HEMICORDULIA ARMSTRONGI SP. N. (ODONATA: ANISOPTERA: CORDULIIDAE) FROM NEW ZEALAND

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Abstract

The dragonfly previously recognised from New Zealand under the name *Hemicordulia australiae* (Rambur, 1842) is described as a new taxon, *Hemicordulia armstrongi* **sp. n.** on the basis of morphological differences in both adults and larvae, as well as adult behavioural differences. Photographic evidence requiring confirmation is presented suggesting that the species might co-occur with *H. australiae* in Australia and that *H. australiae* also might occur in New Zealand.

Introduction

Around the beginning of the 20th century a *Hemicordulia* Selys species began to be collected in New Zealand (Hudson 1950, Armstrong 1978, Rowe 1987). Tillyard (1917), in characterising the odonate fauna of Norfolk Island (750 km NW of New Zealand), commented on the presence of *Hemicordulia australiae* (Rambur, 1842) and noted that specimens represented the darker, northern form: 'The specimens are dark like those recorded from the Kermadec Islands. In Australia, this species ranges along the eastern coast from Victoria to Queensland, becoming darker as it goes north'. The Kermadec Islands lie 1050 km NE of New Zealand. Earlier (Tillyard 1912), he had referred to the Kermadec material as 'a dark and handsome form, practically identical in size and colouring with the specimens found in the Sydney district'. Later (Tillyard 1926), he commented on the presence of *H. australiae* in New Zealand but without mentioning the source of any material.

Tillyard's determination was accepted uncritically within the New Zealand literature (e.g. Armstrong 1958, Fraser 1960, Penniket 1966, Wise 1977, Rowe 1987, Marinov and Ashbee 2019). When visiting New Zealand in 1979, Australian odonatan specialist J.A.L. Watson commented in passing to Rowe and Philip S. Corbet that there was something anomalous about New Zealand examples of *H. australiae* he had seen in the field; however, he was unable to identify what was troubling him. This observation was reported by Rowe (1981a) and the species was designated there as *H.* '*australiae*'. Winstanley and Brock (1983), considering *H. australiae* in the New Zealand region, recorded that larvae from Norfolk Island had a well-formed mid-dorsal crest of strong spines, consistent with Australian descriptions of larvae (e.g. Watson 1962), but differing from descriptions of New Zealand larvae, which lack the median spines (Penniket 1966, Rowe 1981b). Winstanley and Brock (1983) figured the difference in form. In New Zealand the absence of mid-dorsal protuberances was reported as a character distinguishing larval *H. australiae* from those of *Procordulia smithii* (White 1846) (e.g. Penniket

1966, Rowe 1987). Australian descriptions of larvae were consistent and between them Armstrong and Rowe had examined over a thousand exuviae from New Zealand without ever noticing a mid-dorsal ridge of spines. Winstanley (1983) further drew attention to patterns of wing saffronation (yellowing) seen in Australian, Norfolk Island, Kermadec Island and Mayor Island (a small islet 4 km in diameter 30 km off the east coast of NZ North Island) female specimens in contrast to the hyaline (clear) wings of material from New Zealand. On the basis of the distinct larval forms and female wing coloration, Winstanley postulated that two separate species might be involved.

Rambur's description (1842) of male and female *H. australiae* is very complete and a photograph of an original syntype from 'Nouvelle-Hollande' in the Hope Collection, Oxford (specimen ODON0025-01) is available on the web (*http://www.oum.ox.ac.uk/cgi-bin/odonata.cgi?detail_ oid=ODON0025-01*). The pertinent portion of the description relates to the abdominal colour patterning: '(French) *où il est un peu comprimé , déprimé, jaune, ayant sur le dos une bande très-large d'un vert métallique devenant grisâtre sur les deux premiers segments, composée d'une série de taches qui, étroites antérieurernent, se dilatent pour se rétrécir de nouveau, se dilatent postérieurement jusque stir le bord latéral et s'étendent an pen en dessous to long du bord postérieur des segments, en envahissant presque completement les deux derniers, à l'exception du dernier, qui a l'extrémité jaune en dessus'*. This can be translated as: 'where it is a bit constricted, flattened, yellow on the back with a very wide band of metallic green becoming greyish green in the first two segments, composed of a series of spots, narrow anteriorly then expanding, to shrink and then expand posteriorly onto the lateral margin, extending a little below along the edge of the posterior segments, almost completely covering the last two, except the tip of the last (which) is yellow above'.

