

THE EXTERNAL MORPHOLOGY OF THE FINAL-INSTAR LARVA OF *ANTIPODOCHLORA BRAUERI* (SELYS) AND THE DISTRIBUTION OF THE SPECIES IN NEW ZEALAND (ANISOPTERA: CORDULIIDAE)

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The final-instar larva of *A. braueri* is described and illustrated. This is the first formal description of a larva in this genus. The known and suspected distribution in New Zealand of this archaic member of the fauna is discussed. It is suggested that the larva described as *Procordulia smithii* (White), by G.V. HUDSON (1904, *New Zealand Neuroptera*, West & Newman, London) was *A. braueri*.

INTRODUCTION

Despite the paucity of the New Zealand anisopterous odonate fauna, taxonomic studies on the larvae of the endemic species are few. Only the larva of *Uropetala carovei* (White) has been described in any detail (TILLYARD, 1921; WOLFE, 1953), although HUDSON (1904) provided brief notes on this species and on the larva of *Procordulia smithii* (White), both of which he illustrated. Although Hudson's material has not been traced, it is almost certain that the specimen he took to be *P. smithii* was *Antipodochlora braueri* (Selys). PENNIKET (1966) provided keys to adults and final instar larvae of all the odonate species then known to occur in New Zealand; and TOWNS (1978) illustrated an early instar larva he identified as *Procordulia grayi* (Selys) which has since been determined to be *Hemicordulia australiae* (Rambur) (R.J. Rowe, pers.comm., 11.XII.1978).

A. braueri, described by Selys as *Epitheca braueri*, was subsequently transferred to the genus *Somatochlora* and ultimately assigned to the genus *Antipodochlora* by FRASER (1939). Among New Zealand's indigenous dragonflies, it is the one which is encountered least frequently. Recent records

show it to have a discontinuous distribution in the North Island from Kaeo (35°06'S 173°47'E) to Gollans Valley (41°19'S 174°54'E) near Wellington.

The imagines inhabit forested areas and are crepuscular in the sense that their peak activity occurs in the few hours before dusk. I have not found them active at dawn or for several hours afterwards but occasional specimens may be seen otherwise throughout the day hawking within shade. The larvae are usually found in small streams within native forest areas and the extensive clearing of indigenous vegetation which has occurred since the European settlement of New Zealand may account, in the main, for the discontinuous distribution of this species. However, their cryptic colours and behaviour ensure that imagines are not conspicuous even when the existence of large populations of larvae would lead one to expect that adults would be numerous. As an example of this, I have known of a thriving larval population in Crawley Creek (41°21'S 174°58'E) for several seasons and it is unlikely that the colony is of recent origin. The area about Crawley Creek has been the subject of intensive research by trained entomologists over a period of ten years during which time specimens of the other odonate species known to occur in the area were collected. However, the presence of *A. braueri* was not suspected until mention was made of the larval population (M.J. Meads, pers. comm., 12.I.1979).

DESCRIPTION OF THE FINAL-INSTAR LARVA

Material. — 22 specimens: 2 females, Crawley Creek (41°21'S 174°58'E) 4.VIII.1978, 3 males and 3 females, Gollans Stream (41°19'S 174°54'E) 2.IX.1978, 1 male ex unnamed tributary of the Catchpool Stream (41°21'S 174°56'E) 16.IX.1978, 8 males and 5 females Gollans Stream 8.X.1978, all collected by W.J. Winstanley. Other material examined is included in the paragraphs on distribution. Measurements given apply to the foregoing 22 specimens unless otherwise stated. Voucher specimens, a male numbered XVII and a female numbered XVI, each taken from Gollans Stream on 8-X-1978, have been deposited with the National Museum, Wellington where the rest of the material will be lodged later.

