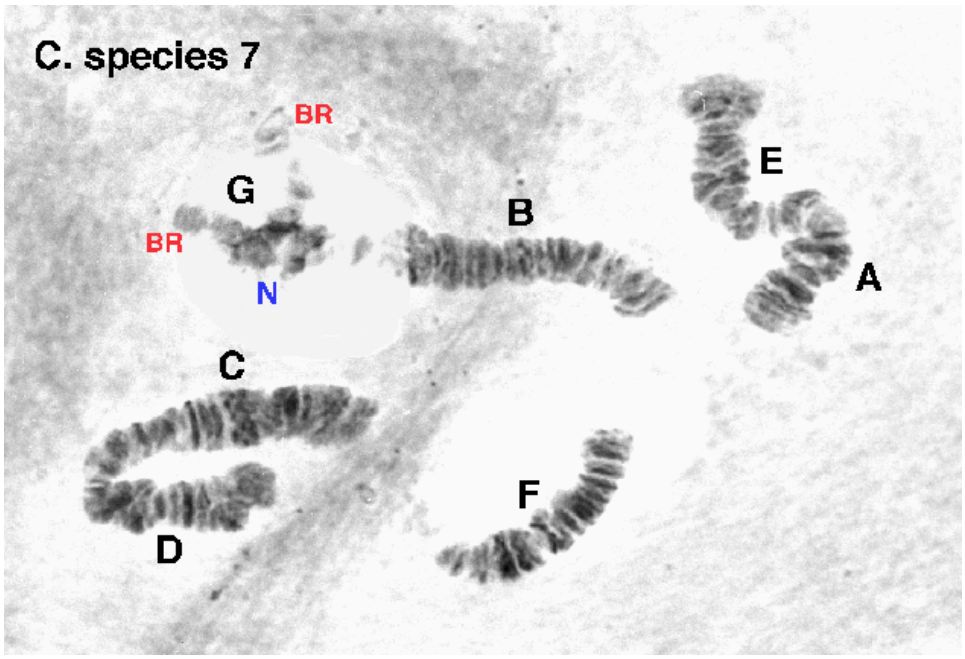
Arm C1:

Arm D1:

Arm E1: 1 - 3e, 10b - 3f, 10c - 13 ie. as E1 *oppositus, analis, forsythi, novaezelandiae, 'thermarum'*

Arm F1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 ie. as *novaezelandiae* F1*, analis, forsythi, oppositus,* F3

Arm G1: Nucleolus near attachment to arm B, with BR towards the distal end.



Localities:
South Island:

10m+ in Lake Pearson, near Cass, Canterbury (NZ.59.1, 2, & 3) (B.V.Timms) 1978/79.

Lake Lochie, c.87 km n.w. Te Anau, Fiordland (NZ.45.1) (Jon & H.I.Martin) 6-i-1974

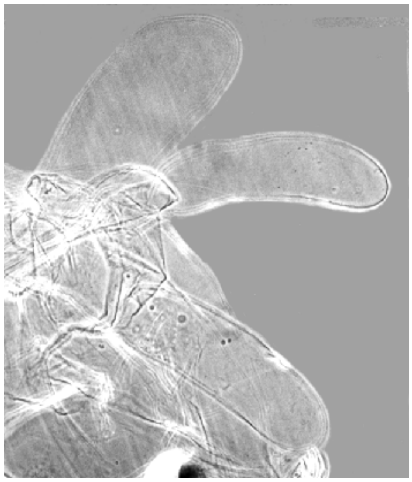
The unique chromosome arm combination was noted by Wülker & Morath (1989)

8. *Chironomus* n.sp. NZ8

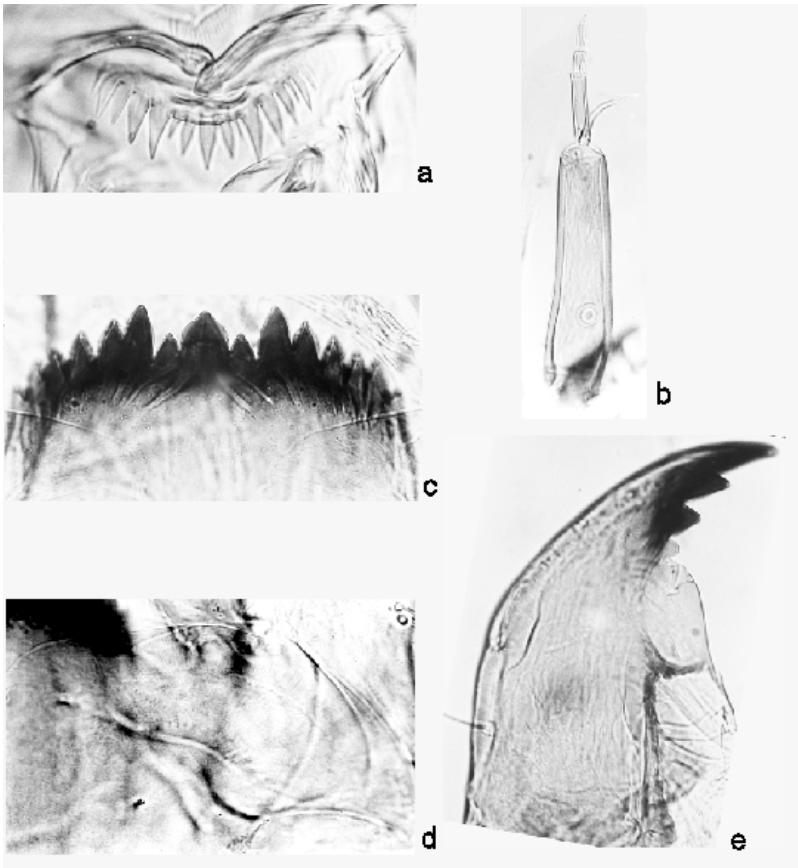
Adult: not known.

Pupa: not known.

Fourth instar larva: bathophilus-type larva. Length about 13-18.7 mm. Head capsule with pale or very slightly darkened FA, pale or some darkening in posterior region of gula. VT about equal, or anterior pair longer (Ant. 1.0-1.48 mm, post 0.96-1.42mm). Anal tubules relatively long and rounded, about 2.5x as long as wide.



Head relatively narrow, mentum width only about half the VHL.
Mentum (c, below) with 4th lateral only slightly reduced (i.e. between type I and II); centre trifid tooth with a relatively broad, squared-off c1 and distinct c2 teeth (i.e. Type IIA). VM (d, below) with about 43 striae on only specimen counted. PE (a, below) with about 14-17 rather uneven teeth. Basal segment of antenna (b, below) relatively long and narrow, about 4 times as long as wide; 4th segment relatively short, only about 20% longer than segment 3. Mandible (e, below) with 3rd inner tooth darkened and almost completely separated (i.e type IIB, tending to type IIIB); about 18-20 furrows on outer surface near the base.



Cytology: 3 polytene chromosomes, modified pseudothummi arm combination (BF, CD, GEA). Arm G is attached to arm E by a loose nucleolar connection, but the reality of this

connection is confirmed by the presence of only six chromosomes in mitotic metaphases. The nucleolus in arm F is either reduced or absent. Arm A has the sequence, derived from A4 by a simple inversion, found in *C. novaezelandiae.* Arm E appears identical to *oppositus* E1, while arm F differs from F1 of *C. zealandicus* by an inversion of about the region from 11-9e. One poor specimen appears to be heterozygous in one chromosome arm, but the arm could not be identified.

Arm A1: 1a-e, 11 - 10, 2c - 1f, 3e - 2e, 7 - 4, 12a-c, 3i-f, 9 - 8, 2d, 13 - 19 ie. as A2 of *novaezelandiae*

Arm B1: Puff (group 7) with proximal dark bands (group 8) near middle of arm.

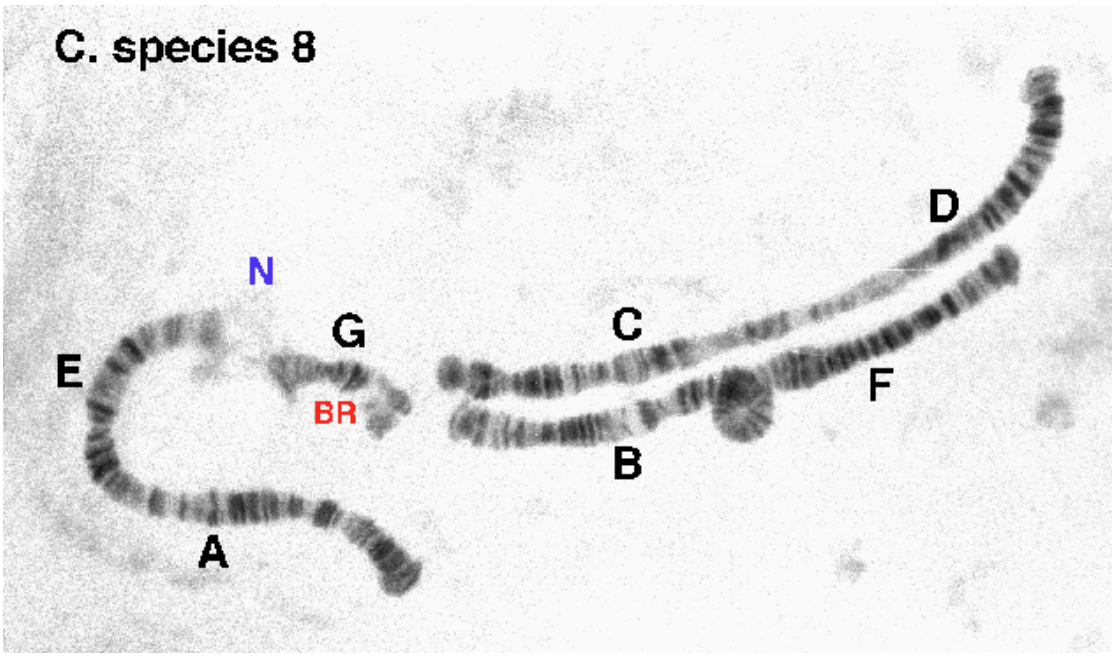
Arm C1:

Arm D1:

Arm E1: 1 - 3e, 10b - 3f, 10c - 13 ie. as *oppositus* E1 (appears no more than 1 band missing)

Arm F1 1 - 2a, 10 - 9f, 11 - 9e, 12 - 15c, 2c - 7, 2b, 15d - 23

Arm G1: attached to arm E.



Localities:

South Island:

13 km north of Haast, Westland (NZ.49.1) (Jon Martin) 8-i-1974.

Lake Pearson, nr. Cass, Canterbury South (NZ.59.1) (B.V. Timms) 12-ix-1978.

9. *Chironomus* n.sp. NZ9

In BOLD Bin: BOLD:AAL7010
The nearest neighbor BIN was listed as BOLD: AAL7011, but this Bin does not seem to exist any longer, and the replacement Bin -BOLD:ACK7128 also does not exist. The *COI* sequence suggests a relationship to the *C. castaneum*-group, which are in the same BOLD Bin, and there are some common sequences in the cytology.

Adult: Male not known.

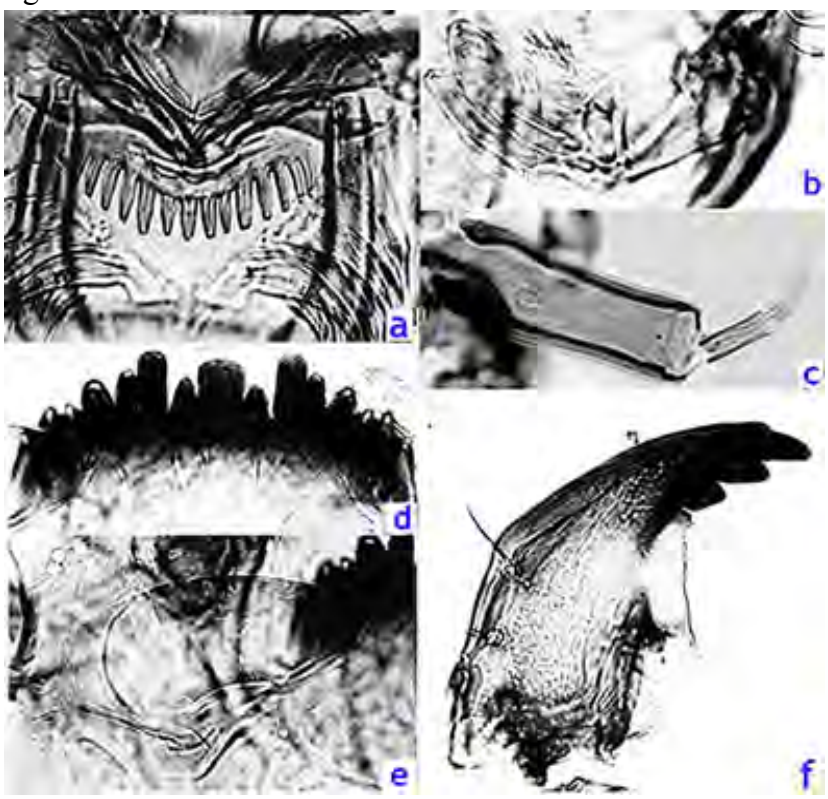
Female: (from a specimen collected by I. Hogg, in BOLD database):

Wing length about 4.3 mm. Colour brown with darker brown postnotum and dark bands across basal part of abdominal segments at least II-VI.
Legs apparently relatively pale with no darkening at knees. Mid femur abt. 1480 µm; mid tibia about 1240 µm (F/T abt 1.19); hind femur abt. 1920 µm, tibia at least 1900 µm (F/T about 1).

Pupa: Not known

Fourth instar larva: salinarius type larva, length 15.5-15.8 mm (female), 12.5-15.7 mm (male). Head capsule with gular region darkened on posterior third, frontoclypeus very slightly to slightly darkened, but with some darkening of the posterior border of the frontoclypeus. Anal tubules about 300-360 µm long, without a constriction, and about 1.5-2.3 times longer than wide, dorsal and ventral pairs generally similar in size. Salivary reservoir 83-124 µm wide and 2.9-4.9 times wider than deep.
Mentum (Fig. d, below) with c1 tooth characteristically broad and flat on top, c2 teeth relatively well separated (type broad IIA); 4th lateral reduced to about the level of the 5th lateral (type II), 6th lateral arising at a slightly lower level than other teeth; width 0.71-0.77 of VHL (i.e. head relatively wide).
VM (Fig. e, below) about 3.6 times wider than deep; with about 36-40 striae; VMR about 0.35-0.38. PE (Fig. a, below) with about 14-15 relatively even teeth (Ty. B). Premandible (Fig. b, below) of type D, with robust teeth, inner tooth about 4-5 times wider than the outer tooth, which narrows to a fine point when not worn.

Antenna (Fig. c, below) with basal segment about 0.4 of the VHL; about 2.81 (2.6-3.2) x longer than wide, RO about a third (0.29-0.36) up from base; AR 1.84 (1.59-2.07); antennal proportions (micron) 125 : 35 : 10 : 15 : 7.
Distance between the antennal bases (199.75 µm) generally similar to that between the S4 setae (204.88 µm) but quite variable; S4 setae separated by 87-95% of the FC width, i.e. often very close to the edge of the FC. S5 setae about level, or anterior to nearby RO.
Mandible (Fig. f, below) about 300 (245-328) µm in length; 3rd inner tooth only partly separated and coloured (type IIB), with about 22.5 (18-26) furrows on outer surface near the base; PecM of 12.4 (11-14) taeniae; Mdt-Mat 22.5-40.5 µm, MTR about 0.26-0.36, dependant on degree of tooth wear.



Gut of most larvae almost filled with sand particles.

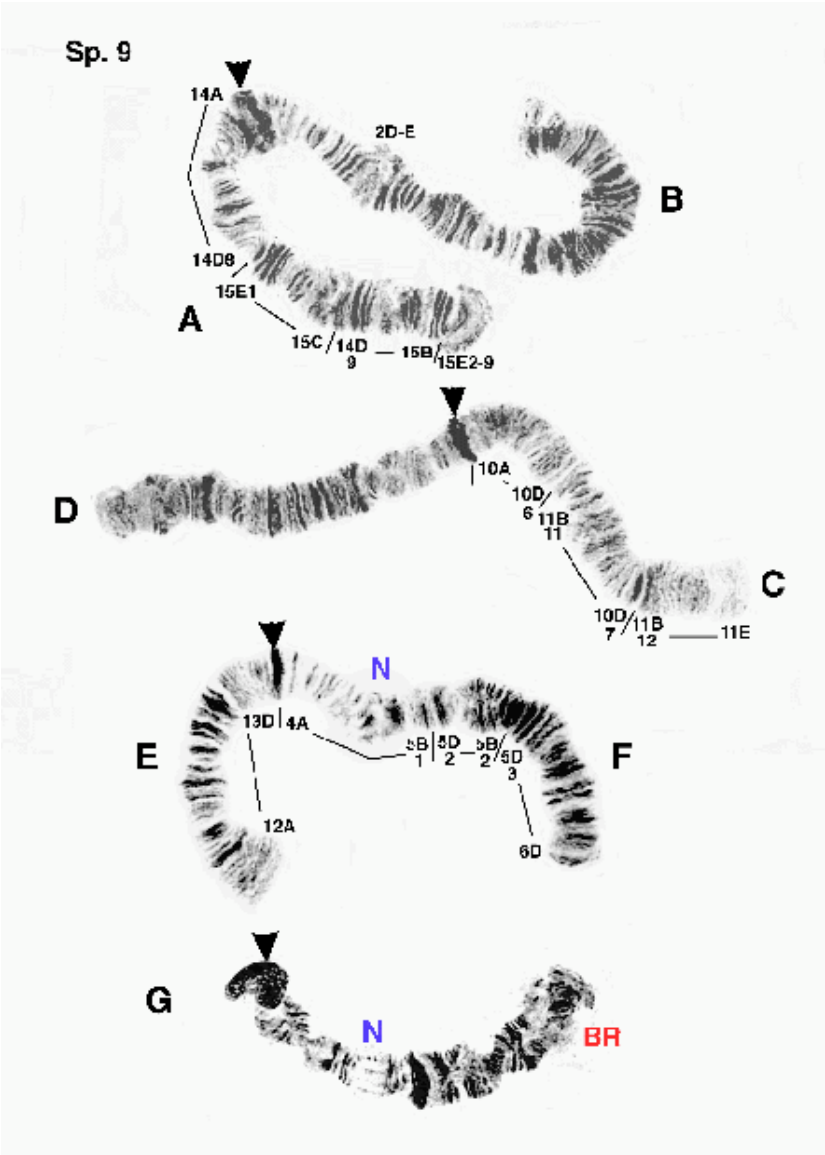
Cytology: 4 polytene chromosomes with thummi cytocomplex arm combination (AB, CD, EF, G). Centromeres heterochromatic. Two nucleoli, one proximal in arm F; the other about one third from the heterochromatic end of arm G. A Balbiani ring developed near distal end of arm G. Arm A with the sequence A4 found in Australian species; arm E with sequence E1 of the Australian species; and arm F as in *oppositus* F3 and *australis*. No polymorphism in small sample examined.

Arm A1:	1a-e, 11-10, 2c-1f, 3e-2d, 8-9, 3f-i, 12c-a, 4-7, 13-19	ie. as A4 *oppositus*
Arm B1:	Puff (group 7) and about 2 distal dark bands (8ab), close to 4 characteristic bands.	
Arm C1:	possibly 10A-10D6, 11B11-10D7, 11B12-11E	ie. as C2 of *forsythi*
Arm D1:	1 - 2, 16c-a,17e-a, 10c-a, 3e - 9, 3d-a, 10d -15, 18 - 24	i.e. as forD1, nzlD2

Arm E1: 1 - 3e, 10b - 3f, 10c – 13 i.e. as *oppositus* E1, *analis,* 'castaneum'-gp

Arm F1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 ie. as *oppositus* F3, *australis, analis, forsythi,* 'castaneum'-gp., etc.

Arm G1: heterochromatic terminal centromere, small nucleolus (or BR?) in middle and BR near the distal end



Localities:

North Island

Lake Karapiro (37.94ºS, 175.56ºE) South Auckland (NZ.77.1) (S. Ibarraran) 15-ii-2007.

Lake Okaro (38.30ºS, 176.40ºE), Rotorua area (NZ.10.8 and NZ.10.9) (D.J.Forsyth 14-ix-1982) and S. Ibarraran 14-ii-2007)

Lake Okareka (38.285ºS, 176.603ºE), Rotorua area (NZ.82.1) (S. Ibarraran) 15-ii-2007.

nr. Te Awamutu, Waikato area (37.802ºS, 175.334ºE) (Ian Hogg) 29-iv-2013

South Island:

Lake Hayes (44.98ºS, 168.80ºE), c.13km n.e. Queenstown, Westland (NZ.47.1) (Jon Martin) 7-i-1974

Mt*COI* sequence suggests that there may be hybridization with *C.* 'castaneum' particularly where they occur together in the same lake, although this is unlikely due to the whole arm translocation difference. On the other hand, there is a possibility that this is a recent whole-arm translocation event from a related pseudothummi-complex species (probably *C.* 'castaneum', sp. 6a, on the basis of current information – see below), with no connection to species of the thummi-cytocomplex. As such, this species would be immediately reproductively isolated from its pseudothummi-cytocomplex parent. The limited mitochondrial DNA difference would then suggest that this event occurred relatively recently.

There are differences at 15 base positions between the three members of the 'castaneum-group':

	Base													
C. spNZ9	G	GC	A	A	T	G	T	T	A	C/G	T	G	A	T
C. 'castaneum' (spNZ6a)	A	G	C	A/G	A/G	T/A	G	T/C	T/C	A/T/G	G/A	T/A	G/A	A/G T/G
C. 'campana' (spNZ6b)	A	A	A	G	G	A	A	C	C	G	A	A	A	G G

The similarity of many of the polymorphic bases of *C.* 'castaneum' with the equivalent base of spNZ9 suggests that the former is the ancestral species in which the translocation occurred. On the other hand, the similarity of the polymorphic bases to those of *C.* 'campana' could be the result of hybridization between these two closely related species.

10. *Chironomus* n. sp. NZ10

See *C.* 'thermarum'

11. *Chironomus* 'spilleri' n.sp. (ms name from D.J. Forsyth)

In BOLD Bins: BOLD AAL7009

Adult:
The adult male of this species is not known for certain because no rearings associated with this larval type are available (such specimens may be in the collection of D.J. Forsyth, now with Ian Boothroyd?).

Fourth instar larva: A bathophilus-type larva. Length about 13-15 mm. VT from 0.6-1.5 mm, anterior pair usually longer. Anal tubules: dorsal pair about three to four times as long as wide, ventral pair often longer with a constriction and about three times as long as wide.
Head capsule with pale FA, slightly dark or dark on posterior region of gula.
Mentum with 4th lateral reduced to about level of 5th laterals (type II); centre trifid tooth with distinct c2 teeth (i.e. type II or worn type III).
VM separated by about 0.29-0.37 of mentum width, with about 43-50 striae. PE with about 10-20 rather uneven teeth.
Basal segment of antenna about 2.7-4.2 times as long as wide; 4th segment relatively short, generally no more than 30% longer than segment 3, which is longer than segment 5; segment proportions (µm) 128 : 32 : 10 : 13: 7. Premandible with inner tooth about 2.2-2.7 times as wide as outer tooth, outer tooth usually shorter.
Mandible with 3rd inner tooth darkened but only slight separation (i.e. type IIB-C); about 17-23 furrows on outer surface near the base.