Selys' (1871) description of *H. australiae* (Rambur) as type for the genus *Hemicordulia* is clearly of Rambur's species. In contrast, Martin's (1907) account from material in Selys' collections has the dorsum of segments 9 and 10 black in the male and in the female the dorsum of segment 10 is yellow. Reliance on Martin might underlie Tillyard's error.

I observed adult *H. australiae* in Canberra, ACT in 2003 and again in 2006. Like Watson, I felt something was different in both appearance and behaviour from New Zealand material with which I was familiar. When adults raised from larvae taken from cattle troughs being used to rear tadpoles at James Cook University campus in Townsville, North Queensland were examined, patterns became clear. These larvae had a mid-dorsal abdominal crest of spines and produced adults with a yellow tip to the abdomen, whereas larvae from New Zealand lacked the dorsal abdominal spines and produced adults with a black tip to the abdomen.

***Hemicordulia armstrongi* sp. n.**

(Figs 1-4)

Type specimens. *Holotype* ♂, NEW ZEALAND: labelled 'Huka Lodge, Waikato River, Taupo TO, 6 Mar 57, J.S. Armstrong, *H. australiai* (sic) ♂ in cop B' in J.S. Armstrong's hand. *Paratype* (*allotype*) ♀, NEW ZEALAND: labelled 'Huka Lodge, Waikato, River Taupo TO, 6 Mar 57 J.S. Armstrong, ♀ *H. australiae*' in J.S. Armstrong's hand. This is the only such female and is presumably 'B'.

The type specimens are from Armstrong's material in the New Zealand Arthropod Collection, currently housed in the Facilities of Landcare Research (a Crown Research Institute) on the Tamaki Campus of the University of Auckland, Auckland. They have been relabelled after the introduction of the NZ locality designator system (Crosby *et al.* 1976). The allotype is missing the right cercus.

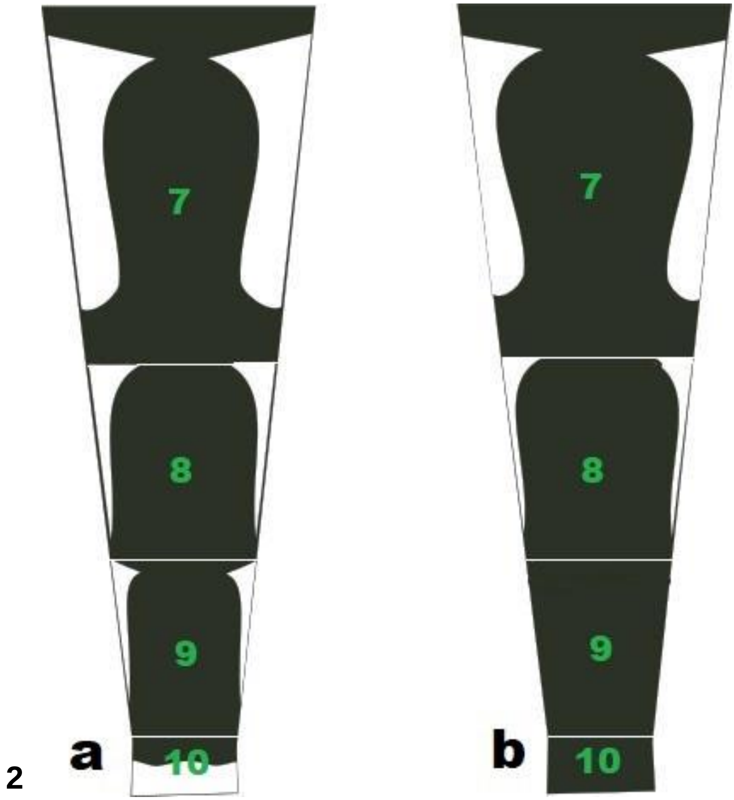
Diagnosis and description. The adult of *H. armstrongi* is extremely similar to that of *H. australiae* in most characters, including the metallic blue colouring of the upper frons in dried specimens (vivid green in live insects) and the general shape of the male superior appendages, including the strong internal spine on the cercus – characters used to distinguish *H. australiae* from other species of *Hemicordulia* in the keys of Watson, Theischinger and Abbey (1991). *Hemicordulia armstrongi* differs from *H. australiae* in five significant features: (1) in abdominal colour pattern, especially of the terminal abdominal segments; (2) in shape of the abdomen; (3) in absence of saffronation in the female wings; (4) in male reproductive behaviour; (5) in absence of a crest of dorsal abdominal spines in larvae.

