The Australian species of *Neozavrelia* Goetghebuer (Diptera: Chironomidae: Tanytarsini)

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Abstract

The genus *Neozavrelia* Goetghebuer (Chironomidae: Diptera) is represented in Australia by two species, described here for the first time. The species conform well in all life-history stages to diagnoses based on Holarctic congeners. An associated female allows provision of a modern description of the female genitalia for the first time. In the larval and pupal stages, both Australian species form tough silk tubes within sandgrain cases in the hygropetric zone of seepages across rock surfaces. One species, *N. optoputealis* sp.n., was found on a limestone seepage in a road cutting in the Blue Mountains, north-west of Sydney. The second species, *N. bowmani* sp.n., came from a seepage on a vertical rock face in a sandstone canyon in an unusual gorge area of central Arnhemland, Northern Territory, where some gondwanan refugial taxa co-occur in a monsoonal/relictual rainforest habitat. The biology of *Neozavrelia* is reviewed, with a suggestion that the hygropetric and perhaps more eurythermic habit appears to be more common than lotic and cool stenothermic habitats.

Key words

Chironomidae, hygropetric, *Neozavrelia*, Tanytarsini

INTRODUCTION

The genus *Neozavrelia* was described by Goetghebuer (in Goetghebuer & Thienemann 1941) for a midge reared by Thienemann from larvae collected in Lunzer See, Austria. The immature stages were described in a subsequent publication by Thienemann (1941). The type species, *N. luteola* Goetghebuer, remained the only known *Neozavrelia* species until Fittkau, in an extensive redes-cription of the genus, added three new species based on the adult stages (Fittkau 1954). Subsequently, two of Fittkau's taxa were treated as synonymous and three more species, from Afghanistan, Europe (Reiss 1968) and Mongolia (Reiss 1971) were added.

The geographical range of the genus was extended by Coffman (1978), who reported pupae from the eastern United States. From the southern Palearctic, and on the male adult alone, Albu (1980) described a new species from Romania, and Cranston (1989) described two species from Saudi Arabia and Israel. In the eastern Palearctic, Sasa and Kawai (1987) recognised two species described previously in other genera actually belonged to *Neozavrelia*: *bicoliocula* (Tokunaga) and *tamanona* (Sasa), and subsequently Sasa (1989) described a third Japanese species, *shoualba* Sasa. In reviewing chironomid zoogeography, Ashe et al. (1987) cited Wiederholm (1983) for an Oriental record of *Neozavrelia*, but no further information on that taxon has been published.

Diagnoses of the immature stages of *Neozavrelia*, which rely on Wiederholm (1983, 1986), were based on a smaller range of taxa than for the subsequent adult male diagnosis (Wiederholm 1989). More recently, additional taxa, including two new species from Australia known in all life-history stages, allow provision of a diagnosis for the female, some emendations to the generic diagnoses of the remaining stages, elaboration of ecological information, and extension of the range of the genus.

METHODS AND MORPHOLOGY

Morphological terminology and abbreviations follow Sæther (1980) except where Langton's (1994) suggested use of 'taenia (adjective taeniate) for 'filamentous' or 'lamellate' setae is adopted. All measurements are in μm, unless stated otherwise. Abbreviations: ANIC, Australian National Insect Collection; L(Le), larva (exuviae); n, number of specimens examined, range shown to demonstrate variation in ability to measure some features of specimens; P(Pe), pupa (exuviae).

*Neozavrelia Goetghebuer in Goetghebuer and Thienemann (1941)*

Type species, *Neozavrelia luteola* Goetghebuer by monotypy.

Generic diagnosis. Larva as in Wiederholm (1983) except that the Lauterborn organ pedicles are so long that they may extend beyond the apex of the antennal flagellum (Fig. 1e,f) and the fifth lateral tooth of mentum may be weak to prominent (Fig. 1b,c).
Pupa as in Wiederholm (1986) except that exuviae may be pale, frontal setae may be absent, thoracic horn may lack apical teeth, wing sheath nose may be small, tergal shagreen may range from virtually absent to widespread, especially on tergites II–VI (Fig. 2b), and anal lobe fringe ranges from restricted to posterior or anterior tuft of few taeniae, to absent (Fig. 2e).

Adult male as in Wiederholm (1989). The antenna appears basically to have 13 flagellomeres, in which the division of the apical flagellomeres can be variably obscured (‘antennenendgled...segmentiert oder nicht segmentiert [Reiss 1968]) and often distinctly reduced, to as low as nine or 10 flagellomeres. Differentiation of species solely by antennal flagellomere number (as in Sasa & Kawai 1987) is suspect.