Cytology: 4 polytene chromosomes with the pseudothummi arm combination (AE, BF, CD, G). Arm G with a subterminal nucleolus and nearby BR. No nucleolus in long chromosomes. Unique sequence in arm B, with puff or BR near the centromere. Polymorphism in arm C.

spiA1: 1a-e, 11 - 10, 2c - 1f, 3e - 2d, 8 - 9, 3f-i, 12c-a, 4 - 7, 13 - 19 i.e. as A4 *oppositus* and A1 of *novaezelandiae, analis, forsythi*

spiB1: Bulb (group7) close to centromere, dark bands further to distal end.

spiC1: as nzlC1

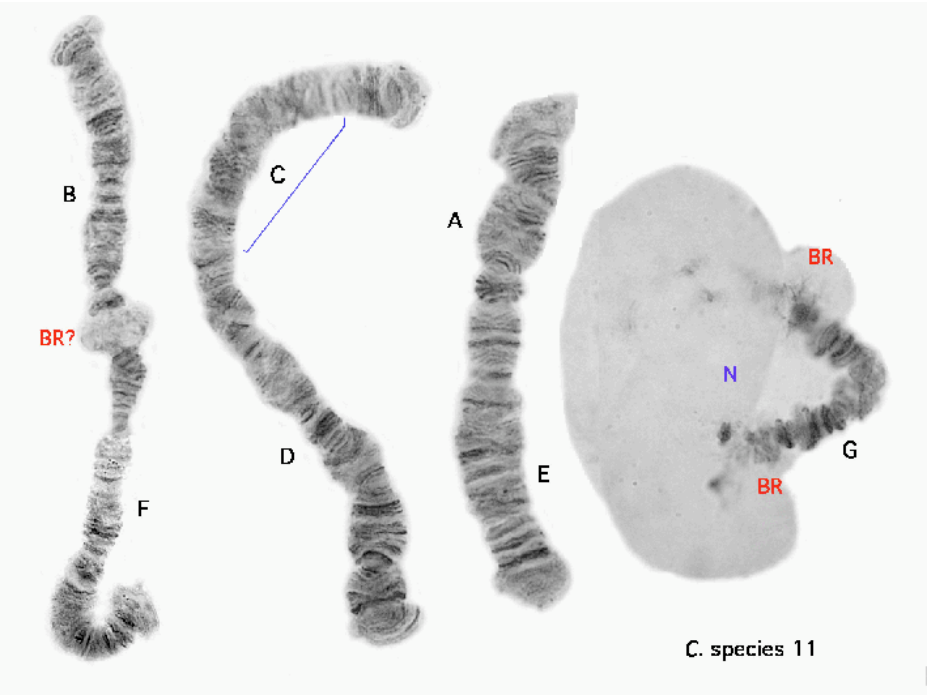
spiC2: inversion of about the extent of nzlC3

spiD1: 1 - 2, 16 - 10d, 3a-d, 9 - 3e, 10a-c, 17 - 24 i.e. as nzlD1

spiE1: 1 - 3e, 11 - 10c, 3f - 10b, 12 - 13 simple inversion from nzlE1

spiF1: 1 - 2a, 10 - 2c, 15c - 11a, 2b, 15d - 23 i.e. as oppositus F3, and F1 of *novaezelandiae, analis, forsythi*, but with no nucleolus

spiG1: Virtually terminal nucleolus with nearby BR.



Possible reared male of this species:

Adult: Colour not determined as specimen very bleached.

Wing length: 5.0 mm, width 0.96, VR 0.98. Crossvein slightly darkened.

Molecular:

Mt *COI* – a number of sequences are in the BOLD database, where they are placed in the BIN AAL7009 or AAL7010.

Localities:

North Island:

Cambridge, South Auckland (37.89ºS, 175.44ºE) (NZ.74.1) (Sofia Ibarrarán) 29-viii-2007.

Lake Ngahewa, South Auckland (38.31ºS, 176.37ºE) (NZ.76.1) (Sofia Ibarrarán) 27 August 2007

Lake Rotoiti, about 16 Km north east of Rotorua, South Auckland (37.28ºN, 174.67ºE) (NZ.19.1) (Jon Martin & D.J. Forsyth) 7-xii-1973.

Lake Tikitapu, South Auckland (37.94ºS, 175.56ºE) (NZ.81.1) (Sofia Ibarrarán) Feb. 2007.

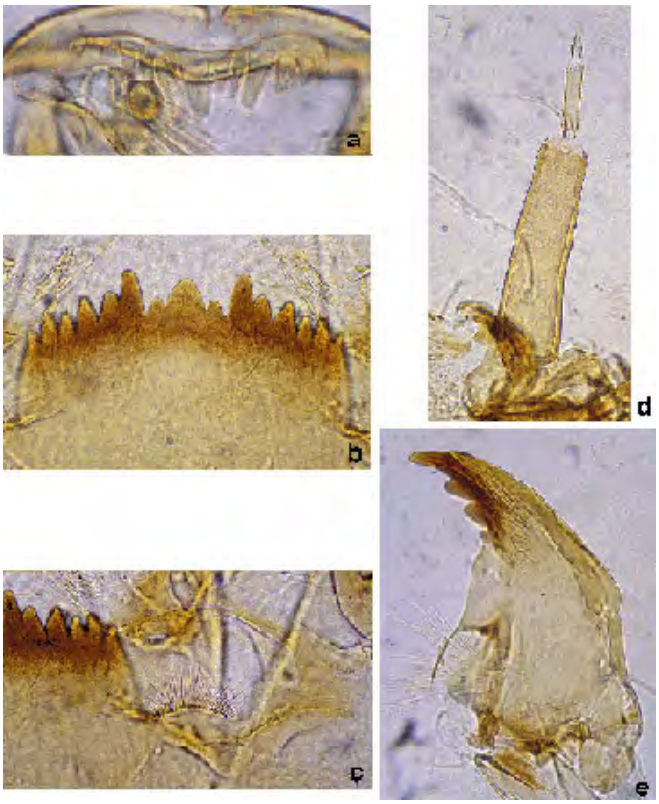
Initially included with *C. novaezelandiae*, but shows consistent differences in the lighter larval dorsal head colour, some unique banding patterns, and the lack of a nucleolus in arm F. The existence of this species was first indicated by the barcoding analyses of Sofia Ibarrarán, and the BIN analyses of the BOLD database place it in a separate BIN.

12. *Chironomus* n.sp. NZ12

In BOLD Bin: BOLD ABZ5458
This Bin also contains some specimens of *C. novaezelandiae.*

Adult and Pupa of this species are not known.

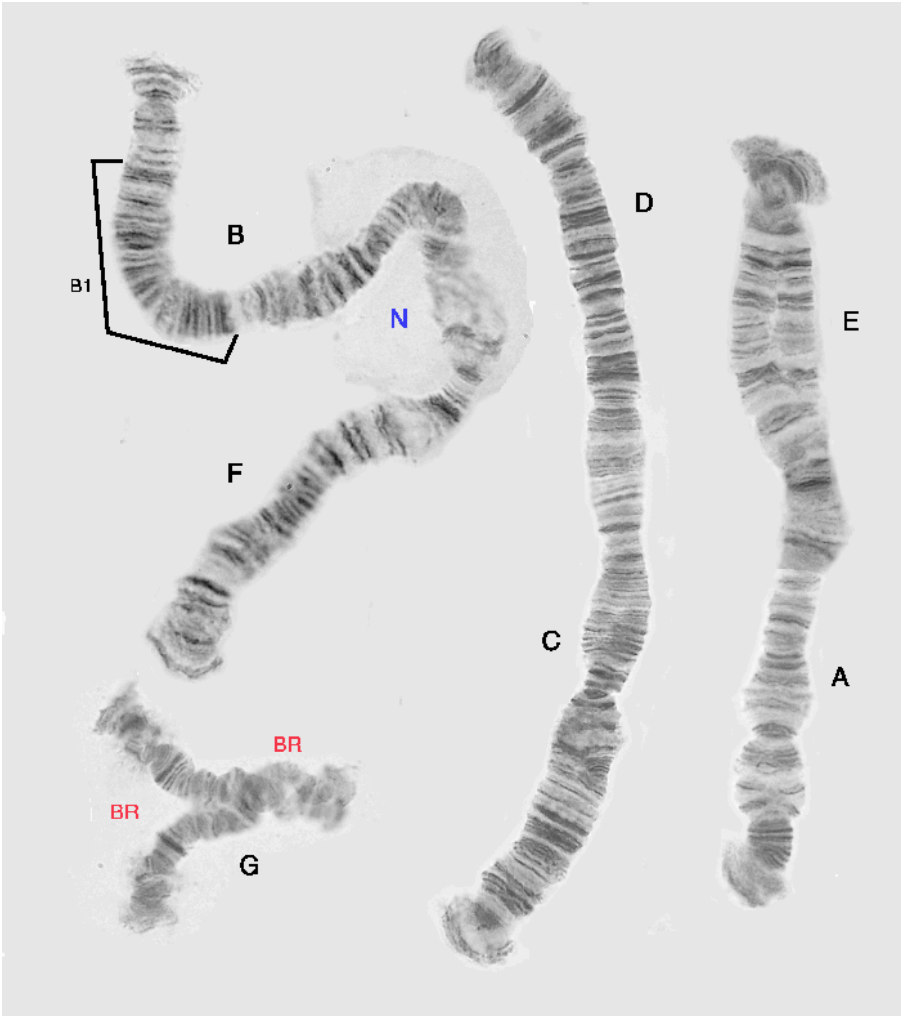
Fourth instar larva: bathophilus-type larva. Length about 17.2-18 mm (female) and 13.8-16.0 (male). Anterior VT about 0.72-1.6 mm; posterior about 0.82-1.46 mm. Dorsal AT possibly longer (392 µm) than the ventral pair (367 µm), both about 2.2 times longer than wide.
Head capsule with pale or slightly darkened FA, pale or slightly dark posterior third of gula.
Mentum (Fig. b, below) with 4th laterals reduced, generally to height of 5th laterals (type 1-II); central tooth with c2 teeth relatively well separated (type narrow IIA).
VMs (Fig. c, below) separated by about 0.4 of MW, with about 25-27 striae. PE (Fig. a, below) with about 11-14 irregular teeth. Premandible with inner tooth at least 2.5 times the width of the outer tooth, outer tooth narrowing to a fine point.
Antenna (Fig. d, below) with A1 0.43 of VHL, and 3.9-4.8 time longer than wide; AR about 2.28-2.78; RO about one third to two fifths up from base of segment 1; ratio of antennal segments (µm): 135 : 37.5 : 9 : 14 : 7.5.
Mandible (Fig. e, below) about 298-327 µm long, with 3rd inner tooth partly darkened and only slightly separated (type IIB); at least 14-18 furrows on outer surface near the base; 11-13 striae in the PecM.



Third instar larva: A single larva was available, anterior VT 1.25 mm long. Gula and FC pale. Mentum width about 0.6 of VHL.
Ventromental plates by about 0.4 of the mentum width; 132 µm wide and 3.1 times wider than deep, and about the same width as the mentum, with 25-27 striae; VMR 0.35-0.36.
Premandible with inner tooth about 2.5 times wider than the outer tooth. PE with 12 teeth.
Distance between antennal bases 100 µm, about 0.95 of that between the S4 setae. The relationships of A1 to the VHL and the distance of the RO from base about the same as in the 4th instar; AR about 1.5, relative length of segments (µm) 83.5 : 32 : 9.5 : 12.5: 6.
Mandible about 190 µm long, of type IIB; with 13 furrows and 10-11 taeniae in the PecM; Mdt-Mat 28 µm, MTR 0.42.

Cytology: 4 polytene chromosomes with the pseudothummi arm combination (AE, BF, CD, G).
Arm G without a nucleolus, but with an obvious subterminal BR. Nucleolus in arm F near the centromere, at about group 19. Polymorphism in arm B, with B2 apparently the more common sequence.

Arm A1:	1a-e, 11 - 10, 2c - 1f, 3e - 2e, 7 - 4, 12a-c, 3i-f, 9 - 8, 2d, 13 - 19	as nzlA2
Arm B1:	Puff with reduced dark bands nearer distal end of arm	as nzlB2
Arm B2:	Distal inversion including the puff (group 7) that returns it to near the middle of the arm.)	as nzlB3
Arm C1:	as nzlC3	
Arm D1:	1 - 2, 16c-a, 17e-a, 10c-a, 3e - 9, 3d-a, 10d -15, 18 - 24	as nzlD2
Arm E1:	1a-c, 5 - 7c, 10g-c, 3f - 4, 1d - 3e, 10b - 7d, 11 - 13	as nzlE3
Arm F1:	1a-e, 12 - 15c, 2c - 10, 2a, 11i-a, 2b, 15d - 23	as nzlF2
Arm G1:	No nucleolus, but an obvious subterminal BR	as nzlG2?



Molecular:

Mt *COI* – a number of sequences are in the BOLD database, where they are placed in the BIN BOLD: ABZ5458. Phylogenetic analysis of the mitochondrial *CO1* sequence places it in the *C. novaezelandiae* complex (see under *C. novaezelandiae*).

Localities:

North Island:

Lake Ngapouri, Waiotapu, South Auckland (NZ.9) (Jon Martin, D.J. Forsyth & S. Ibarrarán) 1972-1973, 2007.

Lake Rotoiti, about 16 Km north east of Rotorua, South Auckland (NZ.19.1) (Jon Martin, D.J. Forsyth) 7-xii-1973 and (S.Ibarrarán) 29-viii-2007.

Kinloch Marina, Lake Taupo, South Auckland (NZ.12.1) (D.J.Forsyth) 18-ix-1972.

South Island

Lake Rotoiti (41.82°S, 172.84°E), Nelson Lakes National Park, Tasman region (NZ.83.1) (B.V.Timms) 1-x-1968.

Initially included with *C. novaezelandiae*, but shows consistent differences in the lighter larval head colour and some unique banding patterns. The existence of this species was

partially supported by the initial barcoding studies of Sofia Ibarraran, and there are some differences in the ITS-1 sequence. More detailed analysis of the *CO1* barcode sequence places it in the *C. novaezelandiae* complex (see under *C. novaezelandiae*) but differing at a number of base positions. The existence of polymorphic sites in *C. novaezelandiae* may result in some specimens being incorrectly assigned to the *C.*spNZ12 Bin.

13. *Chironomus* sp. nr. *antipodensis*

Chironomus antipodensis was described by Sublette and Wirth (1980) from the Antipodes Islands. There has been no record of it from New Zealand itself, but a single, incomplete, adult male was collected near Dunedin, which is much darker than other known New Zealand *Chironomus* specimens, and has a mt*CO1* DNA sequence that differs from other available *COI* sequences. While it lacks a number of key identification characters, it seems to have relationship to *C. antipodensis.*

Adult:

Male:

A dark species, with dark setae that make those on the abdomen and the femurs much more obvious, i.e. it looks a quite "hairy" species.

AR, LR unknown.

Wing length 5.12 mm, width 1.09 mm; VR-0.96. About 4 SCf on brachiolum, about 23 setae in squamal fringe.

Head: Antennae missing, FT about 25 µm long and 13 µm wide, i.e. about twice as long as wide. Palpal proportions (µm) 73 : 65 : 276 : 311 ; (missing). 27 clypeal setae.

Thoracic setae: Acrostichal 11; Dorsolateral - 20-22 in up to 3 rows; prealar - 6; supraalar - 1; scutellar in three rows - 7, 7, and 12.

Leg proportions (micron):

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T
PI	1680	1620	-	-	-	-	-	-	1.04
PII	1800	1690	1000	640	440	280	200	0.59	1.07
PIII	2080	2120	-	-	-	-	-	-	0.98

abt 15 sensilla chaetica on mid Ta1

Abdomen with dark band covering anterior two thirds of tergites; setae very obvious because of their dark colour. About 3 setae centrally on tergite IX, SVo closest to E(i) type of Strenzke (1959). Setae of IVo appear simple, although not all are clear. GC reduces for about the distal third.

Pupa: Not known.

Fourth instar larva: Larvae collected at the same time as this adult were *C. forsythi*, so the larva of this species is not known.

DNA sequence: Obtained although fixed in 85% ethanol until 2011

mt*COI* – does not cluster with current sequences in GenBank or BOLD but may show descent from a common ancestor of Australian species.

Localities:

South Island:

City reservoir, Dunedin, Otago (45.80ºS, 170.87ºE) (NZ.6.2) (J.S. Pillai) 12-iii-1968.

The details of *C. antipodensis* Sublette & Wirth, 1980 are included in case the species does occur on the South Island:

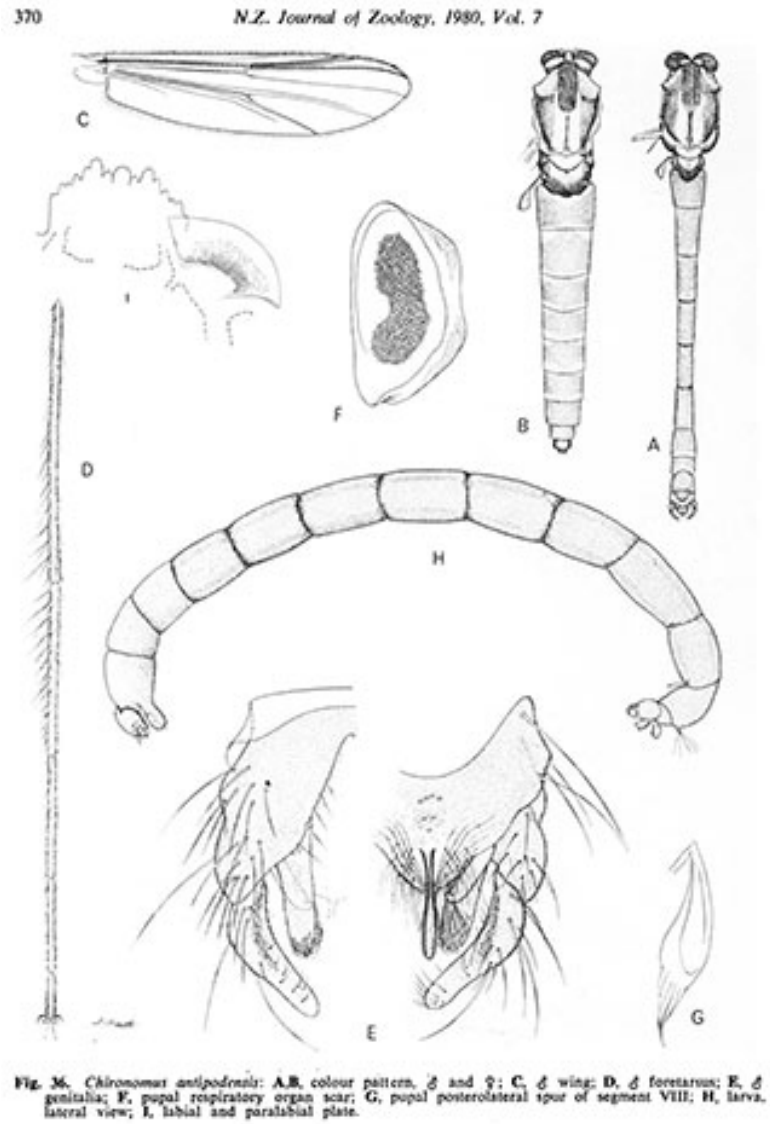


Fig. 36. *Chironomus antipodensis*: A,B, colour pattern, ♂ and ♀; C, ♂ wing; D, ♂ foretarsus; E, ♂ genitalia; F, pupal respiratory organ scar; G, pupal posterolateral spur of segment VIII; H, larva, lateral view; I, labial and paralabial plate.

Morphology of various parts of *C. antipodensis* from Subette & Wirth (1980)

Adult:

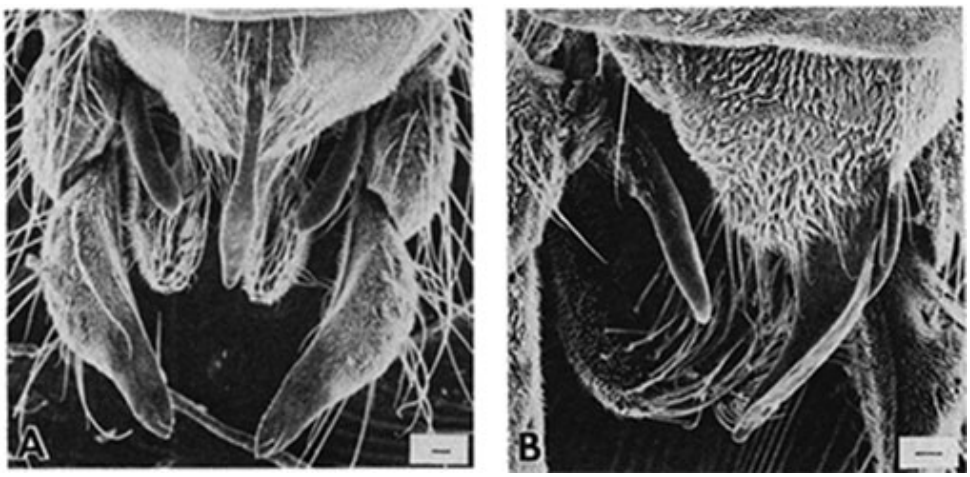
Male: Almost entirely blackish brown; haltere, scutellum and narrow posterolateral spot on terga VII and VIII slightly paler. Foretarsus with distinct beard, BR 4.16-6.36. AR 3.86-4.30; LR1 1.26-1.39; LR2 0.55-0.58; LR3 0.61-0.64.

Wing length 3.86-5.15 mm, VR 0.96 (S&W use Freeman calculation as 1.04)(see Fig. 36c); cross vein dark brown; 20 setae on squamal fringe.
Head: FT 25-31 µm; clypeal width 0.86-0.98 of diameter of antennal pedicel, with 32-62 setae. Palpal proportions (segs 2-5, micron): 76 : 260 : 296 : 316 (holotype).
Thoracic setae: Acrostichal – not recorded; Dorsolateral 16-27 in partial double row; Prealar 5-10; Supra-alar 1; Scutellar in partially double staggered row 26-30.
Leg proportions (Holotype)

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta5/Ti
PI	95	92	122	75	54	40	20	1.26-1.39	1.03	0.22
PII	105	105	59	38	28	19	13	0.55-0.58	1.00	
PIII	127	140	86	60	45	26	15	0.61-0.64	0.91	

BR 4.16-6.36

Abdomen heavily setose, each seta in a paler alveolus. About 7 setae on tergite IX, either in individual pale patches or with a few setae in some patches.



SEMs of hypopygium from Fig. 37 of Sublette & Wirth (1980)

Anal point narrow at base, SVo almost tubular – not like any of the Strenzke types, closest to a D-type. IVo about to tip of anal point and mid-point of the GC which is quite swollen, reducing over posterior third with about 5 setae at the end.

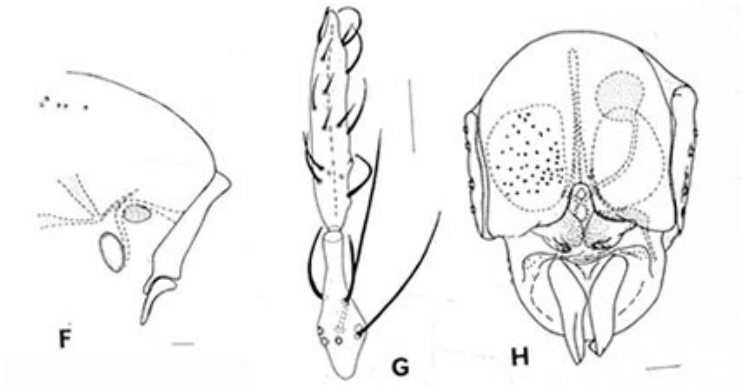


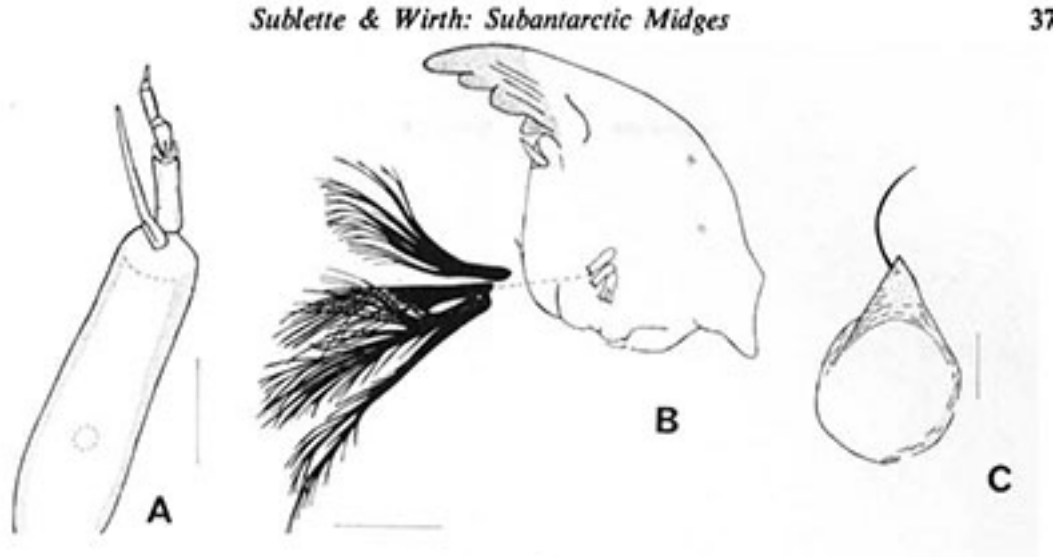
Fig. 35. F–H, *Chironomus antipodensis*:
F ♂ antenpronotum, lateral view (0.1 mm); G, ♀ antenna (0.05 mm); H, ♀ genitalia.