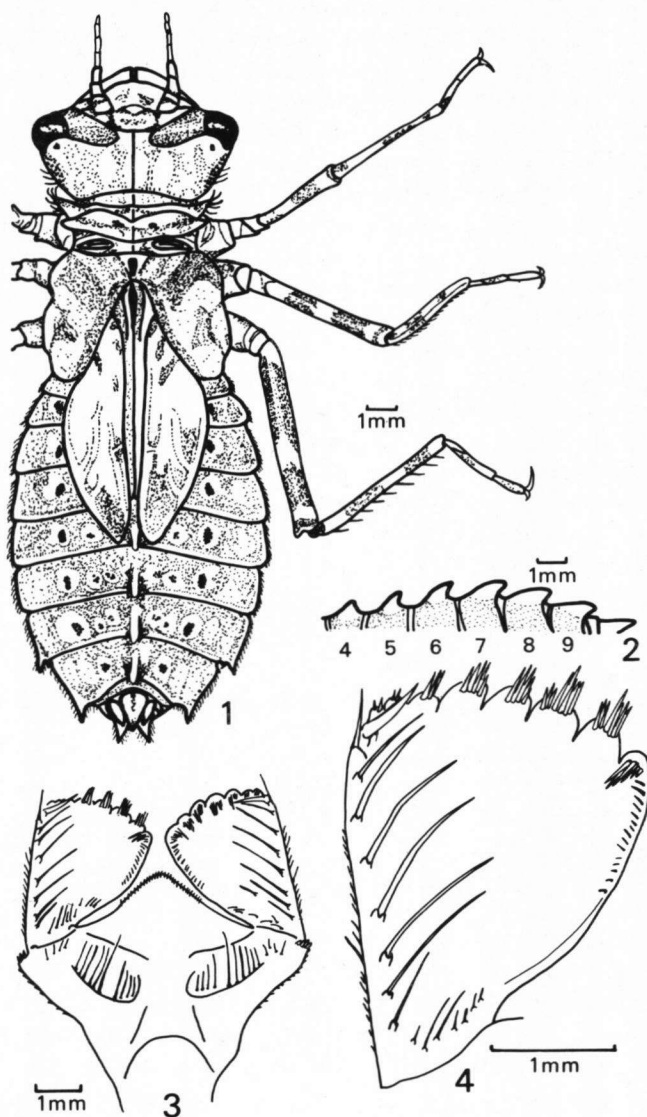
Methods. — Larvae were collected using a Surber sampler (SURBER, 1937). The substrate in front of the net was brushed but not otherwise displaced. Where the water flow was not sufficient to carry displaced organisms into the net, the water was paddled vigorously to generate a sufficient flow.

DESCRIPTION

The terminology used follows CORBET (1953) for the labium. A dorsal view of the final-instar female larva is shown in Figure 1.

Body Length. — Males 21-23 mm, mean 22 mm, females 21-24 mm, mean 22.1 mm. Total length was measured as the distance between the anterior surface of the head (excluding the antennae) and the posterior tip of the anal appendages.

Head wider than long, greatest width at the eyes 6.4-6.8 mm, mean



Figs. 1-4. *Antipodochlora braueri* (Sel.), morphology of the final-instar larva: (1) Dorsal view (♀); — (2) Left lateral view of the dorsal median hooks; — (3) Labial mask; — (4) Left labial palpus.

6.6 mm for males, 6.5–6.9 mm, mean 6.7 mm for females. Length from anterior margin of frons to posterior margin of postocciput 3.0–3.7 mm for males, mean 3.5 mm and 3.2–3.7 mm for females, mean 3.5 mm. Eyes large, lateral and slightly protuberant. Parietal lobes deep behind the eye with a prominent group of setae located dorsally immediately posterior to the eye showing as a dark spot. The postero-lateral margin of the parietal lobe bearing a group of thick, short, curved spiniform setae. The remainder of the head sparsely covered with small setae. Antennae 7 segmented, slender, sparsely hairy and normally held ventrad over the labium. Anterior margin of the frons with a fringe of piliform setae.

Prementum (Fig. 3). — Premental setae usually 10 + 10, rarely 9 + 10 or 10 + 11. Innermost 3 or 4 setae appreciably shorter than the outer setae and with the spacing interrupted between the short and the longer setae. Lateral margin of the prementum bearing scattered spiniform setae. Distal border of median lobe with numerous spiniform setae. Prementum short, extending to the middle of the mesothoracic coxae.

