A preliminary account of the habitat of *Antipodochlora braueri* (Odonata: Corduliidae) in New Zealand

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Abstract

Antipodochlora braueri is a crepuscular, forest inhabiting species. The particular microhabits utilised by the larva and adult are discussed, and observations of the behaviour of both stages within their habitats are recorded.

Keywords: Odonata, Corduliidae, *Antipodochlora braueri*, habitat, behaviour.

INTRODUCTION

New Zealand's mountainous topography and high precipitation has favoured the radiation of insects inhabiting flowing waters, but insects of still waters (e.g., Odonata and Dytiscidae) are poorly represented (Watt 1975). Not surprisingly the three species which appear to make up the ancient component of our odonate fauna are either lotic inhabitants (*Antipodochlora braueri* (Selys, 1871)), live in burrows alongside streams (*Uropetala carovei* (White, 1843)), or can withstand the rigours of a lotic existence (*Xanthocnemis zealandica* (McLachlan, 1873)).

The genus *Antipodochlora* Fraser is monotypic and on this account *A. braueri* is of exceptional interest. Penniket (1966) gave brief notes on the ecology and behaviour of *A. braueri* but there have been few other contributions on the species. It is not a species which features frequently in collections. Several factors contribute to the paucity of information on the species: it is cryptic in its colouration and behaviour, and it has habitat requirements which are very different from most other New Zealand species. In this paper, the distribution of the species is briefly discussed, a guide is given for the field determination of the species in both the adult and larval stages, and a preliminary account is given of types of habitat from which these stages have been taken together with notes on its behaviour in the habitat.

DISTRIBUTION

Hutton (1898) listed Canterbury as a locality for *A. braueri* but there are no recent records from that area. Winstanley (1979) has given records of the species from Kaeo (35°06 'S, 173°47 'E) to Wellington (41°19 'S, 174°54 'E) and there is an unconfirmed report of the species being sighted at Nolan's Creek (44°00 'S, 168°48 'E), a tributary of the Waiatoto River (M. J. Meads pers. comm. 15 May 1979). A dragonfly showing patterns of behaviour similar to *A. braueri* was also seen along the Haast River (43°58 'S, 169°09 'E) in February 1979 (E. C. Forch pers. comm.).

Figure 1 shows the locations from which specimens have been taken and includes the areas from which there are unconfirmed reports of the species.

IDENTIFICATION

Adult. The New Zealand Corduliidae comprises 4 species: 3 endemics, *Procordulia smithii* (White, 1846), *Procordulia grayi* (Selys, 1871), and *A. braueri*; and the self-introduced *Hemicordulia australiae* (Rambur, 1842). The presence of *H. tau*, intimated by Allbrook (1979), is incorrect: *Pantala flavescens* (Fabricius) was the addition to the New Zealand fauna which Allbrook intended to record (J. A. A. Watson, pers. comm.).

Fresh adult specimens of the 4 corduliid species can be separated readily on their abdominal colour patterns. In *A. braueri*, the basic abdominal colour is a bronzy-brown with most of the segments having a lateral colour patch towards the posterior of the segment which varies from a muddy-yellow in early teneral specimens to reddish-brown in the mature adult. Armstrong (1958) and Penniket (1966) illustrate the patterns of the other 3 species. In each the base colour of the abdomen is black, or a brown very close to it. *P. grayi* has a yellow patch laterally on the anterior margin of each segment; *H. australiae* has a sinuous yellow band laterally along the abdomen; and *P. smithii* has a chocolate-brown to yellow-brown band laterally along the abdomen with a narrow transverse bar of the same colour along the posterior margin of each segment which is separated at the mid-line.

The wing venation can be used to confirm the identification in dead specimens when the abdominal colours have faded (Fig. 2). Penniket (1966) relied on the divided triangle of the hindwing as a diagnostic feature of *A. braueri*, but I have also seen this as an aberration in *P. smithii* and *P. grayi*. A more reliable guide is the relationship between the second antenodal vein and the triangle: an extension of this vein would

Fig. 1. The approximate distribution of *Antipodochlora braueri* in New Zealand.

always be proximal to the hindwing triangle in *A. braueri* but would intersect the triangle in the other three species. The specimen illustrated by Penniket (1966) is unusual in this respect and in the placement of the distal cubital crossvein. The female wing differs slightly from the male in the number of antenodal and postnodal veins. In the female, there may also be an oval grey-brown colour patch behind the pterostigma in the forewing; and the hindwing lacks the anal triangle.