Male pronotum, female A5 and genitalia (Sublette & Wirth 1980

Female: (Allotype):
Coloration similar to male, but femora and tibiae paler and terga II-VII with a narrow apical pale fascia.
Wing length 5.82 mm; VR 0.89 (S&W – 1.12); 33 setae in squamal fringe.
Antennal proportions (micron) 204 : 143 : 153 : 153 : 214; AR 0.35; A5/A1 1.05.
Palpal proportion (segs 2-5)(micron): 71: 229: 296 : 347.
Thoracic setae: Acrostichal not noted; Dorsolateral 30 in partially double row; Prealar 7; Supra-alar 1: Scutellum with a staggered double row of 30 setae.
Legs similar to those of male: LR1 1.26; LR2 0.49; LR3 0.60.
Abdominal segment X sickle-shaped; cercus slightly elongated, with ventral margin longer, with a rounded posterior margin.

Pupa: Exuvial length 11.7-12.0 mm. Cephalothorax blackish brown; abdomen paler brown. Cephalic tubercles as Fig. C (below); respiratory base (Fig. F, above) moderately constricted in middle, HR about 2. Shagreen of TII coarse and covering middle third of segment; that of TIII-VI covering central half, VII with a small anterolateral patch of fine shagreen on either side of midline; TVIII largely covered by fine shagreen. Respiratory base partly constricted in middle (Fig. 36F, above).
Spur of segment VIII with about 7 appressed spines; about 80-107 taeniae on swim fin.

Fourth instar larva: a halophilus-type, i.e. some development of posterior VT. Head capsule yellowish brown, VHL 0.42-0.43 mm. Mentum (Fig. 36E, above) appears to be type II-III, with central trifid tooth of type IIA.



Antenna (Fig. A above) with A1 about 4 times longer than wide; RO about 0.34 up from base, AR about 2. PE with about 11 sharp teeth (type 2). Mandible (Fig. B, above) possibly type IIB-C.

Cytology: not known.

Sublette and Wirth (1980) suggest the species resembles *C. zealandicus,* although at that time the true identity and *C. novaezelandiae* was confused. However, they may well have been correct in suggesting that it derived from the *C. zealandicus*-group

14. *Chironomus* n.sp. NZ14

Known only from two larvae and the mt*COI* sequence.
Tentatively in Bold Bin: BOLD ADF7908 (private data)

Adult and Pupa: not known.

Fourth instar larva: (for only one larva) A salinarius type larva; larval head measures suggest it should be at least 15 mm long. Anal tubules 311 x 150 µm (dorsal) and 296 x 140 (ventral), so 2.1 times longer than wide.
Whole of gula very dark, as is the FC. VHL 366 µm, mentum width 0.73 of VHL and VMs separated by 0.44 of width of mentum. 4th laterals of mentum reduced almost to level of 5th laterals (type II), central trifid tooth rather square, with c2 teeth well separated (type IIA).
VM with 44-45 striae, reaching almost to edge particularly at outer ends; VMR 0.29.
PE with 14 regular teeth (type B). Premandible with inner tooth very slightly longer than the inner tooth and 1.8-2.3 times wider.
Distance between S4 setae slightly greater than that between the antennal bases (so likely to be about the same).
Antenna with A1 about 3.5 times longer than wide and almost half the VHL; A2/A1 0.21; AR 2.70; RO about a third up from base of segment; antennal proportions (micron): 176 : 37 : 9 : 11 : 7.
Mandible with 3rd inner tooth well developed and darkened (type IIIA); about 24-26 grooves on the outer surface at the base; 10-12 bristles in the PMan.

Localities:
North Island:

Lake Rotoaira, nr Turangi, South Auckland (39.056°S, 175.705°E) (NZ.70.2 and NZ.70.3) (S.Ibarrarán) Feb.-2007 & 29-viii-2007

mt*COI* – - sequence of the other larva is in BOLD.

15. *Chironomus* 'pseudoppositus'

Adults of this Australian species have been collected in the Waikato area, and identified on the basis of the *COI* barcode sequence. It is not certain how close the morphology is to that of Australian material but it is reasonable to assume it will be similar as this is most likely a recent introduction since it was not identified in extensive sampling in the area in the 1960s-1970s.

The species is in BOLD Bin: BOLD:AAW3993

Male:

A few characters can be recorded for a male;
Wing length about 3.8 mm., width about 0.8 mm, VR about 0.9.
Thorax, scutellum, etc., dark brown. Legs yellowish, darkened at knees.
Leg proportions (micron):

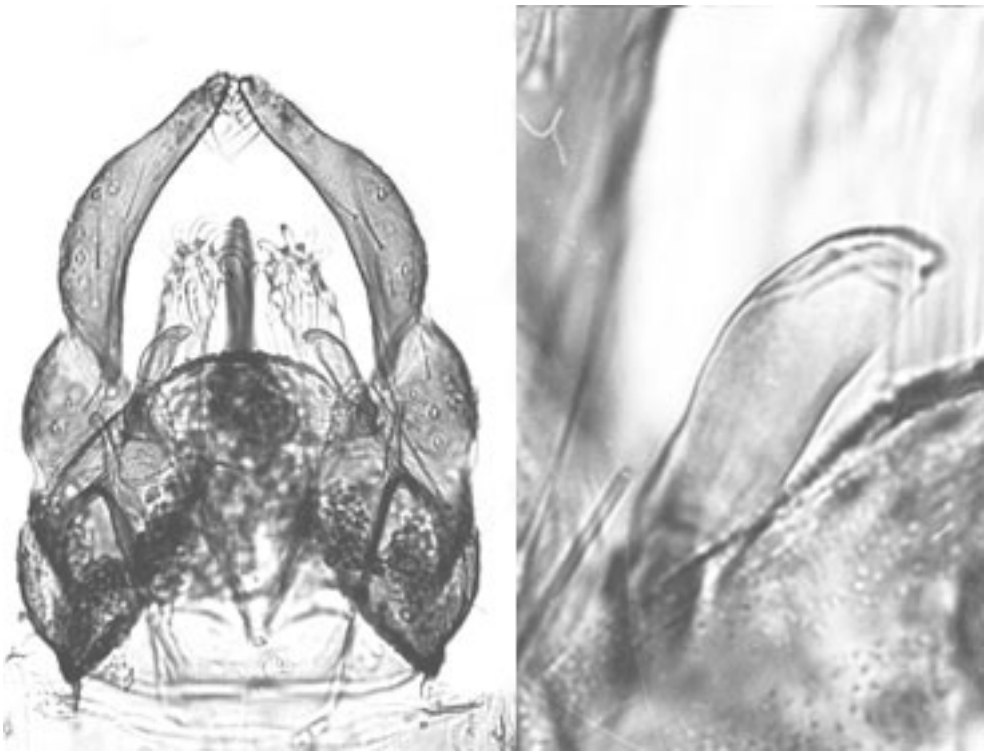
	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T
PI	1530	-	-	-	-	-	-	-	-
PII	1530	-	-	-	-	-	-	-	-
PIII	1730	1730	-	-	-	-	-	-	1.0

Abdominal tergites with dark bands covering about half the segment, arising about 1/4 from anterior margin. This would be slightly lighter than the Australian specimens.

Further data from Australian specimens:

FT variable, length about 21.9 (10-29) µm, abt 2.2 times longer than width at base.
About 23 (19-25) clypeal setae; clypeal width about 0.6 of antennal pedicel diameter.
Mean palpal proportions (micron): 52 : 66 : 199 : 224 : 354; P5/P4 1.5-1.71, P5/P3 1.71-1.95.
Thoracic setae: Acrostichal - abt. 10-17, Dorsocentral 15.9 (11-20), Prealar – 5.1 (4-8), Supraalar - 1.5 (1-2); Scutellar - 2 approximate rows, Ant. - 5.8 (2-8) small, Post. – 12.7 (10-14) larger; total scutellar 17.3 (14-22).
Wing length 3.12 (2.95-3.38) mm, width at crossvein 0.74 (0.68-0.80) mm, VR. 0.94-0.97; Scf on brachiolum 2-3; setae on squamal fringe 24-27; anterior veins hardly darker than posterior, crossvein slightly darkened.
Mean leg lengths (microns) and proportions as follows:

Males	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1258	1047	1805	922	746	648	289	1.5-1.8	1.14-1.37	1.6-2.1
PII	1332	1166	743	405	297	192	143	0.58-0.63	1.04-1.14	-
PIII	1484	1436	1069	595	463	284	172	0.69-0.75	0.96-1.08	-



Male terminalia (left) and SVo (right) of type male

11.4 (7-16) setae on TIX probably in separate pale areas, 4-5+1 setae at tip of gonstylus which is as in holotype (above). SVo generally of the D-type, but occasionally E-type, varying from Strenzke's Fig. d to h.
IVo reaching almost to end of anal point, recurved setae simple. Anal point narrower at base. Gonostylus moderately swollen, narrowing over distal third.

Females:
Wing length 3.60 (2.8-4.2) mm; width at cross vein 1.03 (0.96-1.20) mm, VR 0.89-0.92; 3 or 4 SCf on brachioloum.
Head with FT of variable length: 29.3 (19-48) µm; about 35.5 (27-55) clypeal setae.
Mean antennal proportions (micron): 198 : 128 : 136 : 132 : 171; AR - 0.31 (0.29-0.32); A5/A1 - 0.96 (0.90-1.00). Mean palpal proportions: 59 : 61 : 208 : 245 : 377; P5/P4 1.83-2.13; P5/P3 1.57-1.83.
Thoracic coloration similar to males. Thoracic setae: Acrostichal abt. 15.8 (11-22; Humeral not counted; Dorsolateral (incl. Humeral) 27.2 (23-35); Prealar 6.2 (5-7); Supraalar 1, Scutellum, anterior row 11 (9-14), posterior row 13 (11-20), total Scutellars 25 (20-34).

Mean leg lengths (microns) and proportions as follows:

Female	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1568	1175	2310	1140	925	860	373	1.68-1.82	1.23-1.32	0.61-0.73
PII	1546	1392	821	416	305	198	149	0.56-0.61	1.09-1.11	-
PIII	1668	1669	1199	651	511	301	190	0.67-0.72	0.98-0.99	-

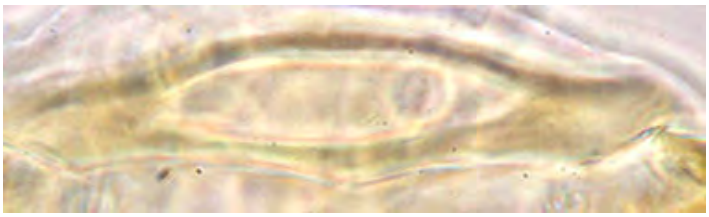
BR - 1.6-1.7

Abdomen relatively dark.

Pupa: Length about 8.4 mm. 54 hooks in row on segment II, 2.8 (1-5) spines on caudolateral spur of segment VIII; 86 taeniae on each side of the swim fin.

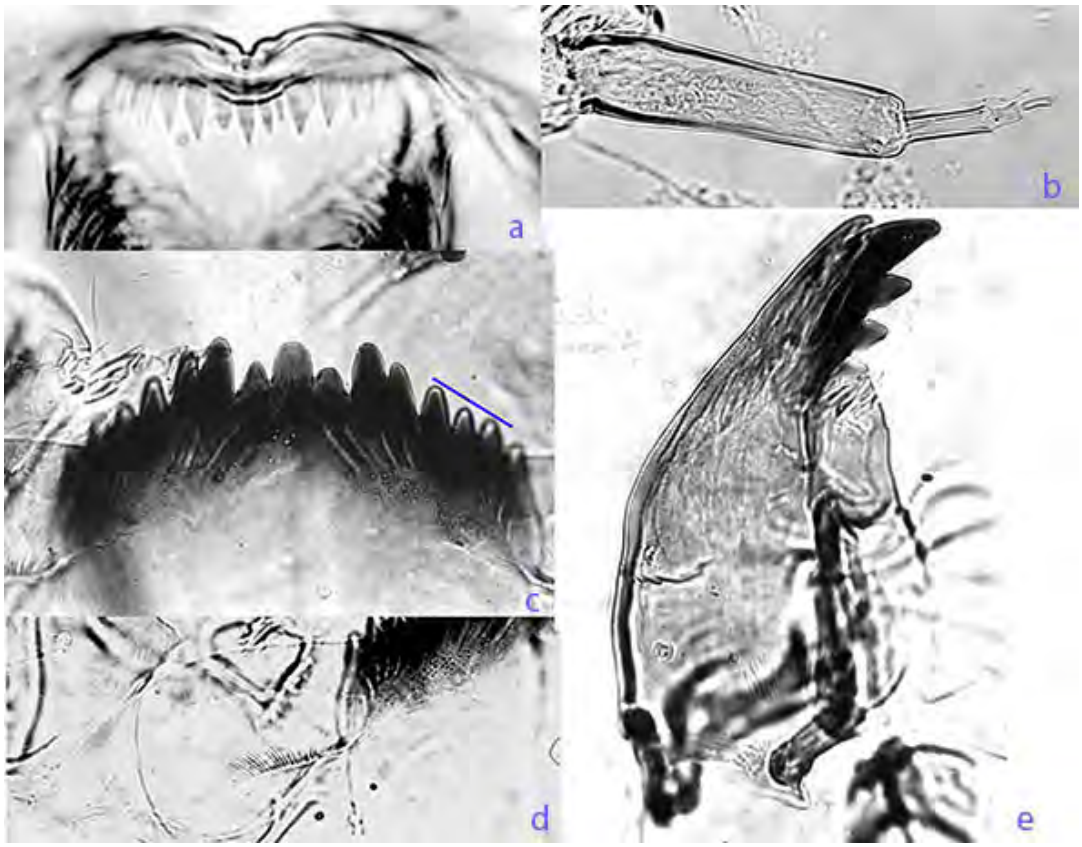
Caudolateral spur on 8th abdominal segment of pupa

Fourth instar larva generally a medium sized bathophilus-type; length about 13.4 (10.2-15.3) mm (female), 11.45 (9.7-13.3) (male), VT well developed, posterior pair usually slightly longer, length of anterior 1.06 (0.42-1.67) mm; of posterior about 1.07 (0.46-2.92) mm. Anal tubules with ventral pair usually longer, about 382 (365-400) µm, than the dorsal pair, about 351 (250-420); and 2.6-4.2 times longer than wide.
Gula varying from pale to posterior third dark, FC often slightly or moderately darkened. Salivary reservoir (below) 63-68 µm wide and 4.2 times wider than deep.



Mentum (c, below) with 4th laterals slightly reduced, sometimes to level of fifth laterals (i.e. between type I-II), and c2 teeth well separated, sometimes the c1 tooth is quite long (i.e. type III, but can appear as IIA when worn).
Ventromentum (d, below) about 3.6 times longer than deep; 1.08-1.11 times the mentum width; with about 30-40 striae; VMR 0.23-0.33. PE (a, below) with about 11-18 sharp teeth (i.e. type A of Proulx *et al.* 2013), occasionally with some reduced teeth.

Premandible with the normal two teeth, about equal in length, and coming to a relatively fine point, inner tooth two to three times the width of the outer.
Basal segment of antenna (b, below) relatively long and narrow, about 3.3-4.5 times as long as wide, RO about a third to a half way up from base; AR about 2.13 (1.89-2.31); A2/A1 about 0.22-0.27; A4/A3 about 0.9-1.3; segment proportions (micron) 124 : 31 : 9 : 12 : 7.
Distance between the antennal bases, 148.25 (114-166) usually greater than distance between S4 setae, 141.6 (119-154), but may be equal or even less in about 1/3 of specimens.
Mandible (e, below) generally of type IA or B, but may be IIB, with about 14.8 (11-18) furrows on outer surface at base; about 11-17 taeniae in PMa; Mdt-Mat 20-23; MTR about 0.28-0.36.



Localities:
North Island:

Waikato area (37.802°S, 175.334°E) (I. Hogg) 13.viii.2012.

For the description of the species in Australia, go to
http://www.chironomidae.net/Martin/AustChironfiles/psoppadt.htm

Chironomus bicoloris Tokunaga, 1964

Chironomus (Chironomus) bicoloris Tokunaga, n. sp. (fig. 10, *f*).

Large yellow species, allied to *plumatisetigerus*, but distinguished from it by smaller frontal tubercles (at most as long as two facets) and dark brown subtriangular or oval markings of scutal vittae. AR about 3.1; LR 1.6-1.7; frontal tubercles small, only as long as 1.5 times of diameter of facet in male and two facets in female; scutal vittae of thorax yellow and with four dark-brown spots, two of these spots elongate subtriangular on posterior half of median vittae and other two on anterior parts of lateral vittae; legs with knee parts dark brown, but knee joints very narrowly pale and usually posterior two pairs with knee parts faintly brownish, rarely tibial base without brown marking; tibial apical ends usually brownish, but in fore leg very faint and sometimes quite pale.

Male: Body 6.18-6.24 mm. long; wings 2.96-3.15 mm. by 0.8-0.82 mm. Head yellowish brown or yellowish pale brown, with mouthparts more brownish, frontal tubercles small, at most as long as 1.5 times diameter of facet, eyes separated above by one-seventh to one-eighth length of eye; palpal segments about 22.5: 17.5: 70.5: 84.5: 112.5; antenna with scape yellowish brown, flagellum and plumose hairs brown, AR 3.1 (3.08-3.11). Thorax mainly yellow, scutum pale yellow, with four yellow vittae and four subtriangular dark brown spots on vittae, scutellum pale yellow, with 15 to 17 bristles along caudal margin and 19 to 27 small setae scattered on anterior part, postscutellum dark brown on anterior half and yellow on caudal half. Legs mainly yellow or pale brownish yellow, but all knee parts dark brown and joints very narrowly pale, all tarsal segments apically brown, last one or two segments somewhat more brownish, fore tibia sometimes pale brown at tip, other tibiae usually more brownish at distal ends and sometimes basal brownish bands absent; LR about 1.69, RL-FT about 115: 99.5. Wing with veins very pale, but fR and r-m dark and covered by small dark spot, fMCu under end of r-m, RL-V 94.3: 70: 110: 94.3. Halter white or yellowish white. Abdomen pale brown, gradually fuscus brown caudad, tergites with somewhat T-shaped basal bands; hypopygium (fig. 10, *f*) brown, anal point slender, style slender, apical half suddenly tapered, dorsal appendage with basal pubescent part oval and setigerous, bare caudal projection not distinctly swollen or curved at tip, ventral appendage almost straight, slightly clavate, with 13 to 15 long curved apical bristles, some of these bristles finely plumose apically.

Female: Body about 6.76 mm. long; wings about 3.33 mm. by 0.98 mm. Generally similar to male, but lateral scutal vitta more brownish. Head with eyes separated above by one-sixth to one-seventh length of eye, frontal tubercles small and about as long as two facets; palpal segments about 25: 25: 85: 99: 143; antenna almost entirely pale brownish yellow, neck parts of intermediate flagellar segments as long as half of segments, six-segmented (25: 64: 45: 50: 41: 69). Scutellum with about 20 bristles along caudal margin and about 25 small setae scattered on anterior part. Leg with RL-FT about 130: 111. Wing with fMCu under origin of r-m, RL-V about 96: 87: 135: 102. Abdomen almost uniformly very pale brown or pale brownish yellow, anterior tergites 2 to 6 with very faint broad fuscus clouds, ultimate segment and cerci brown.

Tokunaga's (1964) description of C. bicoloris.

Type data: holotype USNM US66552 adult male, paratype(s) USNM 2 adult males.

Type locality: Dugor, Weloy, Yap Island.

Australian specimens

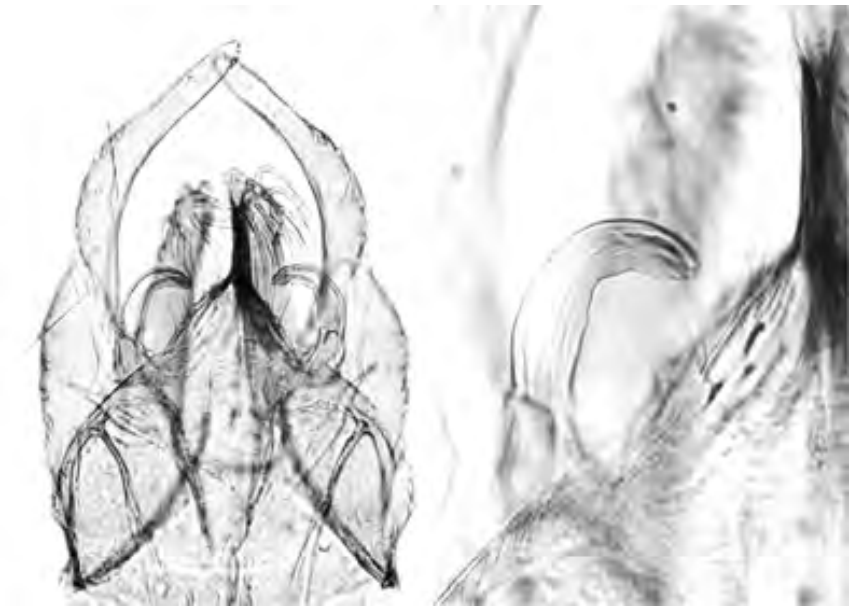
Adult:

Male:

Wing length: 3.34-3.76 mm; wing width 0.82-0.86 mm; VR about 1.0. Brown spot over crossvein; usually 4, or 3, Scf on brachiolum; 22-23 setae on squamal fringe.
AR about 3.10-3.16.
FT longer than in Micronesian specimens - about 50-60 micron and 2.5-2.8 times longer than wide - longer than the width of two eye facets. Clypeus width about 157-170 µm, about 0.75 of diameter of antennal pedicel; with about 27-33 setae.
Palp proportions (micron): 66 : 64 : 253 : 249 : 436; P5/P4 1.75.
Thorax green, vittae, postnotum and sternopleuron reddish brown, vittae with 2-3 darker markings; setae - about 19 acrostichal; 26-30 dorsocentral; 1 supraalar; 6-7 prealars; 28-37 scutellar – 12-17 in 1 or 2 anterior rows and 16-20 in posterior row.
Legs with femur and tibia greenish, tarsi yellowish with at least slight darkening of knees and at tips of tarsi.
Lengths (microns) and proportions as follows:

	Fe	**Ti**	**Ta1**	**Ta2**	**Ta3**	**Ta4**	**Ta5**	**LR**	**F/T**	**BR**
PI	1460	1405	2275-	-	-	-	-	1.62	1.04	-
PII	1540	1485	940	530	390	215	150	0.63-0.67	1.06	-
PIII	1675	1825	1355	750	600	350	155	0.73-0.75	0.93-0.94	-

Abdomen greenish proximally, anterior segments with proximal dark band which becomes larger in the more posterior segments until whole segment is darkened.