Palpus (Fig. 4). — Palpal setae 6 & 7 (1 specimen), 7 & 7 (3 specimens), 7 & 8 or 8 & 7 (10 specimens) or 8 & 8 (8 specimens). Outer margins of palpus bearing a fringe of piliform setae. Distal margin usually with 7 or, rarely, 6 or 8 crenations, that proximal to the moveable hook usually doubly-crenulate and the distal crenation frequently poorly defined. Each crenation bearing up to 14 spiniform setae of unequal length in one or two bunches (Fig. 5). The distal inner border of the palpus with numerous spiniform setae. Near the base of the palpus there is an ill-defined row of 5–7 spiniform setae.

Pronotum. — Anterolateral angles produced as lobes bearing numerous piliform setae. Posterodorsal lobes prominent.

Pterothorax 4.1–4.9 mm, mean 4.6 mm. Wings held parallel, forewings 7.3–8.1 mm, mean 7.7 mm, hindwings 7.0–7.6 mm, mean 7.2 mm. Hindwings

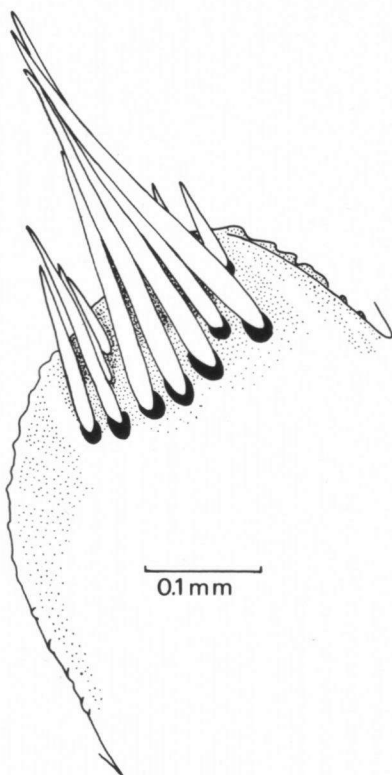


Fig. 5. *Antipodochlora braueri* (Sel.), final-instar larva: diagram of the labial crenation to show the grouping of setae. (Traced from a scanning electron micrograph).

reaching to the middle of abdominal segment 6 or 7. Costal setae inconspicuous.

Legs. — Progressively longer towards the rear. Femora cylindrical with four rows of longitudinal spines, those on the posterior dorsal margin of the metathoracic leg being most prominent. Tibiae with five longitudinal rows of spines. Tarsi 3-segmented, more or less triangular with a longitudinal row of spines on the dorsal angle and on each of the ventral angles. The distal segment of each tarsus with a pair of well developed claws.

Abdomen a truncated oval with posterior lateral spines only on segments 8 and 9. Tergites 4-9 dorsally bearing prominent medial horny hooks aptly likened by PENNIKET (1966) to the teeth of a circular saw (Fig. 2). Viewed anteriorly, the keels give the abdomen a distinctly triquetral appearance. In some earlier instars tergite 3 also has a hook and it may be seen in some final instars as a small spike. Tergites 2-9 with a prominent dark mid-lateral spot, flanked by a lighter area. Tergites covered with scattered short, spiniform setae and with a fringe of slightly longer setae laterally and along the posterior margin. A group of stout setae mesad to the lateral spines on segment 8 gives the appearance of a second spine on this segment. Sternites 3-5 with each lateral plate divided into a small, triangular antero-lateral and a larger, posterior sclerite. Median sternites 2, 3 and 9 in the male showing rudiments of the genitalia with similar rudiments in the female on the posterior margin of segment 8 and on segment 9.

Anal appendages. — Epiproct subtriangular, paraprocts longer and triangular. Epiproct and paraprocts fringed with long piliform setae. Cerci cylindrical, abruptly acuminate distally.