In adult *H. australiae* the anterior extensions of the yellow abdominal markings on segments five, six and seven almost meet dorsally, whereas they are generally separated by dark coloration in *H. armstrongi*; in *H. australiae* there are yellow (or yellow-orange) markings on the anterolateral area of the tergite of abdominal segment nine and the distal half of the dorsum of segment ten is bright yellow, whereas in *H. armstrongi* the dorsum of segments nine and ten are uniformly black (Figs 1-3).

In *H. australiae* the distal portions of the female wings are saffronated; in *H. armstrongi* the wings are hyaline.

In *H. australiae* the male abdomen is flattened but the sides are nearly parallel; in *H. armstrongi* the male abdomen has a narrow neck about segment two then is distinctly broadened to about segment six, before narrowing to segment eight (this feature often collapses in dried specimens).

The later instar larvae of *H. australiae* possess a mid-dorsal crest of prominent blunt spines, whereas these features are absent in *H. armstrongi*. This difference is figured, with comment, in Winstanley and Brock (1983) (Fig. 4).



Figs 1-2. *Hemicordulia* spp: (1) dorsal view of the last abdominal segments of the holotype male of *Hemicordulia armstrongi* **sp. n.**; (2) schematic dorsal view of abdominal segments 7-10 of: (a) *H. australiae* (Rambur) and (b) *H. armstrongi* **sp. n.**

Fig. 3. Male *Hemicordulia* spp in flight: (a) *H. australiae* (ANU Campus, Canberra ACT, 14 December 2006, Rowe); (b) possible *H. armstrongi* (Urunga Wetlands, Urunga NSW, 23 May 2018, Ros Coy).

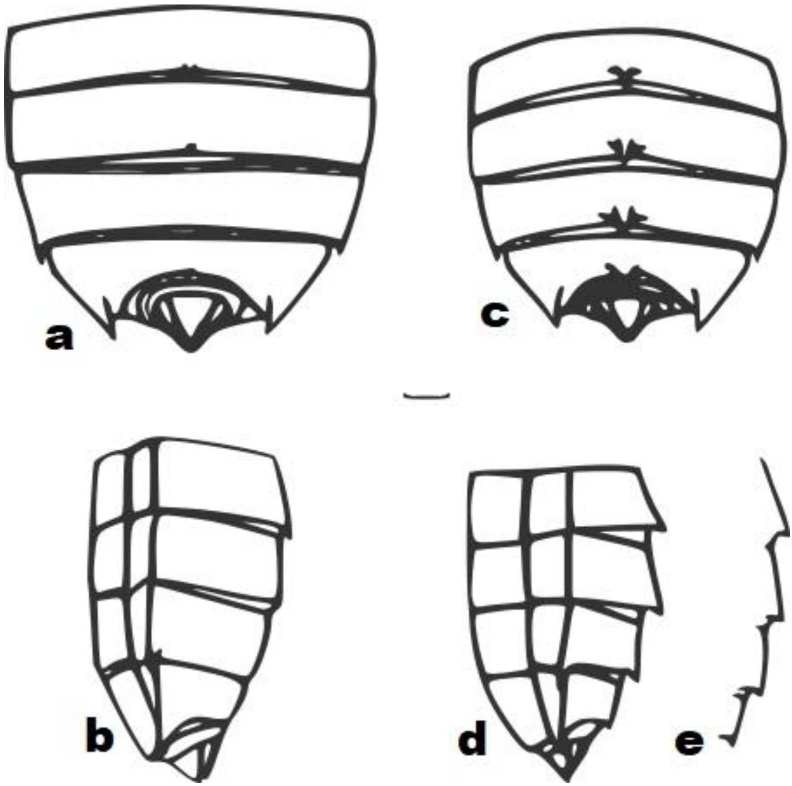


Fig. 4. Dorsal and lateral views of final instar larvae of *Hemicordulia* spp: (a-b) *H. armstrongi*; (c-e) *H. australiae*. Scale bar = 1 mm. (a-d after Winstanley and Brock 1983; e after Theischinger and Hawking 2006).