C. bicoloris: Male hypopygium (left) and superior volsella (right)

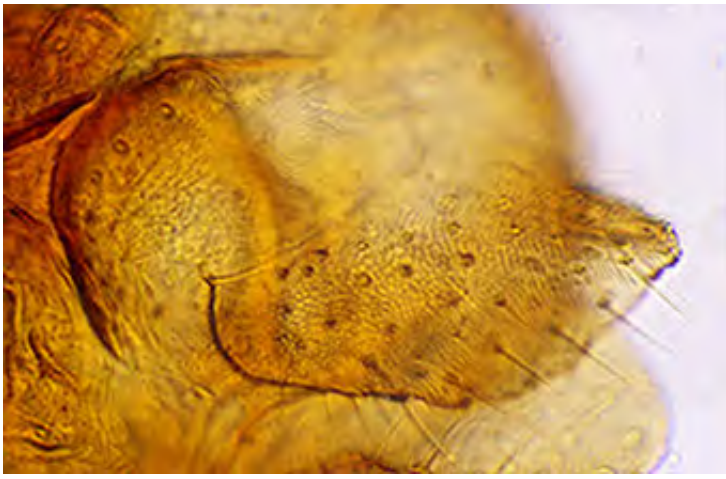
Tergite IX with 14.3 (13-16) setae in a large single pale patch. IVo reaching to about the end of the anal point; setae forked. SVo of the E-type (see above) (most like h of Strenzke 1959) but with what appears to be slight folds at the tip; gonostylus usually slender and tapers gently over posterior half, with 4 long and 1 shorter setae at the distal end.

Female: (based on single specimen from near Sarina Beach, Queensland (AQ.66.1)
Colour yellowish, with brown vittae; legs as in males.
Wing length 3.42 mm., width 0.89 mm.; VR 0.91. 3-4 Scf on brachioum; 17-18 setae on squamal fringe.
Relative length of antennal segments (micron) (percentage of neck in brackets): 164 (25) : 109 (38) : 124 (44) : 118 (45) : 182; AR 0.35, A5/A1 1.11. FT about 22 µm long and 2.5 times longer than wide. Clypeus about 1.7 times the diameter of the antennal pedicel, with 35 setae. Palpal proportions (micron) 63 : 48 : 188 : 250 : 385 (P5/P4 1.54; P5/P3 2.05).
Thoracic setae: Acrostichal abt 14; Humeral 5-6 linear; Dorsocentral 22 (humeral + dorrsocentral 27-28); Prealar 3; Supraalar 1; Scutellar with 2 rows – 7 in anterior row and 10 in posterior row.
Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	Ta4/Ti
PI	1315	935	1770	860	760	705	340	1.89	1.41	0.73
PII	1265	1140	660	350	250	190	135	0.58	1.11	-
PIII	1355	1380	950	510	410	270	160	0.69	0.98	-

BR 1.52

Segment X crescent shaped, about 3.9 times longer than its greatest width and with 9 setae.

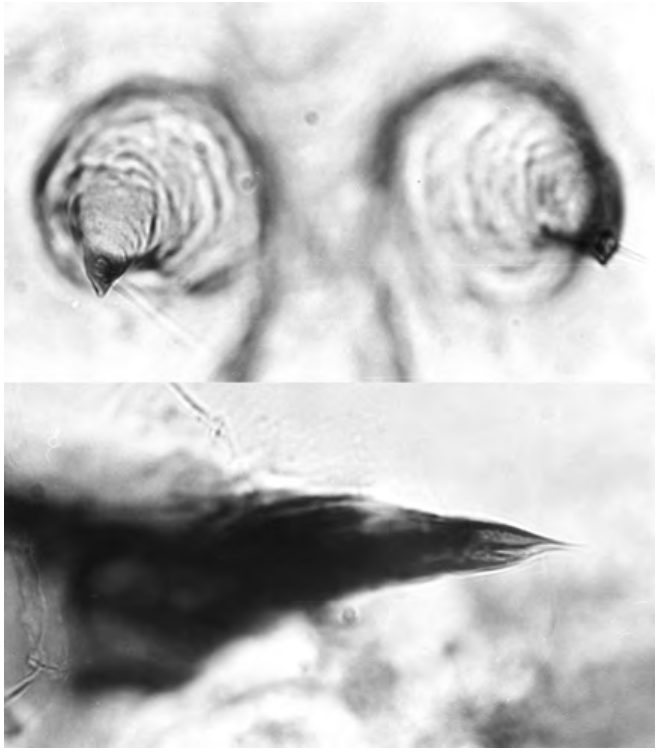


Cercus and segment X (at left) of *C. bicoloris*

Cercus shorter on the dorsal margin, posterior margin slighly curved towards ventral end and merging into the longer ventral margin with a basal bulge.

Pupa: Not previously described. One male and one female exuviae are available. Colour yellow brown, with darker yellow brown cephalothorax and muscle scars. Shagreen sparse in centre of TI, on posterior 2/3 of TII, posterior 3/4 on TIII and TIV, 5/6 on TV, more midline constrained on TVI, mainly on centre line of TVII but with gap along midline, and sparse on anterior with gap in midline of TVIII.

Length about 6.75 mm (male) and 7.07 mm (female), inner margin of wing case 1.42 (f)-1.59 (m) mm. FT small, 53 x 46 µm (male) (below); 45x50 µm (female), with subterminal seta at least 43-53 µm, no indication of frontal warts. Female antennal sheath about 660 µm.
Basal scar about 122 x 68 µm, slightly narrowed in middle, and respiratory base filling almost whole space; HR about 1.71-1.96. Irregular patch lateral/ventral of scar, about 150x75 µm in size.
L-seta at anterior margin of intersegment of III/IV not seen, on IV/V about 56 µm long.
Hook row of segment II occupying about 76-79% of segment width, 92-94 simple recurved hooks.
PSB relatively large on segment II, small on segment III; large PSA on segment IV (abt 151-177 x 101-110 µm) about 26-32% of the segment length. PSB on segment V still relatively large; that on segment VI small with just spines.

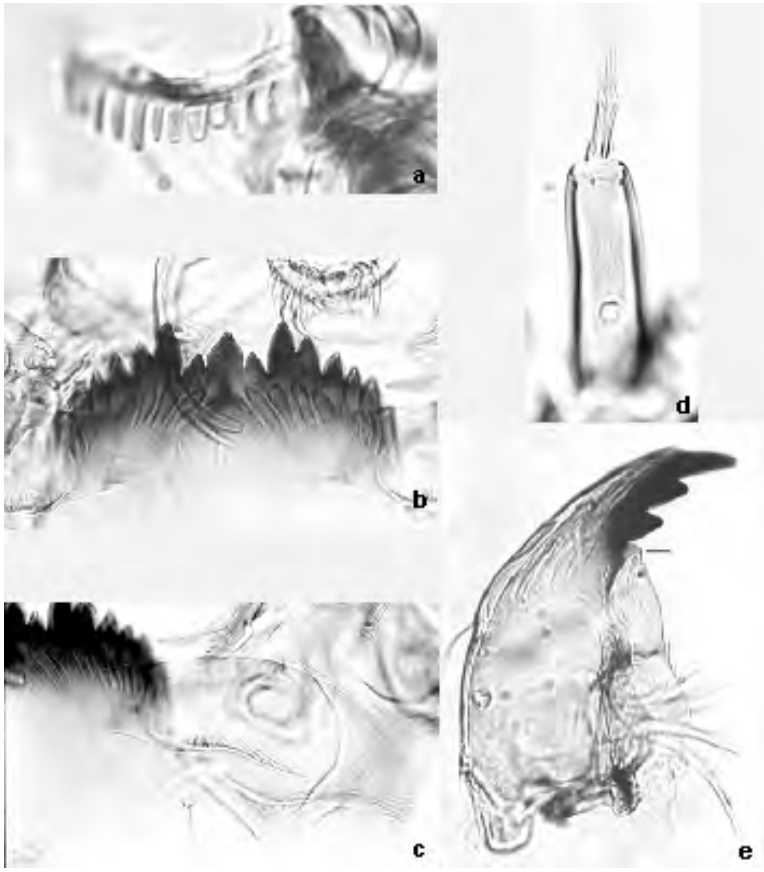


Frontal tubercles and spur of segment VIII of male pupa

Caudolateral spurs of segment VIII have 1-2 spines. About 72 (male) – 83 (female) taeniae, initially uniserial, then partly biserial, with some places triserial, on each side of swim fin.

Fourth instar larva: a medium sized plumosus-type larva (length (female) about 15.2 mm). Anterior VT (1.06 mm) shorter than posterior pair (1.40 mm); TLt about 320 µm. Gula pale or sl. dark over post 1/2; FC pale or very slightly darkened. Clypeal aperture about 99x15 µm, i.e. 6 times longer than wide.
Mentum (b, below) with sculpturing along ventral surface and relatively sharp broad teeth; c2 teeth of central trifid tooth well separated from c1 tooth (type IB-IIA), 4th laterals slightly reduced (type I-II).
PE (a, below) with about 16-18 teeth (type B). Ventromentum (c, below) about 4.3 times longer than deep; with about 36-39 striae; distance between VM plates about 0.28-0.38 of mentum width; VMR about 0.32-0.33.

Distance between the antennal bases probably greater than that between the S4 setae, which are separated by about 70% of FC width at that point.
Antenna (d, below) with basal segment about 3.5 times as long as wide, RO just over a third up from the base; AR about 2.43-2.54; A2/A1 about 0.19-0.20; antennal proportions: 127 : 24 : 7 : 13 : 6.
Mandible (d, below) with third inner tooth only slightly separated and darkened (Type IA-B), and with about 13-20 furrows on outer surface at the base and about 7-10 taeniae in PMa, which appears to run down and away from the inner teeth (just visible in d, below).



Larval mouthparts of *C. bicoloris*
a. Pecten epipharyngis; b. Mentum; c. Ventromental plate; d. Antenna; e. Mandible.

Cytology: 4 polytene chromosomes with the pseudothummi arm combination AE, BF, CD, G. Centromeres heterochromatic.
Arm G closely paired with a small subterminal nucleolus. Main nucleolus near middle of arm C. Polymorphism at least in arm A.

bicA1: 1 - 2c, 10 - 12, 3i - 2d, 9 - 4, 13 - 19 as *holomelas*?

bifA2: approx 1 - 2c, 10 - 12, 3ih, 6 - 9, 2d - 3g, 5 - 4, 13 - 19

bicB1: typical bands (groups 23-28) near centromere, puff (group 7) near middle of the arm

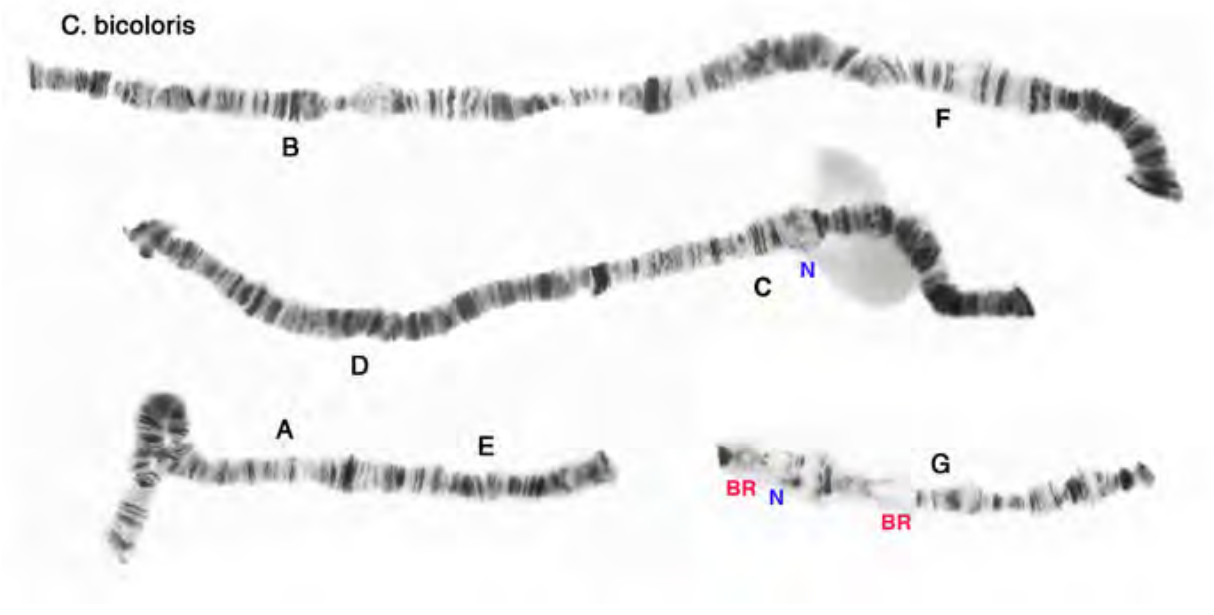
bicC1: NOR near middle of the arm with groups 3-4 immediately distal to it

bicD1:

bicE1: possibly 1 - 3a, 5 - 10b, 4h - 3f, 10c – 13 i.e. as in *aprilinus, atrella, athalassicus*

bicF1: Groups 9-7, 14-15 about 1/3 from end of arm.

bicG1: Small subterminal nucleolus, with a BR between the NOR and the centromere, and another just proximal of the middle of the arm.



Polytene chromosome complement of *C. bicoloris*
Note arm A is heterozygous A1.2

The arrangement of the PMa on the larval mandible appears to be unique among *Chironomus* species. The other distinguishing features are the male SVo and the darker markings on the thoracic vittae.

Found: Micronesia - Caroline Islands: Yap Island (Type locality).
Queensland - Lake Boemingen and Lake Wabby (25.27ºS; 153.80ºE), Fraser Island (H. Burton, light trap); 3 km w. Sarina Beach (21.40ºS; 149.25ºE).

Chironomus circumdatus

***Chironomus circumdatus* (Kieffer 1916)**

Syn.: *C. basitibialis* Tokunaga 1936 (Yamamoto 2013)
C. bharati Singh & Kulshretha 1976 (doubtful synonymy – see description above)
C. costatus sensu Karunakaran 1969 (mtCOI - Wong, unpubl.; cytology - Martin unpubl.)
C. daitoefeus Sasa & Suzuki 2001 (probable synonym – Yamamoto, unpubl.)
C. plumatisetigerus Tokunaga, 1945 (Martin & Saxena 2009)

C. setonis Tokunaga 1936 (Yamamoto 2013)

A member of the broader "*C. flaviplumus* complex"

In BOLD Bin: BOLD:AAG5483

Adult:

Male

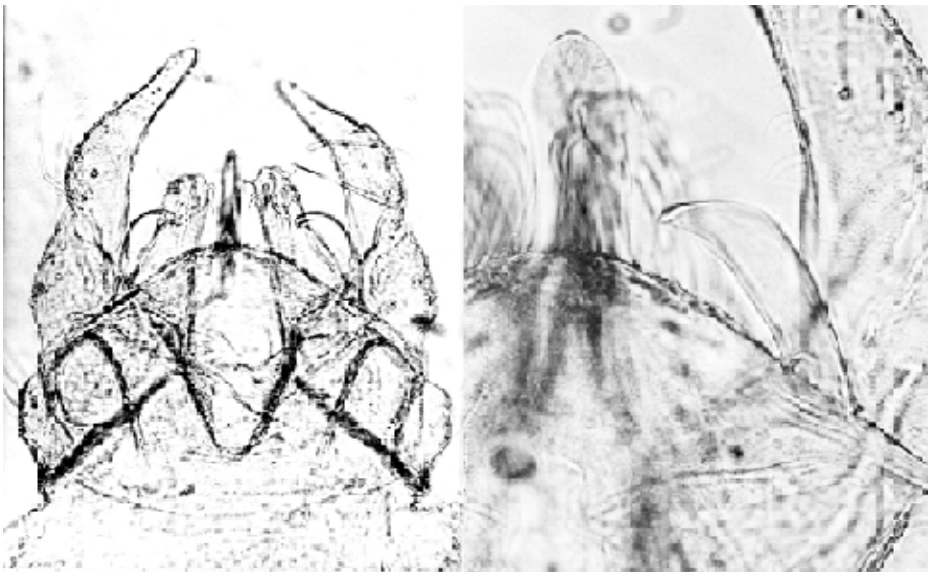
AR about 3.12-3.8. The high value comes from Japanese material (Sasa 1978), Indian specimens are less than 3.5.
FT about 25-43 µm long, 10-17 µm wide. Palpal proportions (µm) 56 : 54 : 213 : 218 : 334; P5/P4 1.53, P5/P3 1.57. Clypeal setae - 17-34.
Thorax greenish, scutal stripes conspicuous with dark brown margins; scutellum pale yellow, postnotum dark brown. Thoracic setae: acrostichals - 13-18; dorsocentrals - 18-27; prealar - 5-6; scutellar - 8-14 in anterior row, 13-26 in posterior row (higher numbers have an intermediate row of 11-12 setae).
Wing length: 2.72-3.04 mm; wing width 0.67-0.74 mm. VR about 1.02-1.05
Wings without darkening of the crossvein. 25-27 setae in squamal fringe.
Legs pale, with darkening at distal ends, also on distal half of Ti4 and all of Ta5.

Leg lengths (microns) and proportions as follows:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1145	1060	1610	835	745	645	325	1.42-1.67	1.04-1.12	1.64-1.9
PII	1230	1110	705	395	295	165	135	0.62-0.66	1.05-1.13	
PIII	1350	1350	1000	560	475	250	170	0.72-0.81	0.97-1.02	

(i.e. ant Ta5/Ti about 0.31)

Abdominal segments pale, but with increasing central dark oval patch, so that tergites V-VIII are virtually all dark.



Male terminalia of *C. circumdatus*
Anal point relatively narrow, superior volsella D-type curved at the tip.

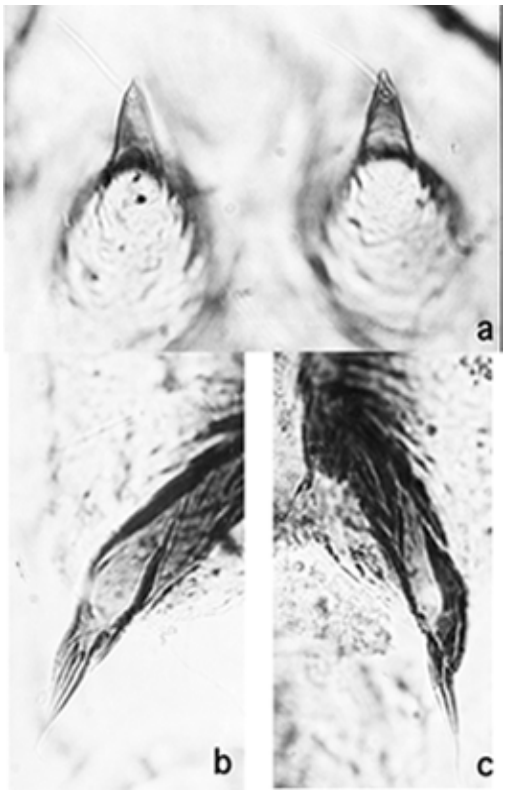
Anal point narrow; 1-16 setae on tergite IX. SVo of the D-type, between d and e of Strenzke (1959), but tip may be more bent. Sasa classes Japanese material as E-type, although one illustration looks more like a D-type. Basal setae on IVo ramose.

Female (based on Sasa 1978):
Wing length 2.8 mm.
Antennal proportions (µm): 80 : 190 : 120 : 120 : 130 : 280; AR 0.5; A5/A1 2.0.
Frontal tubercle short and stout, 24 µm long and 17 µm wide.
Palpal proportions (segs. 2-5) (µm): 60 : 240 : 250: 540.
Leg lengths (microns) and proportions as follows:

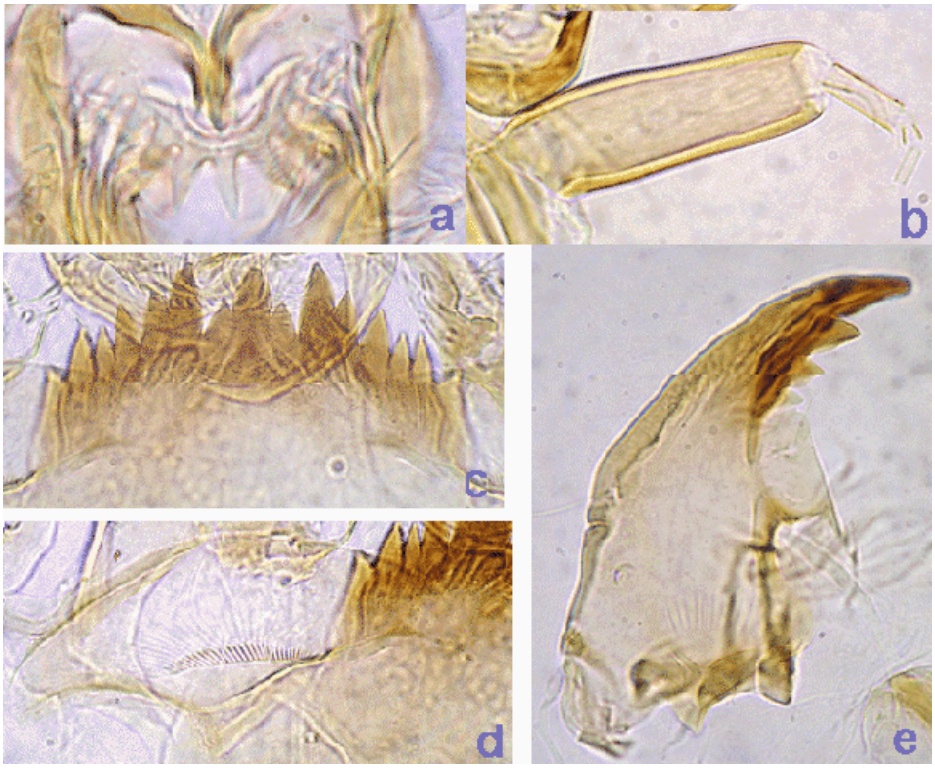
	Fe	**Ti**	**Ta1**	**Ta2**	**Ta3**	**Ta4**	**Ta5**	**LR**	**F/T**	**Ta4/Ti**
PI	1440	1150	2050	1000	930	880	410	1.79	1.25	0.58
PII	1630	1340	810	410	290	180	150	0.60	1.22	0.13
PIII	1490	1490	1150	560	460	270	180	0.77	1.00	0.18

Abdominal tergites brown, with narrow apical pale bands or spots on tergites I to VI.

Pupa: Brown. Exuviae pale brown. Body about 6.6-7.7 mm (male) and 6.5-7.6 mm (female). Frontal tubercles (a, right) about 70-100 µm, with a subapical seta (40-80 µm). Thorax rugose, with 2 pairs of precorneal setae. Abdominal tergite II with median shagreen and about 52-68 hooklets, tergites III-V entirely with shagreen, tergite VI with T-shaped shagreen, tergites VII-VIII with 2 broad patches of shagreen. Caudolateral spur of segment VIII (b & c, right) with about 2-4 spines.



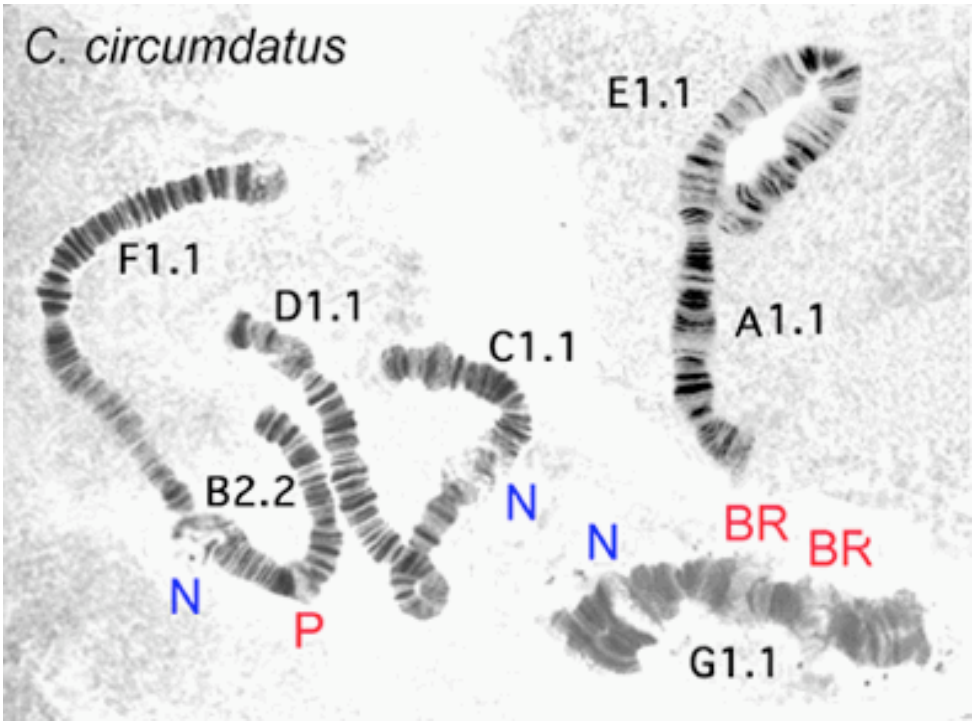
Fourth instar larva: a medium plumosus-type (length 10.6-13.7 mm; females 11.2-12.5 mm), lateral tubules well developed (about 480 µm). Posterior pair of VT generally longer than anterior pair (ant. 1.84; post. 2.48) and coiled. Anal tubules may vary in size in different areas, from about twice as long as wide (Allahabad) to almost three times as long as wide (Jammu), length 290-440 µm, width 165 µm.
Gular region darkened, FC variable from very slightly darkened to dark.
Mentum (c, below) with fourth laterals reduced to about the level of the 5th laterals (type II), 6th laterals pointed outwards; c2 teeth of the central tooth (type III) well separated.
VM (d, below) with about 30-36 striae. PE (a, below) with about 12-15 teeth.
Premandible with inner tooth shorter and about twice the width of the outer.
Antenna (b, below) with basal segment less than 3.5 times as long as wide; A2/A1 about 0.24; A4/A3 about 2.3-2.6. AR about 2-2.3.
Distance between antennal bases greater than that between the S4 setae.
Mandible (e, below) with third inner tooth slightly darkened and only partly separated (type IIB).