Armstrong (1958) described features by which *P. smithii*, *P. grayi*, and *H. australiae* can be identified in flight. Post-teneral male *A. braueri* have a bright green eye as have *P. smithii* and *H. australiae,* but *A. braueri* flies more swiftly and is less inclined to the hovering flight seen in the other two species. Mature females in *P. smithii* and *A. braueri* often, but not invariably, have a postnodal oval colour patch in the forewings. This is saffron yellow in *P. smithii* which contrasts clearly with the grey-brown patch in *A. braueri*. The abdomen in *A. braueri* is wholly dark and shows none of the colour flashes evident in the other three species in flight.

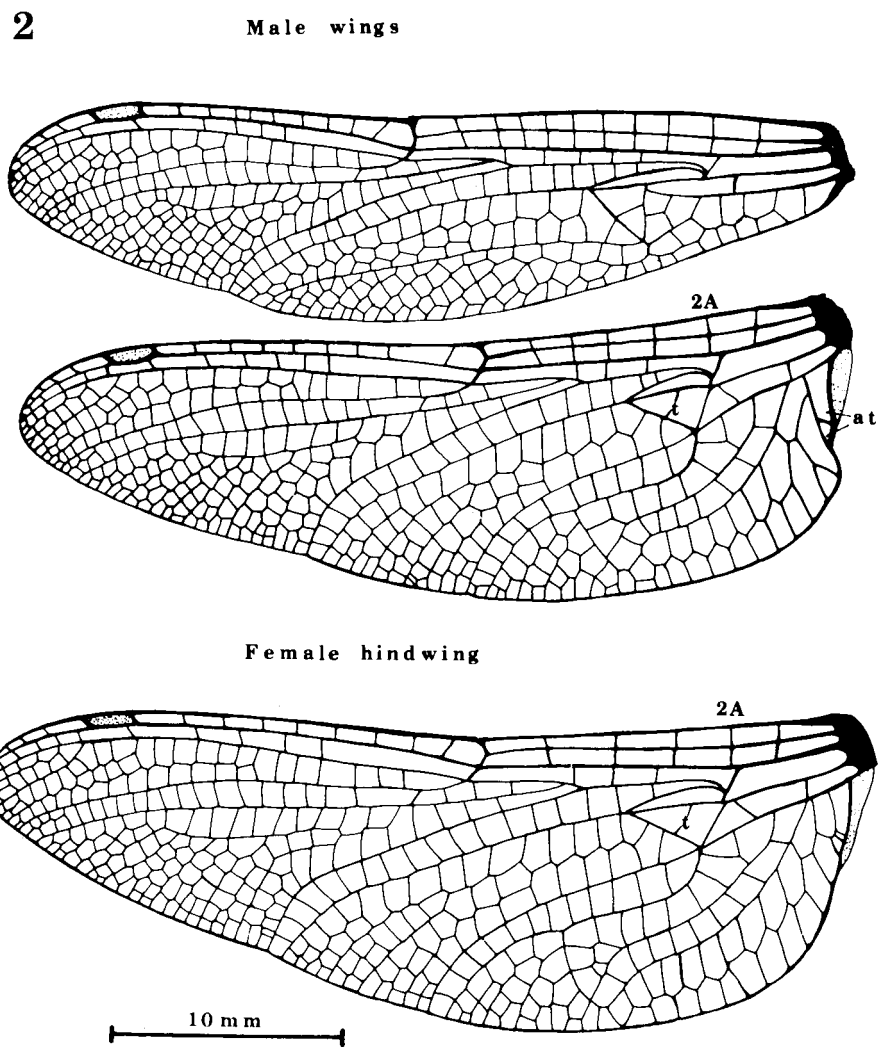

Fig. 2. *A. braueri* male wings and female hindwing. 2A = second antenodal vein; t = triangle; at = analtriangle.

Final-instar larva

Penniket (1966) provided keys to the final-instar larvae of the New Zealand Odonata and this stage in *A. braueri* has been described by Winstanley (1979). Within the New Zealand fauna, median dorsal abdominal hooks are developed only in the corduliid larvae, and those in *A. braueri* serve to identify the species immediately: in *A. braueri* they are prominent and horny; in *P. smithii* they are less prominent, hairy lumps; and in *H. australiae* the hooks consist of a few spines extending beyond the median posterior margin of the abdominal segments but are hardly discernible laterally. *P. grayi* lacks dorsal hooks.