Colour. — Head grey-brown with deep brown markings, posteriorly suffused with green. Neck brown where sclerotised but green elsewhere. Pronotum pale grey-brown and green with dark brown sclerotised borders. Pterothorax mainly very dark brown but anteriorly green-brown speckled with dark brown. A dark brown lateral stripe extends from behind the eye, across the pronotum and along the dorso-lateral margin of the pterothorax to the wing bases. Wings pale grey-brown with deep brown at their bases. Abdominal tergites deep brown between the prominent mid-lateral pigment spots, laterally green or light brown with dark brown, almost black spots. Lateral margin of the abdomen and the tips of the dorsal keel golden brown. Legs grey-brown barred with dark brown. Labial palps and median lobe of prementum light brown speckled with black. Proximal portion of prementum light green. Thoracic sternites and abdomen dark applegreen. Abdomen speckled with small brown setae. Early instars are pale grey-brown ventrally. During the last month or more of the final instar, the pronotum and dorsal pterothorax are conspicuously whitened. All colours are described from living specimens: preserved specimens assume a uniform brown background colour with only the very dark pigments remaining prominent. Larvae kept

on light backgrounds assume a lighter coloration at the moult and larvae from deeply shaded streams have a much darker hue.

MAJOR DISTINGUISHING FEATURES OF THE LARVA OF *ANTIPODOCHLORA BRAUERI*

A. braueri can be readily distinguished from all other corduliid larvae known to occur in New Zealand by the large dorsal hooks on abdominal segments 4-9. Two other species have dorsal hooks developed to some extent; in *Hemicordulia australiae* the hooks are little more than a few spines extending beyond the posterior mid-line margins of the segments and are hardly noticeable in silhouette; *Procordulia smithii* has a low "crest" in the form of hairy lumps on abdominal segments 4-9, the crest being much lower in profile than in *A. braueri*. In each of these species, and in *Procordulia grayi*, the distal margin of the labial palpus is dentate, not crenulate and abdominal segment 9 is conspicuously hairy along the lateral and posterior margins in the two former species, a feature which *A. braueri* does not share.

Antipodochlora braueri has been considered to have affinities with the genera *Epitheca* and *Somatochlora* on the morphological features of the adult, and Professor P.S. Corbet has drawn my attention to the similarity between the larvae of *A. braueri* and *Somatochlora elongata* (Scudder). I have not had the opportunity of examining larvae of *Somatochlora* and *Epitheca* but using the diagnosis of the larvae of these genera in WALKER & CORBET (1975) as a guide, it can be seen that *A. braueri* differs from them in a number of features. Larvae in the genus *Somatochlora* are moderately to very hairy, the pubescence of the abdomen being longest and thickest along the lateral and posterior margins of abdominal segment 9. There is no lateral longitudinal stripe along the thorax and the legs only rarely show pale and dark annuli. The crenulations of the labial palpus each bear a group of only 3-7 or 3-8 setae. In contrast, *A. braueri* is not noticeably hairy, has a lateral longitudinal stripe on the thorax and annuli on the legs, and has up to 14 setae on the crenulations of the labial palpus. In *Epitheca*, the head has a straight posterior border and the lateral abdominal spines on segments 9 are usually much longer than the middorsal length of segment 9. The head in *A. braueri* has a concave hind margin and the lateral abdominal hooks are not as well-developed as in *Epitheca*.

The egg and some early instars of *A. braueri* have now been obtained and an in-depth study of its biology and ecology is intended. A more precise comparison between *A. braueri* and related species will then be possible.

HUDSON (1904) described as *Procordulia smithii* a larva taken from mud at the bottom of a stagnant pool in the Hutt River but there is no indication that the larva was reared to emergence. His description of the larva was as

follows:

"Its length when full grown is about 1 inch. The head is broad and somewhat triangular in shape when the mask is closed. The eyes are prominent and black in colour. The antennae are seven-jointed, the two basal joints being considerably stouter than the remainder. The prothorax is small and has a blunt protuberance at each of its anterior angles, the rest of the thorax is of moderate size. The posterior wing-pads are larger than the anterior. The abdomen is rather large. There is a crest of horny spines on the back and the edges of several of the posterior segments are produced into horny flanges at the sides. The legs are long and slender and are very sparingly clothed with minute bristles. The general colour is dull brown, with a row of black dots on each side of the abdomen.... When enveloped in mud, as the insect always is in a state of nature, it is quite impossible to detect except by means of its movements, which are very deliberate."