Cytology: Four polytene chromosomes with the pseudothummi-cytocomplex combination BF, CD, AE, G. Nucleoli in arm B and C, with a small one also present subterminal in arm G (which is not always present/active). Arm G closely paired with generally 3 obvious BRs from near the nucleolus to the opposite end, depending upon the sequence.
Polymorphism in arms A, B, C, D and G, although Pamual *et al*. report pericentric inversions involving the AE and BF chromosomes. Most polymorphism in arm B.

cirA1: 1 - 3, 12 - 4, 13 - 19 as *pseudothummi* (widespread)

cirA2: 1 - 2c, 10 - 12, 3 - 2d, 9 - 4, 13 - 19 as *holomelas, incertipenis* (widespread)
cirA3: approx. 1 - 2d, 11 - 12, 3 - 2e, 10 - 4, 13 - 19 (Thailand)
cirA-E (called A4): A1-3, 12-5, E11-13, A6-4, 13-19, E 10i-c, 3f, 3a-e, 10ba-4, 2-1 (India and Thailand)
cirB1: Puff just beyond middle of arm with dark bands distal (gps. 8 - 7) (widespread)
cirB2: Puff near nucleolus, with dark bands on proximal side (gps. 7 - 8) (widespread)
cirB3: abt same size as B2, but moved a few bands proximal, ending at nucleolus (India)
cirB4: small inversion distal to the distal break of B2 (Thailand)
cirB5: Similar to B2, but about 2-3 bands shorter at each end (Thailand)
cirB6: Inversion of distal third of arm (Thailand)
cirB7: Small subterminal inversion (Thailand)
cirB8: Small inversion of the region of the BRs (northern India)
cirB-F: involves the characteristic bands (groups 24-26) of arm B, to about F19 (Thailand)
cirC1: Median nucleolus (widespread)
cirC2: Inversion of about a third of the arm distal of the nucleolus (widespread)
cirD1: differs from oppD1 by at least one inversion (widespread)
cirD2: Inversion of approximately the middle third of the arm (widespread)
cirD3: noted by Kumar & Gupta, but seems to be in same region as cirD2 (India)
cirE1: 1 - 2, 4 - 10ab, 3e-a, 3f, 10c - 13 from *aprilinus* by Inv4-3a
cirF1: 1 - 2a, 10d - 2c, 15c - 11a, 2b, 15d - 23 as *oppositus* F3
cirG1: Nucleolus near one end, three BRs towards the other end (most distal not always visible) (widespread)
cirG2: Inversion of over two thirds of the arm, from proximal of the nucleolus to between the two larger BRs (widespread)
cirG3: Inversion of region around the BRs (India)



Found: Type locality – Tainan (abt 23.0ºN, 120.0ºE), Yentempo, (formerly Takao Prefecture), FORMOSA (TAIWAN).
New Guinea - Lake Wisdom (-5.33ºS, 147.10ºE), Long Island, Madang District.
Micronesia – Guam, S. Mariana Is., Palau, Yap, Caroline Islands (Tokunaga 1964, as *C. plumatisetigerus*)
Also found in Australia, India, Malaysia, Singapore, and Thailand.

The morphology was redescribed by Sasa (1978) and Chaudhuri *et al*. (1992). Chaudhuri *et al*. claim the larval VT are not coiled.
Chromosomes described by Kumar & Gupta (1990) and Pramual *et al*. (2008) as *C. circumdatus,* by Kuvangkadilok (1985) from Thailand, and for arms A, E and F (with some errors) by Saxena (1995) as *C. plumatisetigerus*.
There have been numerous studies of mitochondrial *COI* sequence (indicated below).
The species can be bred in the laboratory (Kuvangkadilok 1994).

DNA Sequence:
mt*CO1*: sequence is in GenBank for India (acc. no. KX271850), Pakistan (acc. no. KJ768129), Malaysia acc. no.), Thailand (acc. nos.GU944724, JQ287743-51, KT212956 - 977), Singapore (acc. no. KJ530964-69, KP462069-74, KP462468-69, KP462389-94,68-70, KP462650, 53-56, 59, 62-70, 84), Australia (acc. no. AF19225), China (acc. no. KP902724-29), Japan (acc. no. LC050935).

***Chironomus magnivalva* Kieffer, 1917**

Placed in the subgenus *Camptochironomus* by Cranston & Martin 1989, but this is an artificial grouping of species that mate on the substrate and have enlarged male terminalia. Returned to *Chironomus* by Bugledich *et al*. (1999).
Synonyms: *Chironomus crassiforceps* - incorrect synonymy by Guryev *et al*. (2001) and Peck *et al*. (2002).

In BOLD Bin: BOLD:AAJ4269
The nearest neighbour is BOLD:ACC5271 which contains *C. crassiforceps.*

Adult

A greenish brown species with an enlarged hypopygium, typical of species that mate on substrate.

CHIRONOMUS (CHIRONOMUS) MAGNIVALVA Kieffer

Chironomus magnivalva Kieffer, 1917, p. 219.

Antennae and legs rather short, thorax greenish, stripes brown, abdomen somewhat flattened, male hypopygium not unlike *tepperi* at first sight, but appendage 2 of a more normal, elongate form. This species seems allied to *tepperi* on account of the shape of the styles; it is readily recognized from Kieffer's figure and appears only to be known from Townsville.

Wing length.—2·4–2·5 mm.

Male.—*Head* and mouthparts greenish, antennae browner, A.R. about 2·5, antennae rather short. *Thorax* greenish, stripes either brown or partially brown, dorsocentral bristles not arising from very distinct pits, thorax slightly shining. *Legs* darkened at the knees, somewhat shorter than in most species but not as short as in *tepperi*; L.R. 1·7, posterior L.R. about 0·5, whole posterior tarsus less than one and a half times length of tibia. *Abdomen* rather flattened, brownish green. Hypopygium similar at first sight to *tepperi*, but examination shows resemblance confined to anal point, appendage 1, and styles; appendage 2 not swollen, but of normal elongate form, styles not rounded as they are in *tepperi*.

Female.—Resembles male in colour and general appearance.

Type.—Holotype ♂ from Townsville, Qld., was in the Hungarian National Museum.

Specimens seen.—Townsville, Qld., A. K. O'Gower, 22.i.1959–12.ii.1959, 31 ♂♂, 16 ♀♀.

From Freeman (1961

Male:

Antennal ratio (AR): Kieffer gave the AR as about 2, while Freeman pushed this up to about 2.5. However in one specimen that he measured, it is only about 1.5. AR here is measured from slide mounted secimens: 1.66 (1.46-1.80).Wing Length: 2.54 (2.32-2.83) mm; wing width 0.64 (0.48 - 0.68), VR 0.92 (0.85-1.06); 2.3 (2-3) Scf on brachiolum; 11.1 (10-13) setae on squamal fringe.

Head: FT about 23-36 µm in length, generally columnar, and about twice as long as wide; 28.6 (19-44) clypeal setae. Palpal proportions (micron): 48 : 46 : 155 : 147 : 213; P5/P4 1.42 (1.20-1.75); P5/P3 1.37 (1.15-1.57).

Thoracic setae: Acrostichals 12.1 (10-13); Dorsocentrals 17 (15-21); prealars 5 (4-6); scutellars in two rough rows, 4-9 in anterior row, 8-11 in posterior row, total 15.3 (13-17).

LR about 1.59 (1.6-1.72).

Mean leg measurements (microns) and proportions as follows:

Male	**Fe**	**Ti**	**Ta1**	**Ta2**	**Ta3**	**Ta4**	**Ta5**	**LR**	**F/T**	**BR**
PI	1143	1021	1615	800	699	695	341	1.46-1.74	1.04-1.29	1.27-1.67
PII	1172	1149	569	329	266	192	161	0.47-0.52	0.94-1.08	-
PIII	1323	1338	791	446	396	234	187	0.55-0.69	0.97-1.00	-

Ant Ta4/Ti – 0.68; FeI/FeII – 0.92-1.03

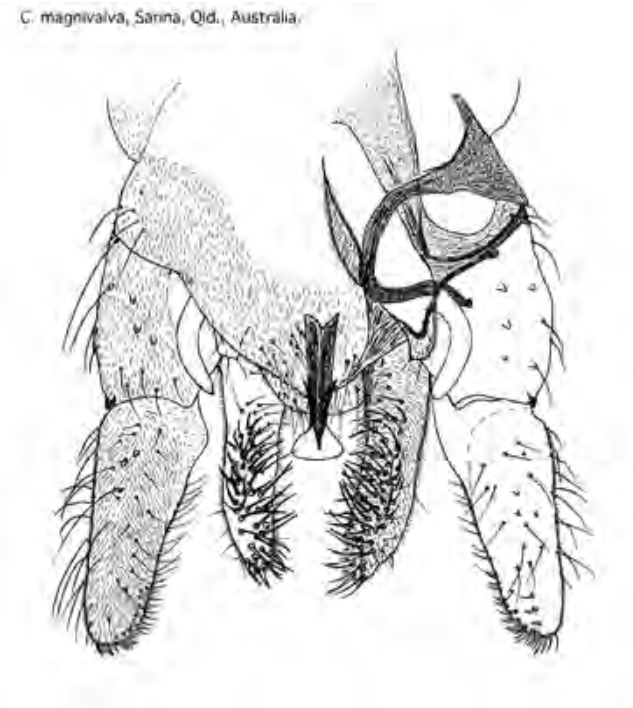


Illustration of the hypopygium of *C. magnivalva*

No setae on TIX; anal point downturned with a flattened triangular tip. SVo normal, closest to E(i) type of Strenzke (1959); IVo also relatively normal, with simple setae on inner margin only, and extending to mid-point or tip of gonostylus. Gonostyle normally broadest at base, but sometimes quite swollen, narrowing slightly and evenly along its length; with numerous spines rather than setae at the tip.

Female:
Coloration essentially as in male; brownish green darkening over the abdominal tergites.
Wing length 2.97 (2.64-3.44) mm, width 0.95 (0.85-1.01) mm; VR 0.95 (0.87-0.97); 2.8 (2-3) Scf on brachiolum; 16.3 (13-20) setae on squamal fringe.
Head: FT about 25-40 µm long and 11-18 µm wide, about twice as long as wide; antennal proportions (micron, with percentage of neck in brackets) 129 (26) : 91 (39) : 98 (39) : 97 (45) : 170. AR about 0.40 (0.37-0.45); A5/A1 1.33 (1.15-1.60). Palpal proportions (micron): 48 : 43 : 146 : 168 : 231.
Thoracic setae: about 13 (10-17) acrostichals; 3.85 (3-6) linear humerals; 20.7 (14-27) Dorsocentrals; 5.1 (4-6) prealars; 1 supraalar; scutellars in two rows – 6.2 (3-8) in anterior row and 10.6 (9-13) in posterior row.
Mean leg measurements (microns) and proportions as follows:

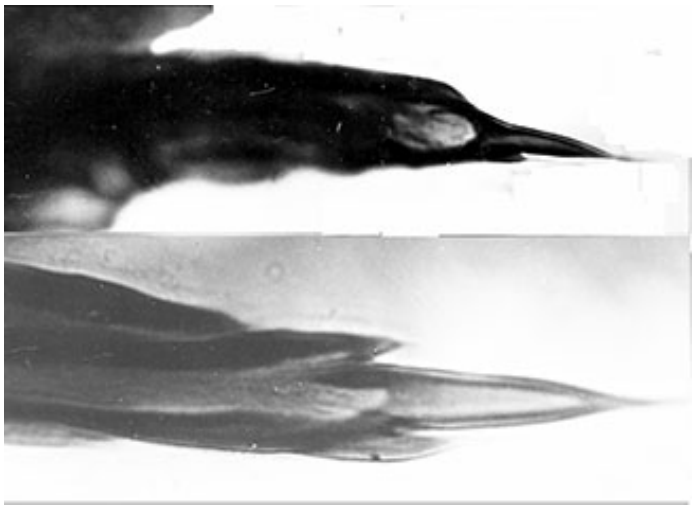
Female	**Fe**	**Ti**	**Ta1**	**Ta2**	**Ta3**	**Ta4**	**Ta5**	**LR**	**F/T**	**Ta4/Ti**
PI	1138	954	1513	715	631	645	323	1.50-1.69	1.13-1.24	0.57-0.78
PII	1160	1150	600	325	250	185	155	0.52-0.53	1.00-1.02	-
PIII	1300	1370	860	470	405	230	190	0.62-0.65	0.94-0.97	-

BR 1.38-1.62. FeI/FeII 0.96-0.99

GcIX with abut 4 setae; segment X larger than usual and oval in shape with about 19.5 (14-24) setae. Cercus (below) essentially oval/rectangular with at best a very small basal extension on dorsal side.

Cercus and segment X of *C. magnivalva*

Pupa: Colour yellowish brown, muscle scars slightly darker; shagreen complete on tergites II-VII, anterior quarter on TVIII, none on TIX.
Length about 6.55 (6.3-6.8) mm (female) and 6.33 (5.04-6.7) mm (male); posterior margin of wingcase about 1.44 (1.27-1.52) µm (female), about 1.34 (1.04-1.49) µm (male); female antennal sheath about 450 (340-550) µm. FT about 57.3 (51-71) µm (female), 71.0 (56-83) µm (male) long and usually wider than long in females but longer than wide in males; some slight indication of frontal warts, also a small tubercle about 21.4 (15-28) µm long and 1.0-2.2 times longer than wide, just anterior to the respiratory scar. Respiratory base 109-159 µm long and 46-66 µm wide, respiratory fibres narrowing in middle, HR 2.45 (2.1-2.7).
About 87 (55-105) recurved spines on second segment, occupying just over half of the segment width (subject to mounting distortions). Pedes spurii B difficult to see on available specimens and only determined for segment II; pedes spurii A on segment IV about 116-182 µm long and about 0.22 (0.13-0.27) of segment length. L-setae at III/IV margin at least 50-106 µm long and at IV/V margin at least 71-96 µm long.
Spurs dark yellow brown, with about 1-3 spines plus 1-3 small spines in many cases where there is only 1 large spine.



Variation of pupal spur (Sarina, Qld above; Nadi, Fiji, below)

Taeniae on anal fin in up to 3 rows towards the posterior end; about 53-115 taeniae but more in females (mean 96.7) than in males (mean 79.3).

Fourth instar larva: a medium sized plumosus-type larva. Length (females) about 19.7 (11.3-14.5) mm.; males about 10.27 (9.8-11.2) mm. Anterior VT (1.48 (0.92-2.36) mm.) slightly shorter than the posterior pair (1.54 (1.08-2.48) mm.); TLt 272.5 (200-360) µm long. Anal tubules about 380 (220-480) µm long and about twice as long as wide.

Gular region at least slightly darkened on posterior half, FC also darkened to some extent, sometimes just along the edges. Salivary reservoir (Fig. c, below) 76.5 (61-88) µm wide and 4.53 (3.50-5.33) times wider than deep.

Mentum (Fig. e, below) with 4th laterals only slightly reduced (essentially type I), and c2 teeth only partly separated from c1 (type IA), 6th laterals arising at a slightly lower level.

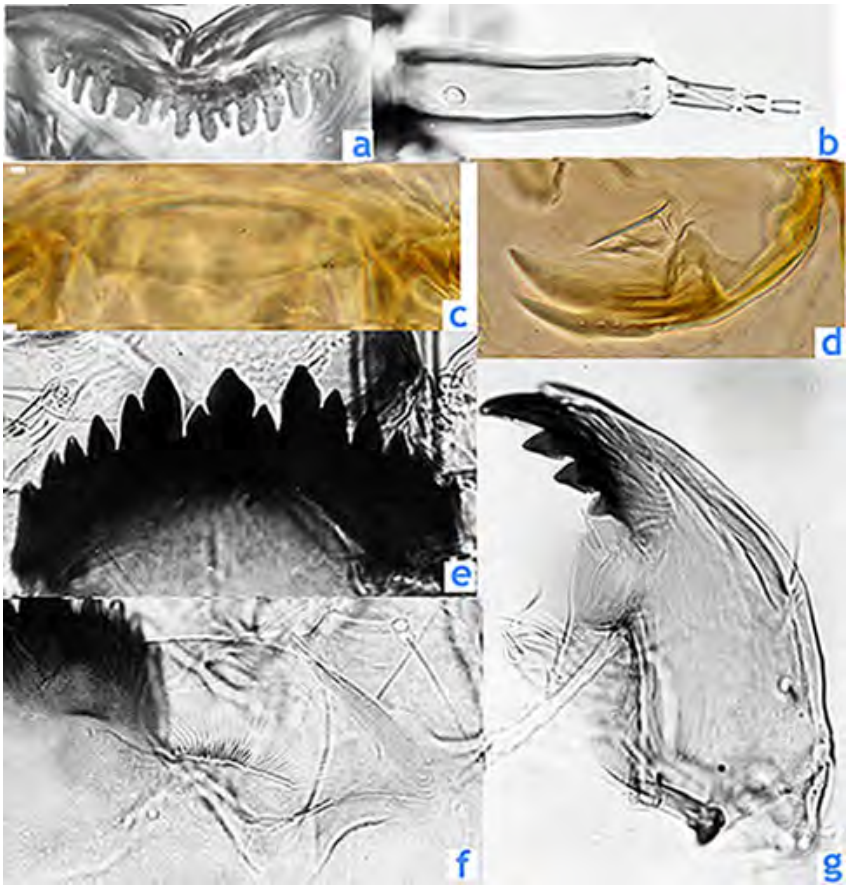
Ventromentum (Fig. f, below) about 168.13 (161-180) µm wide and 3.38 (3.18-3.65) times wider than deep; about 1.09 (1.03-1.18) times wider than the mentum and separated by about 31-39% of MW; with about 34.25 (28-38) striae; VMR 0.26 (0.21-0.32).

Premandible (Fig. d, below) of type B2, with inner tooth about 4.5 times wider than the outer tooth, with both coming to a sharp point when not worn. PE (Fig. a, below) with about 16 (14-17), usually type B teeth.

Antenna (Fig. b, below) with basal segment only about a third of the VHL, but relatively long compared to the other antennal segments, about 3.52 (3.17-3.83) times longer than wide; AR about 1.93 (1.77-2.19); proportions (micron) 110 ; 27 ; 9.5 ; 12 ; 6.5.

Distance between the antennal bases (124-144 µm) greater than that between the S4 setae (121-126.5 µm), which are separated by about 74-76% of the FC width at that point; S5 setae slightly posterior to the nearby RO.

Mandible (Fig. g, below) about 220 (212-230) µm long; with 3rd inner teeth showing some colour and usually only partly separated (type IA-IIIB); about 16.6 (15-18) furrows near the base and about 11.8 (11-13) taeniae in the PecM.



Cytology: 4 polytene chromosomes with the pseudothummi arm combination AE, BF, CD, G. Arm G closely paired with a small nucleolus near the middle of the arm, and three Balbiani rings (BRs), two just distal to the NOR and the other near the somewhat heterochromatic centromere. The most distal BR is not always developed. Nucleolus in arm F with NOR at about group 19. No polymorphism known in Australian samples. Irradiation experiments suggest the MD may be on either arm B or on chromosome CD.

magA1: 1 - 2c, 3 - 2d, 10 - 12, 14 - 13, 4 - 9, 15 - 19 as *crassiforceps*

magB1: A puff with some dark bands on distal side, may be developed near the distal end of the arm

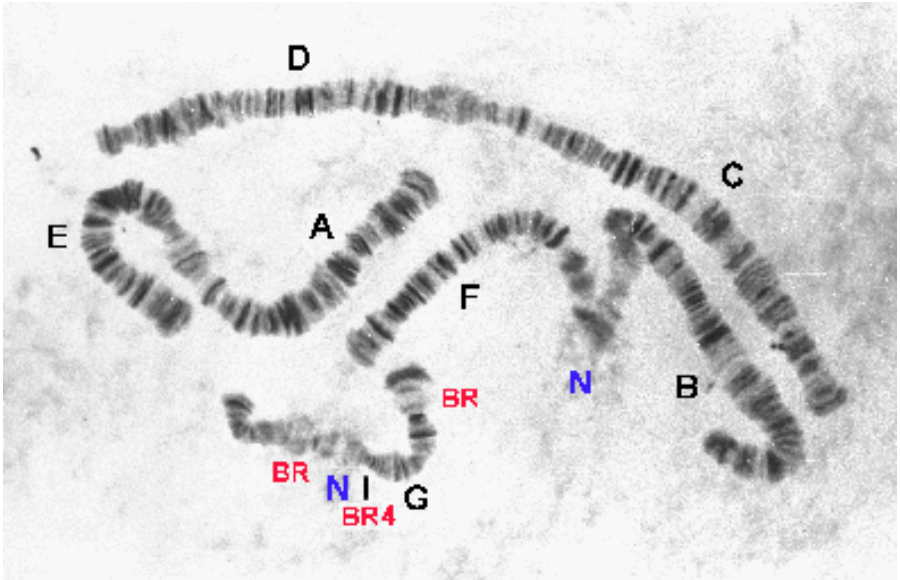
magC1: not mapped. as *crassiforceps*

magD1: not mapped. as *crassiforceps*

magE1: 1 - 3e, 5 - 10b, 4 - 3f, 10c - 13 i.e. as *cingulatus*, etc.

magF1: 1 - 2a, 10d-a, 2b - 9, 11 - 18 NOR 19 - 23 as *crassiforceps*

magG1: Nucleolus and at least one BRs near centre of the arm. Site of BR4 just proximal to NOR, and further BR subterminal.



Guryev *et al.* (2001) and Peck *et al*. (2002) referred Australian specimens from the Alligator Rivers region of the Northern Territory to *C. crassiforceps*. However this is incorrect. Specimens identified *as C. magnivalva* in Australia, Fiji and Tahiti, differ from those identified as *C. crassiforceps* from Japan by a fixed inversion in arm E and more complex changes in arm G. They also differ in mt*COI* sequence.
A possible point of difference in the morphology of the males is that, while the gonostyle of *C. magnivalva* narrows evenly to the distal end, that of *C. crassiforceps* appears to remain the same width for most of its length and then rounds off.

Usually found in shallow waters, pools or the littoral of lagoons.

Molecular Data:

mt*COI* AF192212 (as *C. crassiforceps* but now corrected)

mt*cytB* AF192181 (as *C. crassiforceps* but now corrected)

Found:

Australia - Townsville (Type locality).
Also: Motu Kō. Pukapuka, Cook Islands (-10.88ºS, 165.51ºW) (E.H. Bryan Jr., Bishop Museum).
Cytologically identical material has been collected from Lautoka (-17.67 ºS, 177.50 ºW) and Laucola Bay (-18.25 ºS, 178.33 ºW), Viti Levu, Fiji and Punaauia, Tahiti (-17.53 ºS, 149.57 ºW).