HABITATS

Larval stages

Many species of dragonflies are limited in the type of freshwater that they can use and, as a result, a given type of freshwater habitat generally supports a characteristic

assemblage of dragonflies (Watson 1962). In his treatment of the Southwestern Australian fauna, Watson used 6 broad habitat classifications: **1** permanent rapid streams; **2** permanent slow rivers; **3** rivers drying to pools; **4** permanent lakes and ponds; **5** temporary ponds; and **6** boggy swamps. *A. braueri* can be found in each of the first 3 habitat types, and there is one record of the species from a temporary pond (B. A. Holloway, Stokes Valley, 26 September 1959), although I suspect that this belongs in Watson's third category.

Penniket (1966) suggested that *A. braueri* was probably widely distributed but only in small streams within the bush (i.e., native forest). This latter hypothesis was tested in Gollans Stream (41°19'S, 174°54'E). The stream, which is approximately 15 km long, flows through beech/podocarp/broadleaf forest for about 7 km before passing through a transition zone of about 1 km where the banks are shaded by second-growth vegetation, mainly manuka (*Leptospermum scoparium*), kanuka (*L. ericoides*), toetoe (*Cortaderia toetoe*), and gorse (*Ulex europeus*), after which it enters cleared farm land. On 25 October 1979, composite samples were taken from the streambed at 27 sites over a 3.5 km stretch immediately below the transition zone, and into the lower part of this zone. A Surber sampler (Surber 1937) was used, and 3 or 4 quadrats were brushed at each site to produce each sample. The sample sites were not random but were selected for their similarity to known productive sites higher in the catchment. No larvae of *A. braueri* were obtained from the sites within the farmed block nor for an estimated 200 m into the transition zone. Thereafter, each sampling site would normally produce one or more larvae. The evidence suggests that *A. braueri* is absent from or exists at extremely low densities in the open areas of the stream. It should be noted that in the transition zone the larvae are below the boundaries of the native forest proper, but their presence there may be a result of downstream drift. Neither oviposition nor adult flight has been witnessed in the transition zone although emergence and a dispersal flight must occur.

The dependence of *A. braueri* on shaded streams has also been demonstrated near Taumarunui (38°52'S, 175°19'E); the Oruaiwi Stream used to be one of the more rewarding collecting areas used by Miss Pauline Aston. Severe burning along the banks in 1968 eventually led to the disappearance of *A. braueri* from that stream (pers. comm. to R. J. Rowe, 21 January 1969 *et seq.*).

So far, *A. braueri* has been found mainly in small streams within the forest but there may be exceptions to this. I collected exuviae of *A. braueri* from the banks of the Aniwaniwa Stream (38°44'S, 177°09'E) near its entry into Lake Waikaremoana on 7 and 8 February 1979. At this point, the stream is broad with dense beds of weed along its margins. No vegetation overhangs the banks. No adult activity was observed in this area although oviposition was seen higher up the stream in shaded situations near the Bridal Veil Falls. No larvae or exuviae were recovered at the Bridal Veil Falls, and it is tempting to suggest that the exuviae in the lower Aniwaniwa Stream derived from eggs or larvae which had been carried downstream through the series of cataracts below the falls.

Larvae have been found in streams with a wide variety of flow characteristics as evidenced by the bottom materials of the system: they have been found on mud, sand, and gravel, and amongst cobble-sized (64-256 mm) or larger stones. Within these lotic situations they may congregate in microhabitats where the effects of the current are mitigated; they are found near the edge of the stream, in eddies where leaf trash accumulates, clinging to submerged logs, or under stones. Many, one might say most, of the streams in which they occur are too heavily shaded to support a growth of aquatic macrophytes but, where macrophytes are established, the larvae may shelter under their trailing growth. In the aquarium, larvae rarely leave the bottom to scramble on aquatic weeds.

Pennak (1971) classifies streams with an average width of less than 1 m as temporary. Many of the streams in which *A. braueri* has been found are in this category. Wise (1956) reported collecting a larva, which was later identified as *A. braueri*, from a disconnected pool on the Te Wairere Stream, Little Barrier Island (36°12'S, 175°03'E) on 24 November 1954. I found larvae in similar pools in Crawley Creek (41°21'S, 174°58'E) on 18 February 1979.

Emergence sites

The exuviae collected have usually been within 300 mm or so of the water. Favoured sites for emergence are where stream banks rise steeply from below the water. Exuviae are normally attached firmly to vegetation and, as with the other New Zealand corduliids, sites are selected where the larvae are inclined backwards at about 70°. Only in exceptional circumstances have I found exuviae on bare earth. On the lower Aniwaniwa Stream near the junction with the Te Kumi Stream on 7 and 8 February 1979, low water levels had left a wide expanse of bare mud on the banks; 2 exuviae were taken from earth overhangs here and 7 from one log which also held numbers of *P. grayi* exuviae. Miss Pauline Aston found the exuviae of *A. braueri* clinging to a rock in the Tangarakau Gorge near the junction of the Mangapapa Stream 38°59'S, 174°49'E (pers. comm. to R. J. Rowe 21 January 1967).