Adult female very like that of Stempellinella (Saether 1977). Antenna four-segmented. Genitalia with gonocoxapodeme VIII very faint, scarcely recognisable. Notum short with slightly diverging rami (Fig. 4a). Sternite VIII forming large floor under anterior vagina, without suture (Fig. 4b). Gonapophysis VIII simple (Fig. 4c) with caudolateral point and moderate-length setae. Tergite IX rounded, setose, with slight shoulders. Gonocoxite IX small, with three to four setae. Postgenital plate triangular. Cerci small. Seminal capsule subovoid, with distinct neck. Sinuous spermathecal ducts ending separately.

Neozavrelia optoputealis sp.n.

Types. New South Wales: holotype Le/P male, nr. Capteree, Wishing Well, 33°11'S, 150°00'E, 22.I.1991, P.S. Cranston (ANIC); paratypes, same locality, 1 Le, 1 Pf, 1 Le/Pm (ANIC).

Fourth-instar larva. (n = 3). Mid-dark brown head capsule; body not observed. Total length not measurable, head capsule length 270–280 long. Antennal segment lengths: 31–37, 7–8, 4–5, 5–6, 4, AR 1.5–1.6 (Fig. 1c). Mandible (Fig. 1d) 83–88, mentum (Fig. 1a,b) 55–57, ventromental plate 66–70.

Pupa. (n = 1–3). Pale, with narrow brown apophyses and golden-brown comb. Length 2.3–2.7 mm. Frontal setae 40–45. Thoracic horn 180, without spinules. Nose 2–10 long. Comb with multiple spines (Fig. 2c). Anal lobe fringe of eight to 10 setae of maximum length 110 (Fig. 2a).

Adult male. (n = 1–2, pharate). Pale yellow-brown with brown vittae. Body length ca 2 mm. Antenna with 11 flagellomeres, AR 0.45. Eye with minor pubescence on ventromedian margin. Twelve postoculars, five clypeals. Frontal tubercles absent. Thorax with all setae uniserial, 13–15 ac, 8–10 dc, 2 pa, 6 sc. Wing with microtrichiae restricted to apical quarter and anal lobe of wing; all veins densely setose. LR1 1.9. Hypopygium as in Fig. 3b,d,f.

Fig. 1. Neozavrelia larvae: (a) mentum of N. optoputealis; (b, c) outermost mental teeth of (b) N. optoputealis and (c) N. bowmani; (d) mandible of N. optoputealis; (e,f) antenna of (e) N. optoputealis and (f) N. bowmani.
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**Fig. 2.** Neozavrelia pupae: (a) abdomen of *N. optoputealis*; (b) tergites II and anterior of III of *N. bowmani*; (c,d) anal combs of (c) *N. optoputealis* and (d) *N. bowmani*; (e) anal lobe of *N. bowmani*.

Adult female. (*n* = 1, pharate). Antenna with four flagellomeres, 70, 56, 77, 81; AR 0.4. Thoracic setation: 10 ac, 9 dc, 1 pa, 6 sc. LR, 1.84. Genitalia as in Fig. 4a-c.

**Etymology.** From opto, I wish, and putealis adj. from puteus, a well, alluding to ‘Wishing Well’, the type locality. Male or female.

**Neozavrelia bowmani sp.n.**


**Fourth-instar larva.** (*n* = 3–5). Golden to mid-brown head capsule; body not observed. Total length not measurable, head capsule length 210–225 μm long. Antennal segment lengths: 29–35, 7–9, 11–13, 7–8, 6, AR 0.9–1.1 (Fig. 1f). Mandible 66–70, mentum (Fig. 1c) 51–55, ventromental plate 60–66.

**Pupa.** (*n* = 1–2). Brownish, with darker apophyses and golden-brown comb. Length 2.2 mm. Frontal setae absent. Thoracic horn 154–168 narrower, without spinules. Nose 8–10 long. Comb (posterolateral corner of segment VIII) with few stronger and fewer spinules (Fig. 2d). Anal lobe without taeniae (Fig. 2e).

**Adult male.** (*n* = 1–2, pharate). Pale yellow-brown with brown vittae. Body length 1.8–2.1 mm. Antenna with 12–13 flagellomeres, AR 0.58–0.63. Eye with minor pubescence on ventromedian margin. Frontal tubercles absent. Thorax with eight acrostichals, six dorsocentrals, one to two prealars, four scutellars. Foreleg spur 20–25 long, mid-leg combs and spurs as in Fig. 3g. Wing with microtrichiae restricted to apical and subapical membrane; all veins densely setose. Hypopygium as in Fig. 3a,c,e.