***Chironomus pallidinubeculosus* Tokunaga 1964**

Synonyms:

Chironomus calipterus - misidentification in Bugledich et al. 1999., and other authors.
*Chironomus kiiensis*Tokunaga 1936- incorrect synonymy by Hashimoto *et al.* 1981.

In BOLD Bin: BOLD:AEB0699

Adult

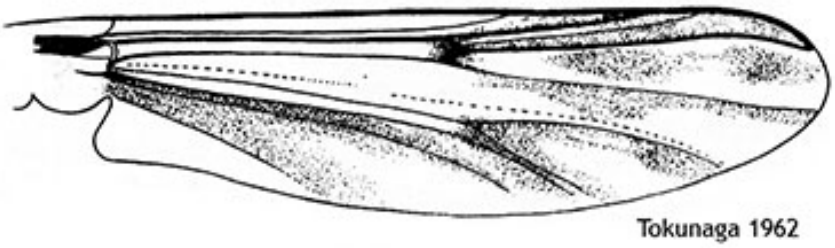
Characterized by the patterned wings. This pattern is very similar to those of other patterned wing *Chironomus* species (see below)
Initially considered to be *C. calipterus*, because of the similar wing pattern. However, cytological examination of specimens from Israel, indicated that the two species were distinct, with the Israeli, and presumably African, chromosome arm combination belonging to the thummi-cytocomplex, unlike this species, which belongs to the psuedothummi-cytocomplex.
The wing pattern is also similar to that of *C. striatipennis*, but the adults of that species are darker, and they differ in mt*COI* sequences.

Tokunaga's original description (1964):

40. Chironomus (Chironomus) pallidinubeculosus Tokunaga, n. sp.

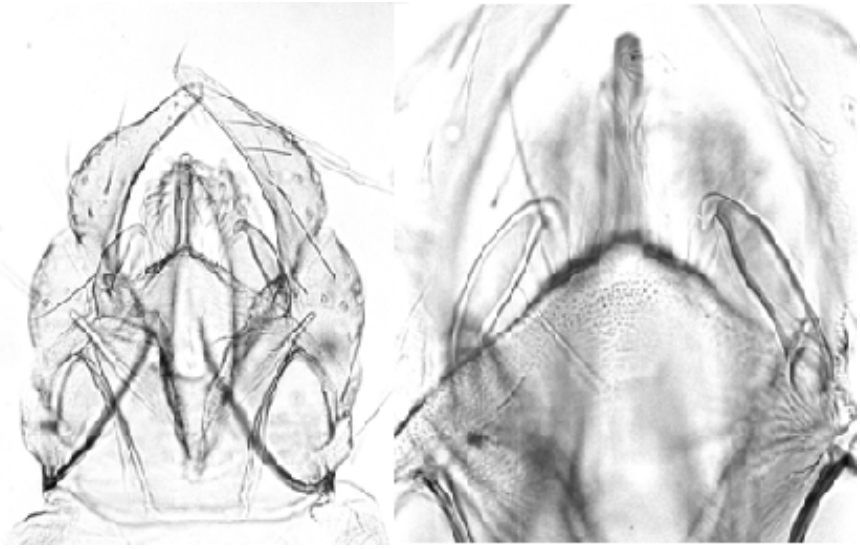
Rather large yellow species, wings with well-developed gray clouds and seams closely resembling African *calipterus* Kieffer; leg marking, value of LR, and structure of male hypopygium also similar to those of *calipterus*. Frontal tubercles large; AR 2.82-2.94, female antenna with last segment much shorter than preceding two together; scutum with yellow vittae on white ground color, lateral scutal vittae each with slender fuscus stripes on both sides, median scutal vittae each with similar fuscus stripe only on outer side in male and uniformly brownish in female. Legs with femora each with narrow preapical pale brown ring, LR 1.78-1.94. Wing with anal lobe well developed, gray clouds and seams rather distinct.

Male: Body 4.2 mm. long; wings 2.07-2.35 mm. by 0.53-0.64 mm. Head pale brownish yellow, with mouthparts pale brown, eyes separated above by about one-fourth length of eye, frontal tubercles large, subcylindrical and as long as about two or two and one-half facets together; palp pale brown and five-segmented (13.3: 13.7: 41.7: 41.3: 64); AR 2.89 (2.82-2.94), scape yellowish brown, other segments and plumose hairs brown, last segments pointed at apex. Thorax mainly white, scutum with four yellow vittae, fuscus slender stripes on both sides of lateral vitta and only outside of median vitta, anterior part of scutum, just behind head, pale fuscus, postscutellum pale brownish yellow, pleural sclerites beneath wing base pale brownish, sternum yellow, scutellum with six bristles along caudal margin. Legs mainly yellow or yellowish white. coxa somewhat brownish, femur with narrow pale-brown ring on preapical part, tarsal segments with apical end brown, last one or two tarsal segments uniformly brown; pulvilli large, LR 1.85 (1.78-1.94), RL-FT 82.7: 64.3. Wing (fig. 10, *a*) with anal lobe well-developed, pale gray clouds and seams rather distinct but ill-defined, main veins white, but r-m and fR dark, fMCu under r-m, RL-V 70.7: 43.7: 79.3: 76.5. Halter white. Abdomen mainly pale brown or yellowish pale brown, tergites 1 to 6 slightly fuscus; hypopygium (fig. 10, *b*) with anal point slightly beyond tip of ventral appendage, oblong at apex and curved downward, style normal, dorsal appendage with basal area subtriangular, setigerous and pubescent, apical bare projection almost straight, slightly curved and not painted at tip, ventral appendage almost straight, with 10 to 11 curved apical bristles, some unequally bifid at tip.



Tokunaga 1962

Male:



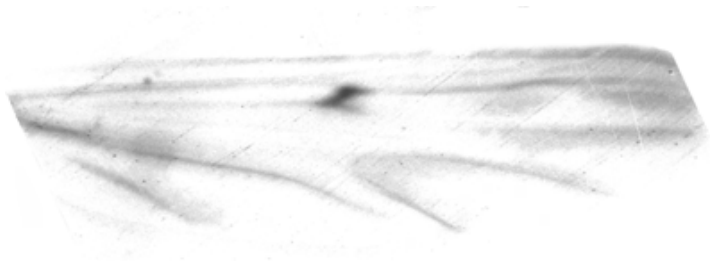
Male hypopygium of Australian specimen of *C. pallidinubeculosus* (left) and superior appendage (right)

Wing length 2.07-2.82 mm; width 0.53-0.68 mm; VR 1.00-1.09. LR 1.59-1.94.
Face yellowish brown, antennae and palps brown. AR about 2.82-3.13.
FT quite large, about 30-60 µm long and 10-15 µm wide. 16-33 clypeal setae. Palpal proportions (µm): 45 : 48 : 143 : 161 : 234.
Thorax yellowish green with brown stripes, lateral stripes darker along the medial edge, and ending in a darker spot; postnotum and sternopleuron brown.
Setae: acrostichals - 9–11; dorsocentrals - 9-11; prealar - 4-5; scutellar in two rows – 2-3 in anterior row, 6-9 in posterior row.
Legs yellow, femur with a dark band just before the knee; tarsal joints darkened.
Leg lengths (microns) (n = 3) and proportions as follows:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1000	915	1470	800	580	480	234	1.59-1.63	0.97-1.20	2.1-3.0
PII	1045	1050	600	353	265	190	138	0.52-0.63	0.98-1.00	-
PIII	1150	1285	985	600	457	273	173	0.75-0.80	0.91-0.93	-

Ant Ta5 about 0.26-0.30 (0.32) length of Ti. About 7 sensilla chaetica on mid Ta1, and perhaps 5 on hind Ta1.

Wings with dark spot over the crossvein and with obvious dark clouds and seams, particularly in cell R5. 17-22 setae in squamal fringe, 2 SCf on branchiolum. Haltere pale.



Wing of an Australian female specimen

Abdomen brown, no obvious bands on the segments. 5-6 (14) setae near centre of TIX. SVo essentially an E-type, perhaps closest to fig. h of Strenzke 1959, but end more sharply curved. IVo reaching about to end of the anal point. Gonostylus abruptly narrowing at distal third.

Female (Micronesian):

40. Chironomus (Chironomus) pallidinubeculosus Tokunaga, n. sp.

Female: Body about 3.12 mm. long; wings about 2.13 mm. by 0.65 mm. Coloration somewhat more brownish than in male, but structures mainly as in male with usual sexual differences. Head brown, with mouthparts dark brown, eyes separated above by one-fifth length of eye; palp five-segmented (10: 10: 32: 40: 55); antenna fuscus pale brown, last segment dark, neck parts of intermediate flagellar segments little shorter than one-half of segments, six-segmented (17: 40: 29: 31: 29: 41). Thorax mainly pale yellow, median scutal vittae uniformly brown or pale brown, postscutellum brown, sternum pale brown, scutellum with six bristles along caudal margin and two small accessory setae on anterior part, RL-FT about 70: 55. Wings with anterior veins pale brown, RL-V about 63: 50: 85: 70. Abdomen, including cerci, uniformly pale

Original description of *C. pallidinubeculosus* female from Tokunaga 1964

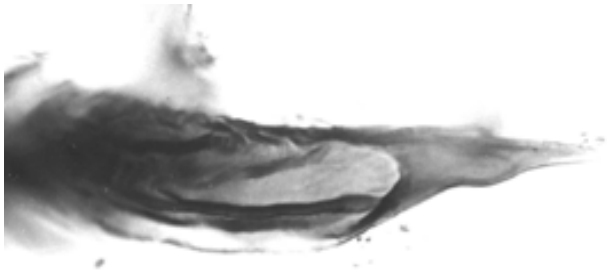
Additional data from Paratype female:
Wing length 2.60 mm, width 0.73 mm, VR 0.89. LR not available.
Antennal proportions (µm): 142 : 99 : 114 : 91 : 165 . Cephalic tubercles about 390 µm.
Palpal proportions (segs. 2 - 5) (µm): 40 : 136 : 136 : 170; P5/P4 1.25-1.38; P5/P3 1.38-1.75. 14 clypeal setae.
thoracic setae: acrostichals - 14; dorsocentrals - abt 22; prealar - at least 2; scutellar in two rows – 5 in anterior row, 8 in posterior row.
2 SCf on branchiolum of wing.
Leg lengths (µm) and proportions as follows:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1040	860	-	-	-	-	-	-	1.21	-
PII	1060	1060	600	320	250	170	110	0.57	1.00	-
PIII	1220	1320	-	-	-	-	-	0.92	-	-

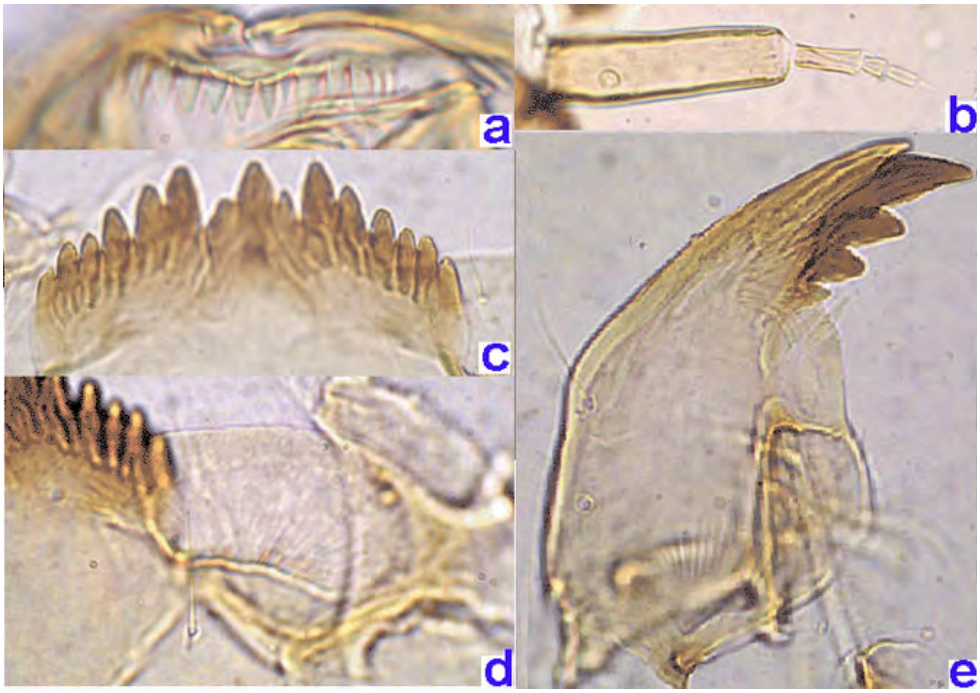
No information available for Australian specimens.

Pupa: Length about 6.7-7.0 mm, posterior margin of wing case about 1.35-1.60 mm.
Head: Cephalic tubercles about 63–79 µm long and about 40–67 µm wide at the base, with a subterminal seta about 40–57 µm long.
Thorax: Prealar tubercle present but small, about 18–23 µm long and 8–10 µm wide. Basal scar of respiratory horn with edge thicker at the anterior end, and pinched at the centre, about 113–116 µm long and 49–57 µm wide. There are a number of small pits (2–4) immediately anterior to the basal scar, and a large, possibly muscle scar just posterior to it.
Abdomen: About 61–75 recurved hooks on posterior margin of segment II, the hook row covering about 60–85% of the width of the segment. Pedes spurii B on segment II, and larger on segment III, and pedes spurii A on segment IV, while those of segment V and VI are small and mainly

identifiable by the spinules. Only 3 L-setae seen on segment III, while the last one on segment IV is at the junction with segment V. Segment VIII with two pairs of larval ventral tubules; caudolateral spur with one main spine and 1 or 2 smaller ones. Anal lobe with about 59-60 taeniae on each side, mostly in a single row but multiple rows at posterior end.

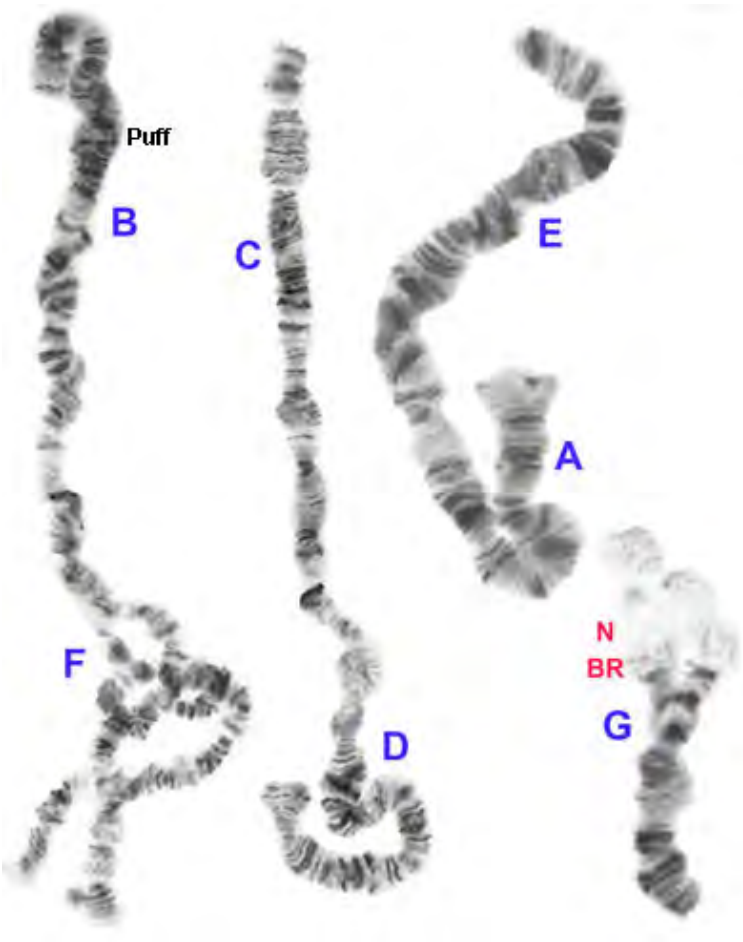


Fourth instar larva: a medium sized (8-10.5 mm) plumosus-type larva. Gula pale or darkened on posterior third; FC slightly dark or dark. Ventral tubules moderately long (ant. 0.84-1.36 mm; post. 0.76-1.48 mm), relative length of anterior and posterior pair variable.
Mentum (c, below) with c2 teeth of central trifid tooth well separated from c1 tooth (type III), 4th laterals slightly reduced (type I).
PE (a, below) with about 16-21 variable but sharp teeth. Ventromental plates (d, below) separated by about 0.32-0.38 of width of mentum; with about 29 - 34 striae. Prm with the two teeth about equal in length, inner tooth about a third wider than the outer tooth. Antenna (b, below) with a moderately long basal segment, which is about 4-4.5 times as long as wide; AR about 1.9-1.96. Antennal proportions: 120 : 27 : 10 : 13 : 6. Mandible (e, below) with third inner tooth only slightly darkened (Type I), and with about 12-14 furrows at the base; also reported to have a double bulge on the inner contour.



Cytology: 4 polytene chromosomes with the pseudothummi arm combination AE, BF, CD, G. Nucleolus virtually terminal in arm G, with very large BR adjacent, separated by only 4-5 bands; normally closely paired, but NOR and BR region may be unpaired. No nucleolus in long chromosomes. Polymorphism in arm F seen in Australian specimen examined.

pnbA1: 1 - 2c, 11 - 7, 4 - 6, 2d - 3, 12 - 19 as *striatipennis*
pnbB1: Puff near the middle of the arm with the dark bands proximal.
pnbC1: Constriction (groups 3 and 4) about one quarter from distal end.
pnbD1:
pnbD2: a simple inversion of about 1/3 of the arm towards the distal end.
pnbE1: 1 - 13 as *piger*, *striatipennis*.
pnbF1: 1 - 2a, 10 - 6, 15 - 11, 2b - 5, 16 - 23 i.e. from *oppositus* F1 by Inv15-5
pnbF2: A simple inversion of about the distal half of the arm
pnbG1: Virtually terminal nucleolus with adjacent BR.



Found: Micronesia - Ulimang, Babelthaup Island, Palau Islands (Type locality).
Australia - Queensland - Noosaville.

Molecular
mt*COI*: There is mt*COI* sequence in BOLD.

***Chironomus preapicalis* Tokunaga 1964**

Male:
Body about 6.96 long, wings abt. 3.19 mm long and 0.9 mm wide.
Head entirely brown, FT cylindrical, as long as the width of two facets. Palps five segmented, proportions 15 : 15 : 65 : 83 : 90; P5/P4 1.08, P5/P3 1.38.; antenna with scape yellowish brown, flagellum and plumose hairs brown., AR about 3.15.
Thorax mainly pale brownish yellow, mesonotum white, vittae yellow and fuscous just behind the head, postnotum brownish on anterior part and yellow on caudal part.
Scutellum with 24 small anterior setae and 13 larger posterior setae (total 37).
Legs with coxae and trochanters pale brownish yellow, other segments mainly yellow.; all femora with small preapical dark rings, fore tibia with sub-basal broad dark band.LR about 1.58.
Wing with veins pale brown, r-m dark and covered by a small dark spot, VR about 1.
Haltere white.
Abdomen very pale brown with T-shaped fuscus basal bands on segments II-VI; hypopygium pale brown with anal point slender and curved ventrad, IVo reaching about to end of anal point, setae finely plumous at ends; SVo closest to D(f) of Strenzke (1959). Gonostyle moderately swollen and reduces gradually over about posterior half.

Female:
Body length about 6.16 mm; wings 3.16-3.9 mm, width 0.96-1.26 mm. Coloration essentially as in male but vittae pale brownish yellow, abdomen with tergal spots triangular.
Palp segments 20.3 : 23.3 : 77 : 86.7 : 132; P5/P4 1.52, P5/P3 1.71. Antenna with scape yellowish brown, flagellum yellow but last segment and neck parts of penultimate two segments fuscus, six segmented (26.7 : 66 : 46.3 : 54.7 : 44 : 81.7), neck parts of intermediate flagellar segments about one half of segments: (AR 0.39; A5/A1 1.24).
Scutellum with more setae than in male. RL-FT 148.7; 122.3. Wing with RL-V 98 : 84.5 : 135 : 103.5.

Possible specimens have been collected in Fiji:
Male:
Colouration: Face yellow-brown, antennae brown, palps light brown. Thorax yellow brown (although may be faded from green) Thoracic vittae dark along edges but pale anteriorly on central, and in middle of all three vittae. Postnotum and sternopleuron brown but darker at posterior postnotum. Legs pale with joints somewhat darkened. Abdomen greenish with saddle spots on segments III-VII. Terminal segments somewhat brownish. Wings pale, anterior veins somewhat darker distally; crossvein slightly darker. Haltere yellowish green.
Head: AR abt 3.21-3.23. FT present, about 15-37 µm long and 6-12.5 µm wide at base. Postocular setae in a double row, reaching to the dorsal apex of the eyes. Palpal

proportions: 60 : 47 : 231 : 232 : 380; P5/P4 1.51-1.78, P5/P3 1.59-170. 18-23 clypeal setae.
Wing length 2.84-2.96 mm, width 0.67-0.68 mm. VR 0.98-1.
Thoracic setae: at least 13 acrostichal; 18-19 dorsolateral in 2 rows; 3-4 prealar; 1 supraalar; Scutellum anteriorly with 5+4-15 setae in two indefinite rows, 12-13 setae in posterior row (total 22-27 setae).
Legs: Anterior tarsi without a beard.
Leg lengths (micron) and proportions:

	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1175	1035	1650	875	820	695	275	1.57-1.62	1.11-1.17	1.53-1.54
PII	1230	1115	700	395	285	160	120	0.63	1.08-1.12	-
PIII	1350	1355	990	510	400	235	150	0.73-0.74	0.97-1.03	-

Setae on TIX: 11-12 in individual spots.
Anal point narrow at base and widening at tip; IVo almost to end of anal point; SVo closest to S(f) type of Strenzke 1959. Gonostyle only moderately swollen and narrows gently over posterior half, with 1+3-6 setae at tip.

Holotype male (US66555), Ngarsung, Airai, Babelthaup I., Palau. Allotype female, Ulimang, Babelthaup I, Palau.
Found: Kolonia, Yap I; Agric. Expt. Sta., Colonia, Ponape; all Micronesia.
Fiji: Nadi (-16.33ºS, 179.50ºE), Viti Levu.

Chironomus samoensis **Edwards 1928**

Tokunaga's (1964) description of *C. samoensis* seems to be the most reliable description of the adult with much more information than in the original description.

Chironomus (Chironomus) samoensis Edwards (fig. 12, *a*).

Chironomus samoensis Edwards, 1928, Insects of Samoa 6 (2) : 67.

Chironomus dorsalis, Tokunaga, 1940, Philippine Jour. Sci. 71 : 220.

Chironomus eximius Johannsen, 1946, B. P. Bishop Mus., Bull. 189 : 193.

Large yellow species, scutal vittae yellow; legs yellow, but all tarsal segments apically black or brown; frontal tubercles cylindrical or oblong; AR 2.7-3.09; LR 1.75-1.92, in female fore tarsus with segment 4 far longer than 3 and slightly longer than 2; wing with fR and r-m usually more brownish or fuscus than other veins; abdomen pale brownish yellow or yellow, tergites of basal segments 2 to 6 of male and 2 to 4 of female with round or rhombic pale fuscus spots; male hypopygium of *dorsalis* type.

Male: Body about 4.5 mm. long; wings 2.2-2.3 mm. by 0.59-0.61 mm. Almost entirely yellow. Head with mouthparts pale brownish yellow, eyes separated above by one-fourth length of eye, frontal tubercles subcylindrical and slightly shorter than width of two facets; palp five-segmented (about 15.7: 14: 62.7: 69.3: 100); antenna with scape yellowish brown, other segments brown, plumose hairs very pale brown, AR 2.86 (2.7-3.09). Thorax mainly yellow, scutum white, with vittae yellow, scutellum white, with 9 to 10 bristles along caudal margin and seven to nine small setae on anterior part, postscutellum faintly fuscus on middle part. Legs yellow, only dark or brown at distal ends of all tarsal segments; LR 1.81 (1.75-1.84), RL-FT 85: 70. Halter yellowish white. Wing with fR and r-m usually somewhat fuscus, fMCu under origin of r-m, RL-V 72: 49.5: 81.5: 75.2. Abdomen pale brownish yellow, basal segments 2 to 6 with oval or rhombic faint spots on tergites; hypopygium (fig. 12, *a*) of *dorsalis* type, anal point rather large, style normal, dorsal appendage setigerous (with eight to nine setae) on basal part and bare caudal projection stout and subtriangular, ventral appendage stout, with 12 to 18 strong apical bristles, some of these bristles bifid or trifid apically.