There are eight points which lead me to conclude that the larva described was *Antipodochlora braueri*. The larva of neither *Procordulia smithii* nor *A. braueri* usually reaches a size of one inch, but *A. braueri* is slightly the more robust and closer to this measurement. *P. smithii* has a low medial "crest" but this is hairy and quite unlike the prominent horny dorsal hooks in *A. braueri*. Both species have long slender legs but those of *P. smithii* are clothed in long piliform setae and the minute bristles which Hudson mentions put one in mind of the condition in *A. braueri*. The larva of *A. braueri* is a deeper shade of brown than are *P. smithii* larvae I have examined; and again Hudson's colour illustration more closely resembles the shade of *A. braueri*. The black, lateral abdominal spots were absent in *P. smithii* I have examined. The movement of the larva referred to by Hudson also slightly favours *A. braueri*: in my experience *A. braueri* moves more vigorously than does any other of our endemic species of corduliids in or out of the water. Hudson's illustrations show two further features which favour *A. braueri*: he shows eight palpal setae whereas *P. smithii* usually has only six; and he shows the anal pyramid as a long structure whereas the pyramid in *P. smithii* is proportionately smaller than in *A. braueri* and hardly protrudes beyond the level of the posterior lateral spines on the ninth abdominal segment.

DISTRIBUTION

The approximate sites from which imagines and larvae are known are shown in Figure 6. Exact map references have been recorded with few specimens and those now given are necessarily approximate only. FRASER (1960) gave Whangarei (35°43'S 174°20'E) and Gollans Valley (41°19'S 174°54'E) as locality areas for the species. Miss Pauline Aston, to whom is due the credit for first rearing adults from larvae, collected larvae and imagines from the Oruawai, Okahukara and Taringamotu Streams about Taumaranui (38°52'S 175°19'E) (R.J. Rowe, pers. comm., 8.XI.1978). PENNIKET (1966) also recorded the species from the Waiorohi stream (37°46'S 176°08'E) near Tauranga.

During the course of this study, I have examined imagines from Kao 35°06'S 173°47'E (E. Clarke, 17.I.1921), Whenuapai 36°46'S 174°38'E (P.T. Leaf, 4.XII.1973 and 10.XII.1973), Henderson 36°53'S 174°38'E (K.A.J. Wise, 31.X.1956), Whangaparapara Harbour, Great Barrier Island 36°15'E 175°24'S (K.A.J. Wise, 16.XII.1950), Cook's Beach 36°51'S 175°44'E (M.J. Meads, 27.I.1979), Waipoua Forest 35°37'S 173°35'E (J.S. Armstrong, 29.XII.1961), Waikare-iti 38°43'S 177°10'E (J.T. Salmon, 3.II.1937), Aniwanui Falls 38°45'S 177°10'E (A. Beauchamp, 6.II.1979), Waikanae River 40°52'S 175°09'E (D. and P. Bennet, 9.I.1970), Maungakotukutuku Stream 40°58'S 175°02'E (I.M. Henderson, 6.XII.1978), Catchpool Stream 41°21'S 174°56'E (G.W. Gibbs, 1.I.1975) and from the Five Mile Stream, Meads, 27.I.1979), Waipoua Forest 35°37'S 173°35'E (J.S. Armstrong, 29.XII.1961), Waikare-iti 38°43'S 177°10'E (J.T. Salmon, 3.II.1937), Aniwanui Falls 38°45'S 177°10'E (A. Beauchamp, 6.II.1979), Waikanae River 40°52'S 175°09'E (D. and P. Bennet, 9.I.1970), Maungakotukutuku Stream 40°58'S 175°02'E (I.M. Henderson, 6.XII.1978), Catchpool Stream 41°21'S 174°56'E (G.W. Gibbs, 1.I.1975) and from the Five Mile Stream, Orongorongo Valley 41°21'S 174°58'E (G.W. Gibbs, 18.II.1978). I have also examined specimens taken by various people (G.V. Hudson, J.S. Armstrong, R.G. Ordish, G. Laurie, F.M. O'Brien) from the Gollans Valley area and its immediate surroundings; all were taken in January except two specimens taken in Gollans Valley by J.S. Armstrong on December 6, 1958. I observed the species flying in good numbers from December 2 (1978) onwards in Gollans Valley and Butterfly Creek. The last opportunity I had for observing the species this season was on 20-II-1979 in the Orongorongo Valley where conditions for observation are not as good as in Gollans Valley. Only low numbers of *A.*