**Adult female.** Unknown.

**Etymology.** Named for David Bowman, ardent territorean and conservationist, and guide to the type locality. To be treated as a noun in apposition.

**Key to larvae of Australian Neozavrelia**

1. Each of apical three flagellomeres of antenna > 5 μm long; AR about 1 (Fig. 1f). Outermost (fifth) lateral mental tooth strong (Fig. 1c) .................. *N. bowmani*
   - Each of apical three flagellomeres of antenna < 5 μm long; AR about 1.5 (Fig. 1e). Outermost (fifth) lateral mental tooth weak (Fig. 1b) ........... *N. optoputealis*

**Key to pupae of Australian Neozavrelia**

1. Anal lobe without fringe (Fig. 2e). Comb of fewer stronger marginal spines (Fig. 2d). Frontal setae absent .................................................... *N. bowmani*
   - Anal lobe with sparse fringe (Fig. 2a). Comb with more and finer marginal spines (Fig. 2c). Frontal setae present ........................................... *N. optoputealis*

**Key to adult males of Australian Neozavrelia**

1. Anal point narrow. Superior volsella with postero-median inner-directed projection (Fig. 3a,c). Median volsella (Fig. 3e) medially directed ............ *N. bowmani*
   - Anal point broad. Superior volsella without projection (Fig. 3b, d). Median volsella (Fig. 3f) posteriorly directed ........................................... *N. optoputealis*

**Comments**

*Neozavrelia bowmani*, with 13 reasonably distinct flagellomeres, lack of frontal tubercles and particular
genitalic features resembles *Neozavrelia bernensis*, the basal taxon in Reiss's (1968) male adult-based phylogenetic argumentation scheme. This basal position somewhat conflicts with the pupa of *N. bowmani*, in which the loss of the anal lobe taeniae must be considered a derived feature, otherwise found only in *Neozavrelia longiappendiculata* Albu (Langton 1991). *Neozavrelia optoputealis* resembles the more derived species from Saudi Arabia (Cranston, 1989), but is unique in genitalic features, including the simple setae on the median volsella. Ideally, all life-history features should be considered in deducing the phylogeny (e.g. Cranston & Edward 1998) and, since in this genus too few immature stages are known, further speculation is unwarranted.

**Ecology**

The sites from which the two Australian species of *Neozavrelia* have been collected are extremely similar: vertical rockfaces across which a thin film of water seeped. On the surface the many tubes of fine sand grains appear to be randomly orientated with respect to aspect and water flow. All tubes contained an inner lining of silk, the extreme toughness of which prevented manipulation in the field to remove any contents. Under a dissection microscope, a proportion of the tubes were seen to contain pupae, both pharate adults and exuviae, some of which retained larval exuviae attached posteriorly. Some tubes were found in virtually dry areas of the rock face, but the inability to examine each tube for content *in situ* means that it is impossible to say if these supported live *Neozavrelia*.

In the Blue Mountains at Capertee the exposed rock is limestone, which provides a similar habitat to that described for congeners in Europe (Fittkau 1954), whereas in Podocarpus Canyon (Arnhemland) the rock is ancient (Precambrian), weathered sandstone. The geological structure and permeability of limestone obviously leads to large numbers of seepages that probably flow with some permanence. In contrast, one might expect seepages in sandstone to be ephemeral, especially during the dry period...
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in the monsoonal tropics. However, in the case of Podocarpus canyon, the deep and fully shaded (by forest and aspect) gorge appears to provide a cool and humid microclimate even during the dry season. This is reflected in the site containing gondwanan taxa purported to be relictual from cooler periods, such as *Aphrotenielia* (Aphroteniinae) and the plant genus *Podocarpus* (Podocarpaceae).

No exuviae that can be allocated to *Neozavrelia* have been discovered among extensive collections made in many hundreds of Australian lotic systems or dozens of lentic systems surveyed with the pupal exuvial technique. This, together with observations on the remnant pupal exuvial contents of the tubes, suggests that the adult emergence occurs from the tube, with the exuviae retained in the tube. The generality of this behaviour cannot be determined at present. Exuviae of *Neozavrelia* are found in various standing European waters (Langton 1991) in which they never seem to be abundant (P.H. Langton, pers. comm.). There may be some European species that live other than in the strict hygropetric zone observed for both Australian taxa and for certain European species. Alternatively, the hygropetric habitat may be normal for all members of the genus, but circumstances can lead to increased transport of exuviae to lotic and even lentic habitats. Further collections in comparable seepage habitats are required to establish which is correct.

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**REFERENCES**


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