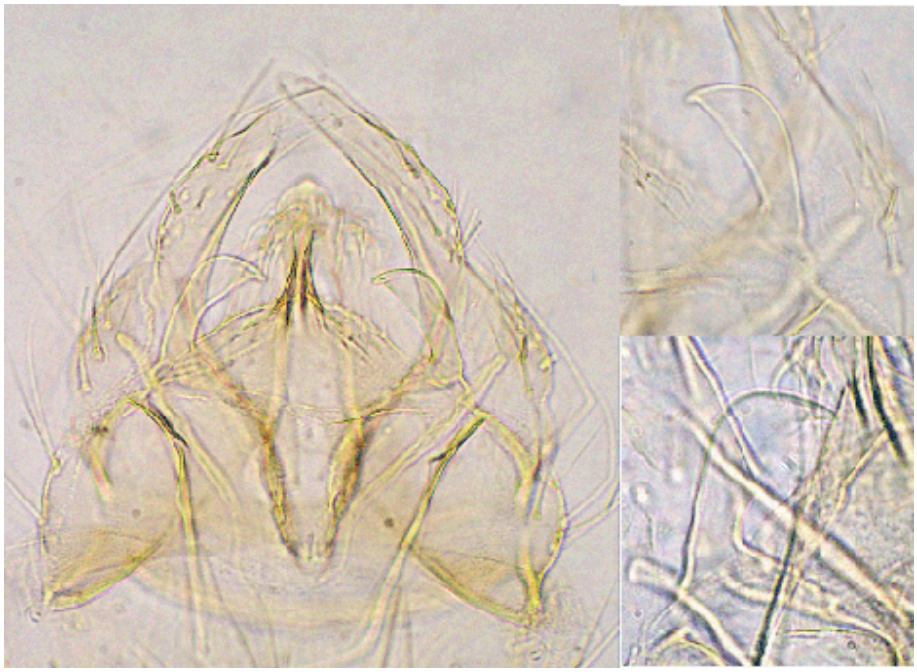
Female: Body 4.92 (4.68-5.07) mm. long; wings 2.88 (2.52-3.12) mm. by 0.84 (0.78-0.91) mm. Similar to male in color and structure with usual sexual differences. Head with eyes separated above by one-sixth length of eye, frontal tubercles oblong; palp five-segmented (13.5 : 12.5 : 57.5 : 70 : 87); antenna with scape and basal two-thirds of segment 2 yellow, other parts fuscus, neck parts rather long, six-segmented (22 : 49.5 : 38 : 39.5 : 37.3 : 55.3). Scutellum with 13 to 14 bristles and 8 to 11 small setae. LR 1.86-1.92, RL-FT 110: 86.5, RL-T 163.5: 84.5: 81.5: 88.5: 38.5. Wing with fMCu under or just beyond origin of r-m, RL-V 85.3: 67.3: 110: 92.7. Abdomen yellow, with tergal oval faint fuscus spots on segments 2 to 4.

Specimens from Micronesia are probably *C. samoensis*, and the illustration is presumably intended to depict the somewhat beaked SVo seen in some specimens. The misinterpretation of this illustration may be partly responsible for the identification of *C. samoensis* in other locations, which have an S-type SVo. However, they also differ in other characters and are mis-identifications.

While the females are largely dismissed as "like the male apart from the usual sexual differences", the relative lengths of the fore leg segments appear to be useful in separating the species of this group.

Tokunaga makes the important point that the fore tarsus has Ta4 far longer than Ta3, and slightly longer than Ta2, although examination of a pharate female from Tutuila, American Samoa, suggests that Ta2 and Ta4 can be about equal in length.

Additional data from specimens from Tutuila, Pago Pago, American Samoa:



Male hypopygium of *Chironomus samoensis* (left), superior volsella (right)
Note the appearance of a beak in the lower figure.

Male
Head: AR - 2.94 (2.51 - 3.23, 4); frontal tubercles 33 µm (29-38,4) long and 15µm (14-17,3) wide; palpal proportions (micron) - 46 : 46 : 193 : 234 : 354; clypeal setae 17-23.
Thoracic setae: Acrostichal - at least 14 or 15; dorsocentral - 17-21; prealar - 4-5; scutellar in two rough rows, ant. 5-12, post. 12-15.
Wing length 2.58 mm (2.40-2.68, 4), width 0.63 mm (0.60-0.66, 4), VR 1.03 (1.02-1.04, 4).
Legs, pale, tarsi slightly darker.
Relative length of leg segments (micron) (4):

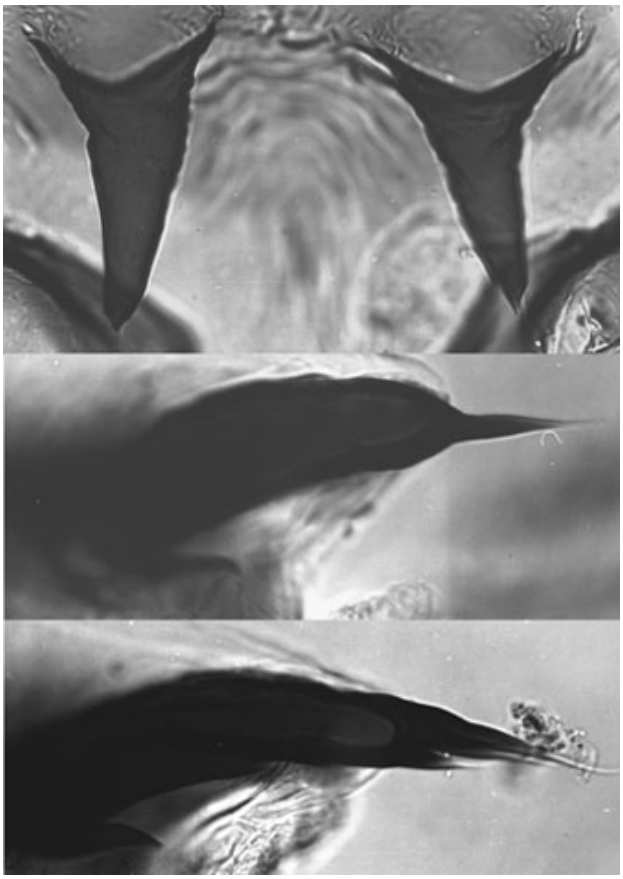
	Fe	**Ti**	**Ta1**	**Ta2**	**Ta3**	**Ta4**	**Ta5**	**LR**	**F/T**	**BR**
PI	1107	1000	1507	810	750	670	330	1.50-1.52	1.08-1.12	1.54-1.75
PII	1290	1155	720	380	270	175	120	0.62	1.12	-
PIII	1445	1350	1120	575	435	260	145	0.83	1.07	-

Abdomen pale, with darkening as described by Edward. Hypopygium (above) similar to that of *C. dorsalis*, with the SVo of the D type, similar to fig. e of Strenzke (1959), but sometimes with the development of a beak. The IV has mainly simple, curved setae, but a small number appear to have a small simple fork near the tip. About 4-6 setae on the 9th tergite near the base of the anal point.

Female:
No females are available amongst the material, but some characters could be obtained from a pupa with a pharate female. An important character is the relative proportions of the fore leg, particularly the tarsi, as Tokunaga (1964) notes that the Ta4 of specimens he assigned to *C. samoensis* was unusually long. The approximate lengths of these segments were measured (in micron) as:

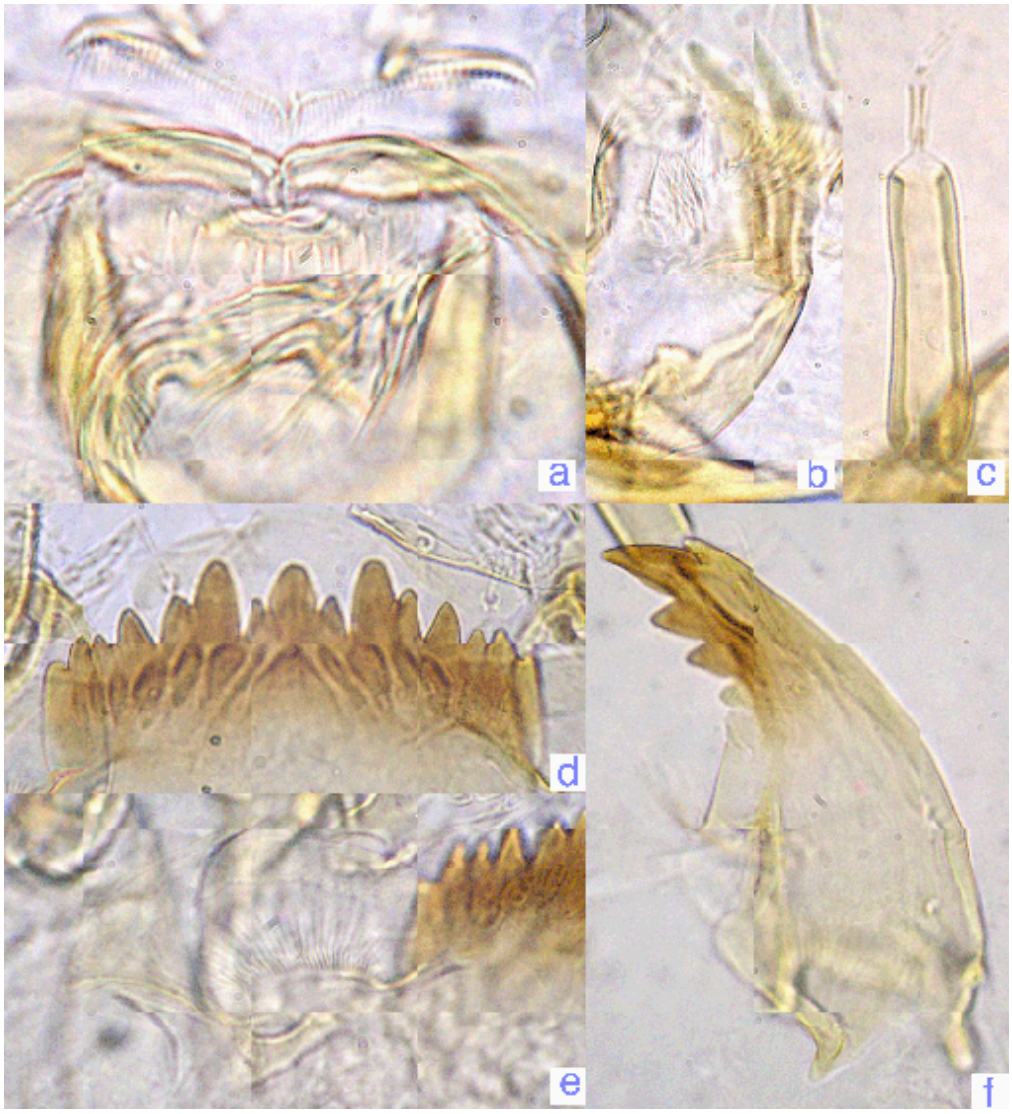
Fe 900 ; Ti 750 ; Ta1 1020 ; Ta2 620 : Ta3 470 : Ta4 610 : Ta5 340; Ta4 about same length as Ta2, and about one third longer than Ta3.
Other characters:
Head - frontal tubercles - length 23µm, width 13 µm. Antennal segments (µm) 144 : 109 : 116 : 106 : 215. About 24 clypeal setae.
Thoracic setae: Acrostichal 14, dorsocentral 31, prealar 5, scutellar in two rows, ant. 14, post. 14.

Pupa:
Exuviae length (male) 6.8 (6.5-7.0, 3) mm., inner margin of wing case about 1.34 (1.27-1.42, 3) mm (male). Pale, with darkened caudolateral spurs. Cephalic tubules 93 (76-115, 4) µm long and 78 (56-94, 4) µm across the base, subterminal bristle about 68-80 µm in length. Basal ring about 142 (129-164,5) by 68 (54-85,5) µm. About 67-77 hooks in row on segment II. Slight development of PSB on segment II, PSA largest in segment IV, reducing in segments V and VI. Caudolateral spur of segment VIII about 180 &#181m and 1-3 spines. About 78-88 taeniae on each side of the anal lobe of male.



Fourth instar larva:
A medium sized plumosus-type; length about 12.5-12.7 mm (female) and 10.8-11.8 mm (male); TLt about 280-360 µm; VT relatively long (anterior 1.76-2.16 mm; posterior 1.80-2.68 mm), posterior pair longer and coiled; AT moderately long (about 1.6-2.6 times longer than wide), dorsal pair (240-410 µm) slightly longer than ventral pair (215-370 µm). Head capsule pale with darkening of the posterior half of the gula, FC sometimes pale but mostly with slight darkening, ventral head length 261-318 µm. Distance between antennal bases greater than the distance between the S4 setae.

Mentum (Fig. d, below) wider than usual, about 0.6 of ventral head length; centre trifid teeth with c2 teeth well developed (essentially type IV); 4th laterals reduced to about the level of 5th laterals (type II), 6th lateral variable, sometimes arising at same level as other laterals but generally appearing to be at a slightly lower level, apparently due to wear.
Ventromental plates (Fig. f, below) separated by about 35-41% of the width of the mentum; each with about 32-35 striae; VMR about 0.36. PE (Fig. a, below) with about 13 (10-16, 8) sharp pointed teeth.
Premandible (Fig. b, below) with sharp teeth, outer tooth shorter than inner tooth, which is about twice as wide as the outer tooth.
Antenna (Fig. c, below) with moderately long A1, almost 4 times longer than wide, RO between 0.4 and 0.5 up from the base of the segment; relative length of antennal segments (micron) 110 : 24 : 6 : 11: 7 ; AR 2.03-2.30.
Mandible (Fig. f, below) about 208-228 mm long, with 3rd inner tooth relatively pale and only partly separated (type IIA), about 13 (12-14,8) furrows on outer surface at base, PMa sparse, with about 8 (7-10,5) setae.



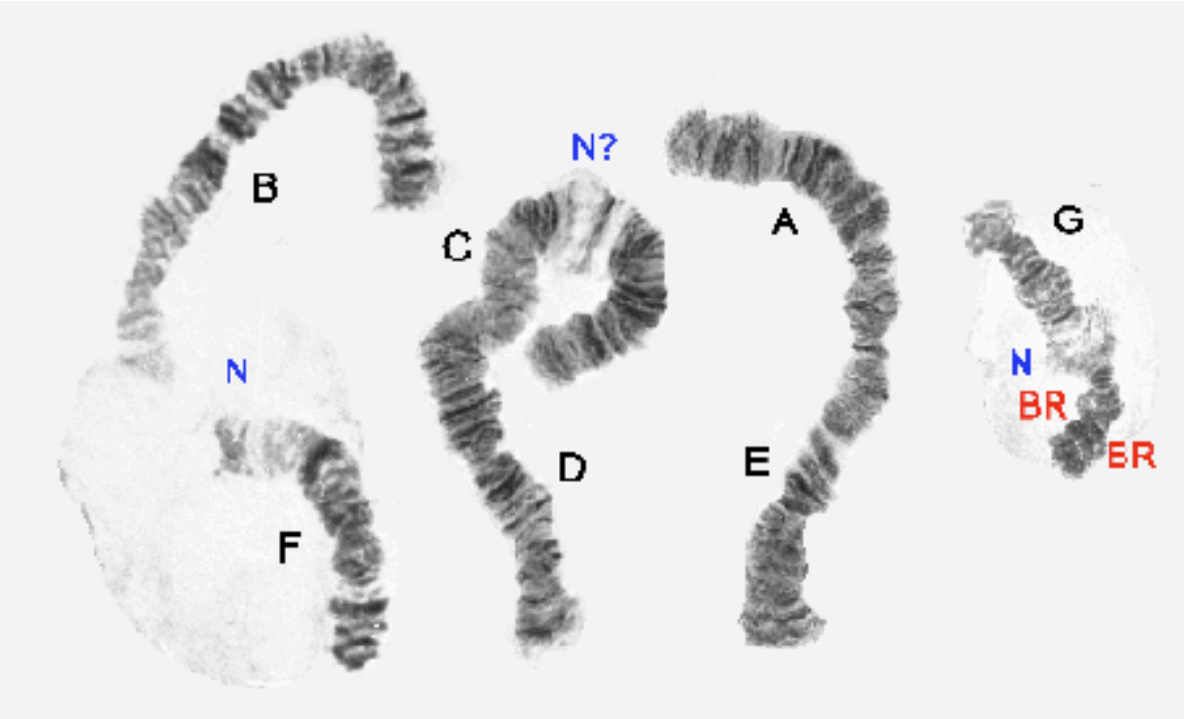
Larval head capsule characters of *C. samoensis*

Cytology: 4 polytene chromosomes with the pseudothummi arm combination AE, BF, CD, G.

Nucleolus medial in arm G; two Balbiani rings distal to the nucleolus.
A further nucleolus at about group 20 of arm F and there is a large puff in arm C that might also be a nucleolus.
All chromosomes closely paired. No polymorphism in the available specimens.

samA1:	1 - 2c, 10 - 12, 3 - 2d, 9 - 4, 13 – 19	as *holomelas*
samB1:	Puff of group 7 near distal end of the arm with dark bands proximal to it.	
samC1:	Characteristic groups 3-4 just proximal to the large puff.	
samD1:		
samE1:	Groups 11-13 near centromere.	
samF1:	Groups 20-23 near centromere, with nucleolus about group 20.	

The polytene chromosomes of *C. samoensis* also differ from those described for the others species in the group. The arm combination is pseudothummi-cytocomplex, as in the other species, but the most obvious difference is that the nucleolus in arm G is near the middle of the arm, rather than almost terminal. There is a second nucleolus near the diagnostic bands of arm F, and generally a large puff, which may be a nucleolus, near the middle of arm C.



Polytene chromosome complement of *C. samoensis*

Diagnosis

Based on these descriptions, diagnostic features of the species are: Frontal tubercles relatively long; LR about 1.50-1.52, fore Ta5 about one third of the length of the fore tibia, SVo of the D-type, or "beaked"; in female fore Ta4 longer than Ta3 and about the same length as Ta2. In larva, antennal segment 3 relatively short, usually shorter than A5. In the polytene chromosomes, the nucleolus in arm G is median, and there is a further nucleolus about region 20 of arm F and usually a large puff in arm C.

Found: Type localities - Apia, Western Samoa; Faratogo, Tutuila (now American Samoa); Tonga.
American Samoa - Mapusaga, Tutuila.

Micronesia – South Mariana Is.; Palau, Yap, Truk, Ponanpe, Kusaie, , Caroline Atolls, Marshall Is.(Tokunaga 1964)

***Chironomus vitellinus* Freeman 1961**

Synonyms:

Incorrectly placed as a synonym of *C. javanus* by Chaudhuri *et al.* 1992

Yamamoto (2002) has suggested that this species should be in a separate subgenus *Austrochironomus*.

In BOLD Bin: BOLD:AAG6924
as *C. javanus,* but most specimens are actually *C. vitellinus.*

Adult:

This is rather variable species across its wide distribution. This is likely due to different selection pressures in different habiats but also. in some cases, to genetic drift if island populations re established by a small number of founders.

Freeman's original description:

Thorax of a yolky colour, dull with prctically no pruinosity; legs whitish, especially on tibiae, tarsal segments black at joints; abdomen without dark markings but quite strongly pruinose at incisures and on segments 5 and 7; anal point of male narrow in side view. The white legs with dark marked tarsi and the pale abdomen make this species easily recognized: the hypopygium is also characteristic.
Wing length. – 2.5-3.0 mm.
Male. – Head., mouthparts, and antennae yellowish brown, plumes paler, FT present, A.R. abot 4.5. *Thorax* a dull reddish yellow, yolky colour, very slightly pruinose near the front; shoulders and immediate areas slightly tinged with greenish; dorsocentral bristles only present in in posterior half of thorax. *Legs* with femora very pale green, tibiae and tarsi whitish, the tarsi have definite black markings across the joints between segments; anterior tarsi not bearded, LR about 1.8. *Wings* pale, crossvein darkened. *Abdomen* yellowish green, lacking definite darkmarkings; incisures and segments 5 and 7 with quite strong pruinosity; hypopygium with anal point narrow at base, curved and finger-like in lateral aspect; appendage 2 (IVo) short and stout, styles broad at base and rather sharply narrowed at apex.

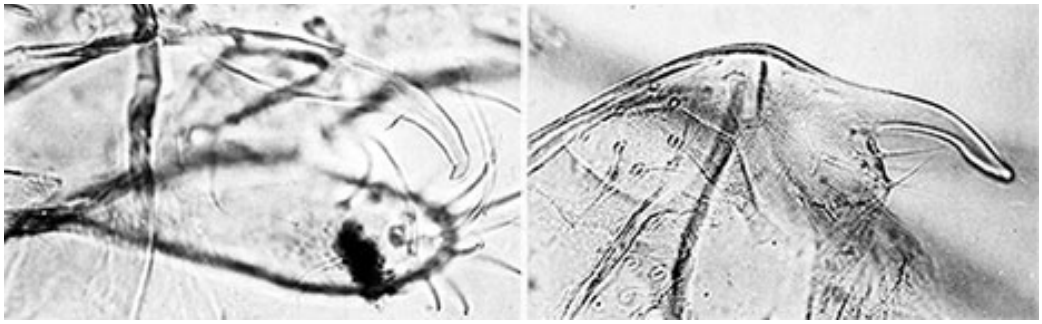
Female. – Resembles male; sensory hairs on apical antennal segment longer than usual.

Further information from a Paratype male from Mafulu, Papua New Guinea:
Cephalic tubercles about 30 µm; 14 clypeal setae.
Palpal proportions (segs 2-5 (µm)) 60 : 170 : 200 : 140 (shrivelled).
Thoracic setae: 6-7 dorsocentral; prealar 4; others not evident.

Leg lengths (micron) and proportions:

Male	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1220	1050	1120	955	840	770	350	1.60	1.16	no beard
PII	1305	1130	760	395	280-	190	140	0.67	1.15	-
PIII	1435	1445	1130	610	465	290	160	0.78	0.99	-

9 setae in individual pale spots on TIX. Setae on IVo simple.



SVo and IVo (left) and lateral view of anal point of paratype male of *C. vitellinus*

Further descriptions:

Male

Wing length 2.64 (2.07-3.00) mm, width 0.64 (0.56-0.73) mm; VR 0.95 (0.92-0.98); 2 Scf on brachiolum, 19.5 (17-22) setae on squamal fringe.

Freeman (1961) quotes the AR as about 4.5, but in other populations the AR is lower: 3.34 (2.89-4.5).

Head: FT 43.7 (30-55) µm long and 2.4-2.6 times longer than wide. Palpal proportions (micron): 49 : 46 : 157.5 : 191 : 272 :P5/P4 1.45 (1.25-1.74); P5/P3 1.79 (1.40-2.17). Clypeus about 0.60 (0.47-0.75) of antennal pedicel, with about 18.2 (11-23) setae.

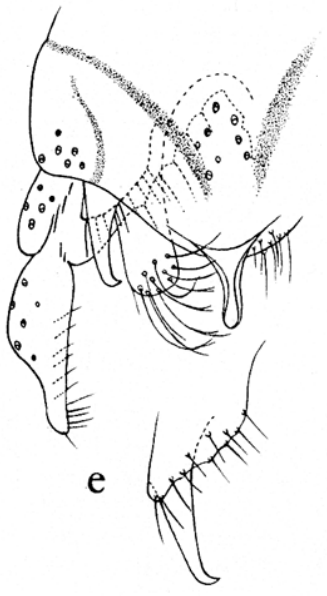
Thoracic setae: acrostichal at least 11-14; dorsocentrals 9.7 (5-14); Prealar 4.25 (3-5); Supraalar 1; Scutellar 10.75 (13-17), 2-6 in anterior row, 5-11 in posterior row.