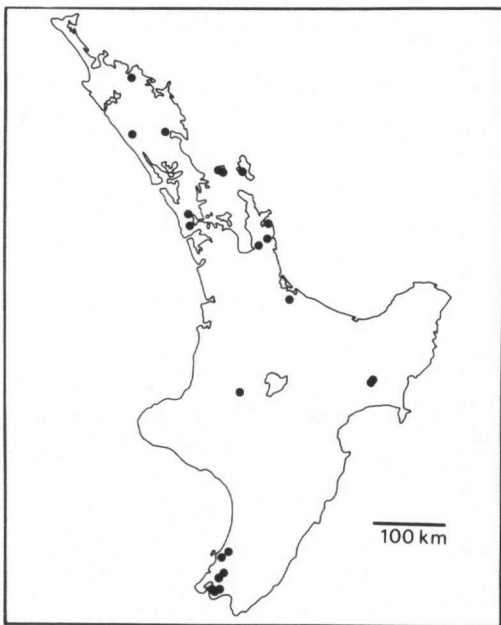


Fig. 6. North Island of New Zealand showing the approximate locations from which *Antipodochlora braueri* (Sel.) has been recorded.

braueri were seen on this day but a teneral male was taken by A.J. Beauchamp which suggests that the flight season lasts for at least several more weeks. I have examined larval material from the location detailed in the description of the larva and also from Hikuai, Coromandel 37°04'S 175°46'E (M. McCall, 5.II.1954), Naenae, Hutt Valley 41°12'S 174°57'E (D. Fairfax, 19.IV.1955), Butterfly Creek 41°20'S 174°53'E (R.G. Ordish, 4.III.1958), Stokes Valley 41°11'S 174°59'E (B.A. Holloway, 26.IX.1959), Maungapuwerawera Stream 38°44'S 177°10'E (I.M. Henderson, 8.II.1979) and from a tributary of the Wainuiomata River along the Coast Road, 41°22'S 174°54'E (R.G. Ordish, 10.IV.1960). The National Museum, Wellington, holds a series of exuviae from Butterfly Creek, and one from Wainuiomata (J. Harris, October, 1975) taken from a stream flowing into the Riskend Golf Course (R.G. Ordish, pers. comm., 21.VIII.1978).

WISE (1956) collected a larva from the Te Wairere Stream, Little Barrier Island 36°12'S 175°03'E on 24.XI.1954. He tentatively identified this as *P. smithii*, following HUDSON's (1904) description, but suggested that it might instead be *A. braueri*. I have examined the larva and confirm that it is *A. braueri*. Similarly, the larva reported by WINTERBOURN (1964) from the Awaroa Stream, Little Barrier Island 36°13'S 175°04'E (August, 1963) has proved to be *A. braueri* (M.J. Winterbourn, pers. comm., 18.X.1978).

R.J. Rowe (pers. comm., 8.XI.1978) has sighted adults in the Kauaeranga Valley 37°09'S 175°36'E near Thames on several occasions: on February 11, 1971 one flew briefly from a stand of manuka (*Leptospermum* sp.) near the middle of the day and had probably been disturbed; on January 22, 1976 one was seen flying at 18.40 hours (sunset 19.20 hrs). On January 29, 1978 males were seen feeding at 14.10 hrs during an overcast spell, and he took a larva from a weed-choked, spring-fed, side stream of the Kauaeranga River on this same day. He has also taken an adult from Waipoua Forest (12.I.1967 at 19.40 hrs, with sunset being approximately 19.22 hrs). All times given here have been adjusted from New Zealand Standard Time to conform with the solar noon.

HUTTON (1898) gave Canterbury as the type locality for *A. braueri*. HUDSON (1904) reiterated this as did STOUT (1969) but there have been no recent reports of the species from that area (V.M. Stout, pers. comm., 17.VIII.1978). It seems unlikely, however, that this archaic member of the fauna is absent entirely from the South Island. Probably it occurs unnoticed in suitable habitats in northwest Nelson and the West Coast. HUDSON (1950) thought of the species as being primarily associated with beech forest (*Nothofagus* spp.), but its occurrence in the northern kauri (*Agathis australis*) forests show that this association is not invariable. The biology of *A. braueri* is currently being investigated. Further studies should fill some gaps in the known range of this inconspicuous species.

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