An occasional specimen may travel some distance from the stream to complete emergence. One female taken from Crawley Creek had travelled approximately 2 m from the creek and 1.2 m up a tree fern stump where it emerged within an opossum trap from which it could not escape (M. J. Meads pers. comm. 12 January 1979).

Adults

Like their larvae, adult *A. braueri* are mainly forest-inhabiting. *A. braueri* is a crepuscular species in that peak adult activity occurs over water in the few hours before dusk. Armstrong (1975) reported seeing the species in good light on very few occasions. I have looked for the species at dawn but have not found it active then or for a few hours afterwards. In lowland situations, occasional specimens may be seen throughout the day hawking in shaded places within the forest. Shaded forest tracks appear to be attractive feeding areas for the species as do the open areas above forested streams. During the warmer part of the day, the tendency appears to be for hawking adults to move to higher levels in the canopy. Overcast conditions may lead to more of the population being on the wing during the day, and in more open areas. *P. smithii* may also remain active under heavily overcast conditions.

A different behaviour pattern seems to be elicited in forest habitats at higher altitude with the species being active over a longer period of the day. Corbet (1962) discusses similar behavioural changes with altitude in other crepuscular species. At the Maungapuwerawera Stream (38°44'S, 177°10'E), the outlet stream of Lake Waikareiti (approximately 884 m above sea level), intensive territorial behaviour between males with frequent clashes was witnessed from mid-morning throughout the day on 9 February 1979, a bright day with clear skies. The vivid green eyes of the male are conspicuous in dim surroundings and it is likely that these are the sign stimuli releasing intraspecific aggression. I have not seen teneral males, in which the eyes are brown, molested by mature males.

Oviposition usually takes place in the evening so that *A. braueri* avoids the interference which other species, for example *P. grayi*, contend with earlier in the day over streams from *Xanthocnemis zealandica*. Females oviposit on the surface usually in the still water immediately above a riffle, but may also use the still margins of long pools.

Hudson (1950) considered *A. braueri* to have a particular association with beech forest (*Nothofagus* spp.). The species has also been taken within kauri (*Agathis australis*) forest and in areas where there is no longer mature forest cover about its breeding

streams, merely second growth. K. A. J. Wise (pers. comm. 15 August 1978) has taken the adult from citrus orchards near Henderson, which suggests that the species is capable of adjusting to habitats somewhat different from those to which it is primarily adapted.

Some crepuscular and shade active species have a tendency to enter dwellings and other buildings (Corbet 1962). I have had reports on several occasions of dragonflies making a nuisance of themselves in the evening but have so far confirmed only *P. smithii* entering houses. It would be interesting to know if *A. braueri* also does this.

FLIGHT SEASON

My information on the flight period of *A. braueri* is incomplete. The earliest record I have in the flight season is a specimen taken by K. A. J. Wise at Henderson (36°53'S, 174°38'E) on 31 October 1956. The latest specimen I have was taken by A. J. Beauchamp in the Orongorongo Valley (41°23'S, 174°56'E) on 20 February 1979. Since this was a teneral male, I would expect the flight season to extend for a few weeks beyond this date about Wellington. The British Museum (Natural History) holds a female specimen taken from Whangarei (35°43'S, 174°20'E) by E. S. Gourlay between 18 and 20 April 1931, indicating a flight season approaching 6 months in these more northern latitudes.

DISCUSSION

A. braueri is a species to which Fraser (1939) attributed archaic features, and there is little doubt that it is an ancient member of the New Zealand fauna. As such, it has evolved adapted to the prevailing, extensive forests which dominated the pre-human landscape. Although it appears to be a true forest species, it is not restricted to any one forest type, and its occurrence in orchards suggests that perhaps shade alone is its critical habitat requirement. There seems little doubt that the natural range of the species has been depleted with the removal of vast tracts of native forest in the post-European era. It will be interesting to see whether the exotic forests now being established can offer a suitable habitat substitute.

The presence of *A. braueri* on the South Island is yet to be confirmed, but it is likely that it still persists there in many areas unnoticed. If it is indeed in the Haast area it seems logical to suggest that it should be found further north in the areas of Nelson and the West Coast where intact tracts of forest should offer suitable habitats.

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