Leg lengths (microns) and proportions as follows:

Male	Fe	Ti	Ta1	Ta2	Ta3	Ta4	Ta5	LR	F/T	BR
PI	1245	970	1480	895	715	740	340	1.56-1.93	1.11-1.27	0.46-1.60
PII	1215	1085	715	370	270-	180	135	0.64-0.70	1.10-1.17	-
PIII	1325	1345	1075	575	425	270	165	0.77-0.83	0.95-1.00	-

Tergite IX with 6.3 (5-9) setae in individual pale patches.

Hypopygium with narrow anal point expanded at distal end, strongly turned down and narrow in lateral aspect (see above); SVo well developed and curved, perhaps closest to E(g) of Strenzke (1959); IVo reaching about to 1/3-1/2 length of gonostylus, with 12-14 incurved simple setae (although Tokunaga's figure appears to show them as forked). Gonostylus may not be as swollen as shown in Tokunaga's figure but narrows conspicuously over posterior third to half, with 5+1 setae at the tip.



Male terminalia from Tokunaga 1964

Female

Freeman's (1961) description of *C. vitellinus* – Resembles male; sensory hairs on apical antennal segment longer than usual.

Other specimens:

Wing length 2.91 (2.58-3.16) mm, width 0.79 (0.75-0.91) mm; VR 0.91 (0.89-0.93); 2 Scf on brachiolum; 15.6 (13-16) setae in squamal fringe.

Coloration essentially as in male.

Head: FT present 28.1 (7.5-35) long and 1.0-2.8 times longer than wide. Antennal segments (micron) with percentage neck in brackets: 171 (28) : 126 (46) : 130 (49) : 129 (49) : 240; AR 0.37 (0.33-0.43); A5/A1 1.23 (1.0-1.46).

Palpal segments (micron): 54 : 50 : 180 : 220 : 335; P5/P4 1.4; P5/P3 1.86. Clypeus heart-shaped, about 1.28-1.55 wider than antennal pedicel; abt 23 (16-39) setae.

Thoracic setae: Acrostichals – 11.5 (9-16); Humerals – 3.6 (3-5), mostly linear but may be grouped (e.g. as a triangle); Dorsocentrals – 15.2 (9-260); 18.7 (13-30) including the Humerals (lower in Pacific Islands); Prealars – 5 (4-8); Scutellars in two rows – 2.2 (0-6) in anterior row and 10 (8-13) in posterior row (total 8-19).

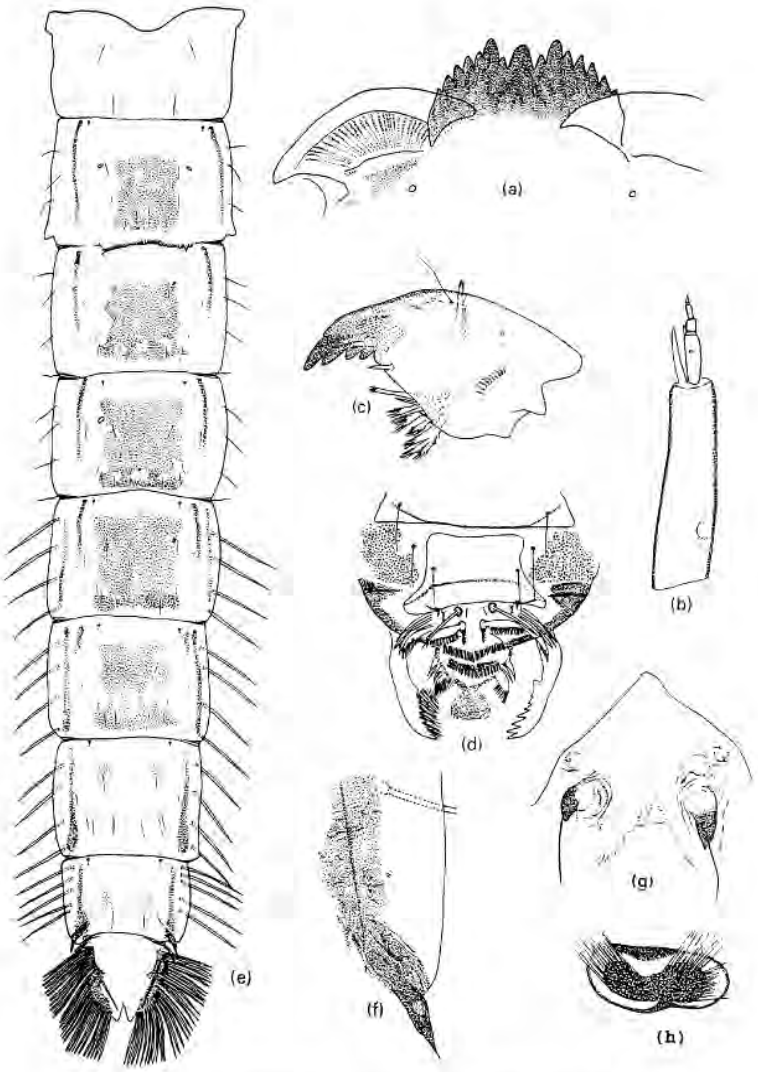
Leg lengths (microns) and proportions as follows:

Female	**Fe**	**Ti**	**Ta1**	**Ta2**	**Ta3**	**Ta4**	**Ta5**	**LR**	**F/T**	**Ta4/Ti**
PI	1345	950	1715	975	825	875	390	1.69-1.92	1.16-1.65	0.80-0.99
PII	1240	1160	690	335	245	180	125	0.58-0.65	1.04-1.13	
PIII	1365	1460	980	500	415	270	150	0.63-0.77	0.90-0.99	

Anterior Ta4 longer than Ta3.

GcIX with 3.7 (2-6) setae; segment X usually a half-oval 91-177 µm wide and 2.99 (2.1-5.36) times longer than greatest width, with about 11.4 (10-13) setae. Sasa & Hasagawa (1983) note that the cercus is roughly rhombic, 112x152 µm; usually with a ventral basal bulge.

Pupa has been illustrated by P.S. Cranston in his Electronic Guide to Chironomidae of Australia (reproduced below with permission).
Length: Male 6.38 (6.38–6.70) mm; female 7.01 (6.90–7.14) mm. Exuviae grey. Cephalic tubercles 86.3 (81-110) µm long and 56.5 (51-70) µm in diameter, subapical seta about 56 (38-90) µm long, i.e. about as long as the FT. There is slight development of a frontal wart (see Cranston figure g below) – abt 38 x 6 µm. Respiratory base about 132.7 (119-157) x 62.25 (51-81) µm wide; HR 2.16 (1.94-2.35). 2 pairs of precorneal setae.
Abdomen with PSA caudolateral on segments IV-VI, that on segment IV about 145 (116-157) x 89 (71-111) µm wide and about 22 (18-24)% of the segment length; PSB basolateral on segment I and small caudolateral on segment II, which also bears a caudal row of about 66.2 (54-81) hooks which occupy 58-68% of the segment width. Caudolateral spur of segment VIII usually with 1+2sm (1-4) spines, although commonly only 1 is long. Swim fin with about 70.29 (61-78) taeniae in two rough rows (particularly distally).



CHIRONOMINAE: Chironomini: *Chironomus vitellinus* Freeman. Larva: (a) mentum, (b) antenna, (c) mandible, (d) dorsal head; Pupa: (e) tergites, (f) posterolateral spur, (g) cephalic area, (h) base of thoracic horn.

Reproduced from Cranston's Electronic Guide to Chironomidae of Australia, (with permission)

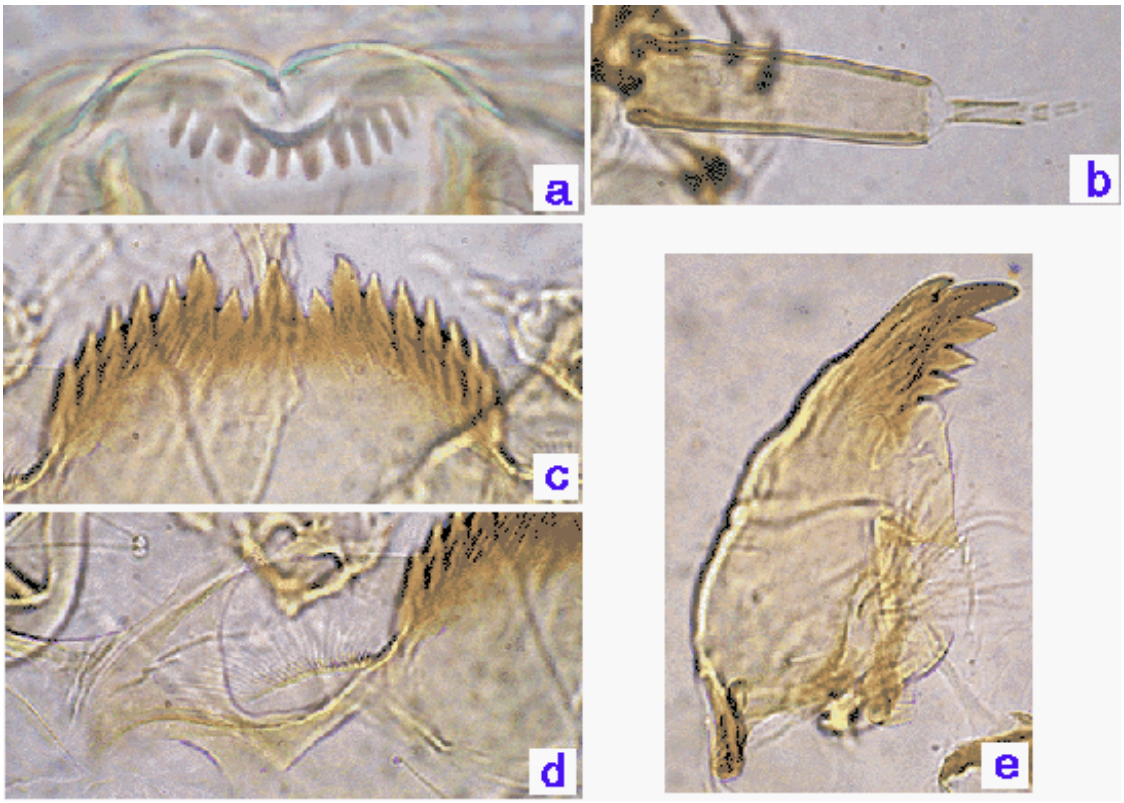
Fourth instar larva: a medium sized, essentially plumosus-type larva, although TLt (656 (520-800) µm long are more ventrally placed than in other species. Length 11.5 (10.5-12.5)(female) 9.75 (9-10.5)(male) µm and VT long, anterior pair 1.84 (1.32-1.84) µm generally longer than posterior pair 1.62 (0.96-2.16) µm. AT with median constriction, dorsal about 550 (500-600) µm long and 3.57 times longer than wide; ventral 430 (420-440) µm long and 3.67 times longer than wide. Salivary reservoir (1 specimen) 86 x 15 µm (5.4 times wider than deep.

Gula pale or slightly darkened on posterior third, slightly wider than mentum width and widest at the posterior margin; FC pale.

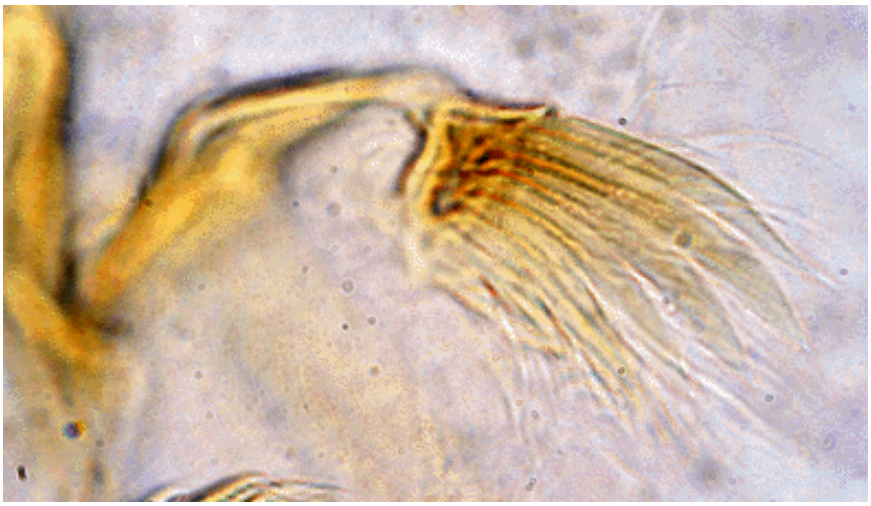
Mentum (c, below) with the central trifid tooth set below the 1st laterals (although not always obvious if the 1st laterals are worn), and the c2 teeth markedly separated from c1 tooth (type IIA) and pointed towards it; 4th laterals at most slightly reduced (type I). PE (a, below) with about 14 (12-16) often irregular teeth (Type D). Ventromental plates (d, below) about 3.8 times wider than deep; separated by about 0.36 of the mentum width, with about 31 (27-32) striae.

Antenna (b, below) with the basal segment about 3.5 times as long as wide; AR about 2.65 (2.47-2.83); ratio of segments 116.5 : 25 : 5.5 : 8 : 5. Distance between S4 setae (142 µm) larger than with between antennal bases (121µm). S5 setae about level with nearby RO.

Mandible (e, below) about 207 (199-215) µm long, with third inner tooth darkened and completely separated (type IIIC), with three spines on inner margin, and about 11-12 furrows on the outer surface at the base; Mdt/Mat about 24, MTR 0.38 (0.32-0.48).



The larva is most readily recognised by the unusual premandible, which has 7 teeth (as opposed to *C. javanus* which has only 6) rather than the usual two.

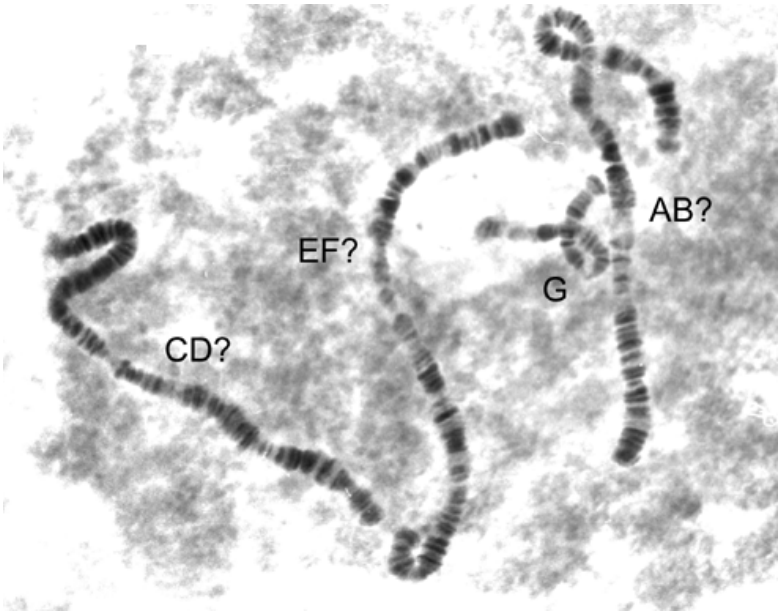


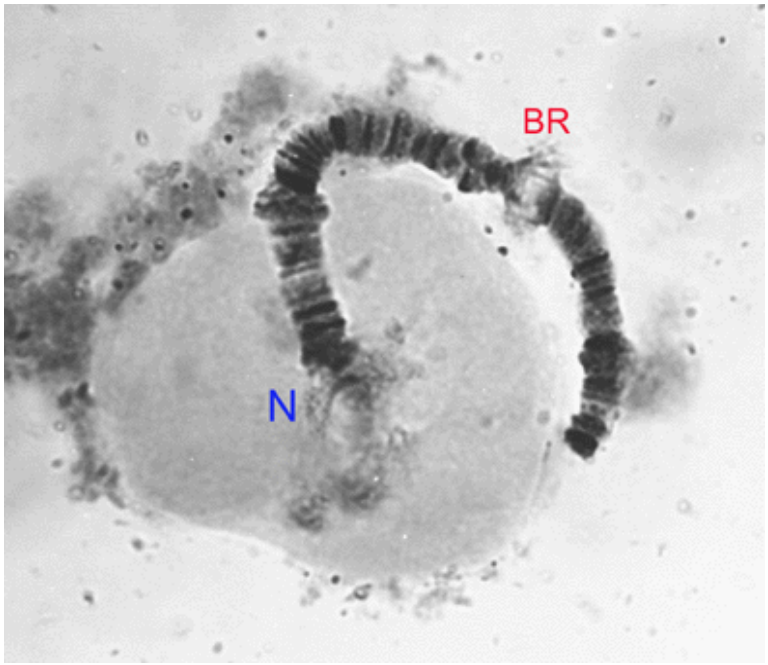
Premandible of C. vitellinus larva with 7 teeth.

Some larval characters have also been illustrated by P.S. Cranston in his Electronic Guide to Chironomidae of Australia, as *C. vitellinus*. These are reproduced with the pupa above (with permission).

Cytology: 4 polytene chromosomes, possibly with the thummi arm combination AB, CD, EF, G, but Keyl arms very difficult to recognize. Nucleolus virtually terminal in arm G, with large BR near middle of the arm; closely paired. No nucleolus in long chromosomes.

vitA1:
vitB1: Puff (gp. 7) about one third from distal end of the arm with dark bands distal.
vitC1:
vitD1:
vitE1:
vitF1:
vitG1: Nucleolus subterminal,BR about one third from other end; closely paired.





Molecular: The mitochondrial *COI* barcode sequence is available in GenBank (Accession number DQ648203) for a specimen from Japan.
It seems likely that the majority of specimens identified as *C. javanus* in the BOLD database are actually *C. vitellinus.*

The males are easily recognised by the unusual genitalia and the larvae by the multitoothed premandible.
The pupa is a fairly typical for *Chironomus* but the possibility of frontal warts is unusual.
The female may be distinguished by the generally wider segment X (often semi-oval) and the fore Ta4 being longer than Ta3.

Found: Type locality - Darwin, NORTHERN TERRITORY.
Fiji: Nadi (-16.33ºS, 179.50ºE), Viti Levu ; Labasa (-16.33ºS, 179.50ºE), Macuata Province, Vanua Levu.
Papua New Guinea: Mafulu (Paratype)
Micronesia: Caroline Islands and Marshall Islands (as *C. javanus*) (Tokunaga 1964)
Broadly distributed through India, Indonesia, Japan and Pacific Islands. Also recorded at Blantyre, Malawi.

Chironomus* species Fiji1 (Chironomus* "harrisi")

Larvae and reared adult male from a channel with thick red gravel bottom, going under a road

In BOLD Bin: BOLD:AEB1420

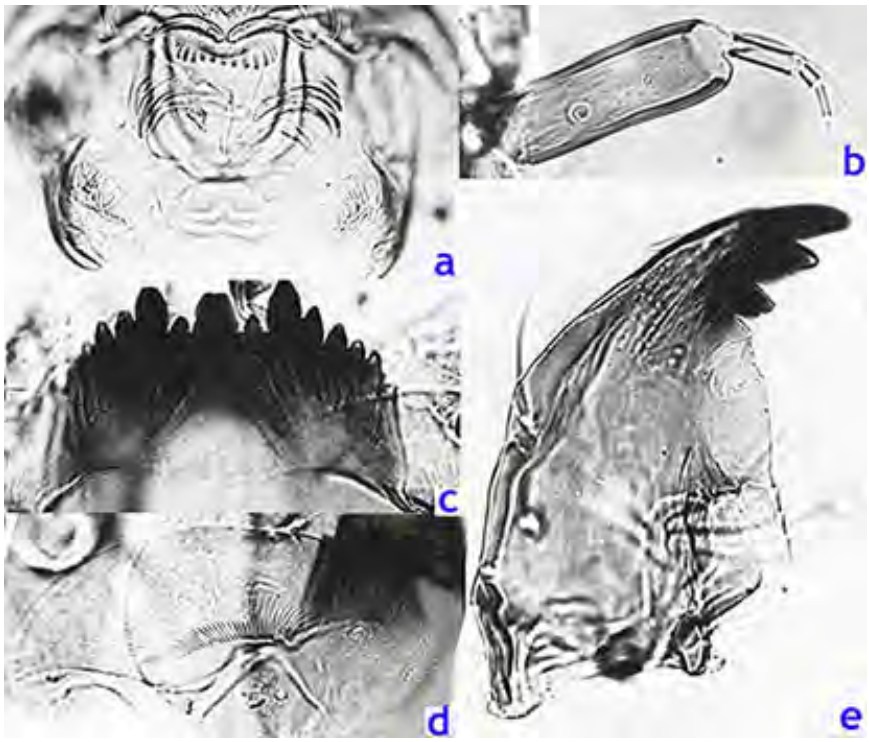
Adult:

Male; Wing length 3.0 mm, VR about 1; 3 Scf on brachiolum; squama fringed. Crossvein and posterior fork both darkened.
Head: AR 2.43; Frontal tubercles 50.5 µm and 3.3 times longer than wide. Clypeus broader (1.06) than diameter of antennal pedicel; 34 clypeal setae. Palp proportions: 50 : 70 : 230 : 270 : 360 : P5/P4 1.33.
Thorax appears pale. Setae: Acrostichal at least 9; Dorsolateral 9 in about 2 rows; prealar - 6; supraalar - 1; scutellar 22, with about 9 in anterior row, 13 in posterior row.
Leg lengths (micron) and proportions:

Pupa: Exuvia quite dark. Cephalic tubercles about as wide as long, subterminal setae about as long as tubercle. Spur of segment VIII with about 7 closely applied spines.

Fourth instar larva: Small bathophilus-type larva, 12.3-14.7 mm (female 14.2-14.7 mm; male 12.3.mm); anterior VT longer 0.64 (0.48-0.72) mm. than posterior pair 0.58 (0.48-0.62 µm); dorsal anal tubules longer (260-361 µm long and 110-150 µm wide; 2.17-2.72 times longer than wide), than ventral pair (280-365 µm long and 113-180 µm wide; 2-2.7 times longer than wide). Salivary reservoir about 86-88 wide and 20 µm deep (4.25-4.4 times wider than deep).
Head with pale gula and frontoclypeus. Mentum with central trifid tooth of type IIA or III, VM (Fig. d, below) width 190-209 µm, about 3.2-3.6 times wider than deep; 1.2-1.27 times wider than mentum and separated by about 0.29-0.31 of the mentum width; about 34-43 striae; VMR about 0.22-0.30.
PE (Fig. a, below) with about 11-14 teeth, probably of type B when not worn. Premandible (Fig. a, below) probably of type B, of the normal *Chironomus*-type, clearly distinguishing it from *C. vitellinus*; outer tooth about 3-3.5 times wider than the outer tooth.
Antenna ((Fig. b, below) with A1 relatively short (0.38 of VHL); 3.2 times longer than wide, with RO about 1/3 up from base of segment; AR 1.71-1.74; A2 about 0.29 of A1; segment proportions (micron) 105 : 30 : 9.5 : 13 : 7.5.

Mandible (Fig. e, below) of type IA-B; length 200-216 µm; 17-19 furrows on outer surface near base; 9-11 taeniae in PMan; Mdt-Mat 30 (MTR 0.43-0.44).



Cytology: Four polytene chromosomes of the pseudothummi-cytocomplex – AE, BF, CD, G. No polymorphism in available specimens. Main nucleolus appears to be distal on arm F. Arm G closely paired with a nucleolus or large BR just anterior to middle of the chromosome. Other BRs may be developed near each end.

Tokunaga (1964) described 6 species from Micronesia that have dark spots over the cross-veins, but none of these fit the characteristics of this species and so it is considered to be a new species.

Holotype: Adult male with pupal and larval exuvia from Wiaqele, Vanua Levu, Fiji, FVA.3.1 reared male 1 (8 September 1967), JM; Paratypes: larvae, same data as holotype.

Other specimens: Skylodge Hotel, Nadi, Viti Levu, FVI.2.2 larvae reared from an eggmass (27 February 1971), JM.

The proposed species name is an acknowledgement to Howard and Merran Harris who provided accommodation and assisted with my field work on Vanua Levu.

Found:

Fiji: 3Km w. Waiqele (-16.55°S, 179.50°E), Macuata Province, Vanua Levu.
Skylodge Hotel, Nadi (-18.13°S, 178.45°E), Viti Levu.

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