Etymology. After publishing his 1983 paper, Bill Winstanley commented to me that if the New Zealand form was specifically distinct then it should be named after the pioneering New Zealand Odonatologist John Armstrong. Armstrong's work included a paper on oviposition and egg development in this now recognised species and on its (temporary) displacement of the New Zealand endemic *Procordulia grayi* (Selys, 1876) from the Taupo region of New Zealand (Armstrong 1958, 1978). I have followed Bill's suggestion.

Discussion. *Hemicordulia armstrongi* **sp. n.** is extensively figured in Rowe (1987), under the name *H. australiae*. It is clearly an adventive species in New Zealand, with an unknown date of arrival. It was not recorded until the end of the nineteenth century despite a strong history of early collections (Rowe 1987). Museum records date from early in the twentieth century. Armstrong (1978) discussed early records and population development.

In 25 years in Townsville, North Queensland, Australia, I have seen only typical *H. australiae* and never any 'darkened northern form' (i.e. specimens like New Zealand material). In Australia, *Hemicordulia* species tend to be vagrants and I might never have collected appropriate habitats or at appropriate times. What is clear is that typical *H. australiae* occurs into the tropics and there is no particular cline. Tillyard's (1917) view that *H. australiae* is a clinal species is not supported. The existence of clear inter-linked larval and adult characters makes that position untenable.

The two species are readily distinguishable in flight from a distance of five to ten metres through the differences in abdominal colour pattern. *H. armstrongi* appears darker and the yellow terminal marking of *H. australiae* are especially distinctive.

Behaviourally, mature male *H. australiae* patrol water margins, thus closely resembling the behaviour of *Hemicordulia tau* Selys, whereas mature male *H. armstrongi* tend to hover in the centre of small open pools, cut off by vegetation from the main water body – earning them the sobriquet 'sentry' in Rowe (1987), which is followed by Marinov and Ashbee (2019).

Since no species of *Hemicordulia* resembling *H. australiae* is known from any Pacific Islands north of New Zealand (the arc from New Caledonia through to Tahiti), the origin of the new population of *H. armstrongi* that arrived in NZ in the early 20th century might have been Australia. '*Hemicordulia australiae*' is recorded from much of Australia, Indonesia (Lesser Sunda Islands), Norfolk Island, Kermadec Islands and 'New Zealand' (Watson, Theischinger and Abbey 1991, Lieftinck 1953, Winstanley 1983). However, searches of museum collections did not turn up any Australian *H. armstrongi* material. Gunther Theischinger kindly examined his own extensive collection as well as that of The Australian Museum in Sydney, without finding *H. armstrongi*. Chris Burwell inspected material in the Queensland Museum, Brisbane, again without finding *H. armstrongi*. I examined material in The Australian National Insect Collection in Canberra, again without finding *H. armstrongi*. But Martin (1907), on the basis of Australian material from Victoria, New South Wales and Queensland in Selys' collections, describes a male conforming to *H. armstrongi* as the male of *H. australiae*, *contra* Rambur (1842) and Selys (1871). Allbrook (1979) and Theischinger and Hawking (2006) illustrated *H. australiae*, whereas Taylor (2012), in a photographic guide to the West Australian fauna, illustrated a male *H. australiae* on the front cover and a male *H. armstrongi* form, with abdominal tergites 9 and 10 black, in the *H. australiae* species account about p.16. By the time of the search for Australian material Taylor had died and the actual locality for his photograph could not be confirmed. However, recent photographs which might be *H. armstrongi* from northern New South Wales and southern Queensland have been posted on the internet (e.g. Fig. 3). The status of specimens and sightings conforming to *H.*

armstrongi in Australia requires clarification and cannot yet be verified in the absence of actual modern specimens.

Winstanley (1983) recorded what might be *H. australiae* from Mayor Island, New Zealand. Since that work was published, specimens resembling *H. australiae* have been photographed in the North Island of New Zealand, so both species possibly occur there. This also requires confirmation based on collected specimens. The possibility that apparent sightings of *H. armstongi* in Australia and of *H. australiae* in New Zealand are based on infrequent vagrants cannot be ruled out and no supporting evidence based on breeding or immature stages is available.

Modification of larval keys

In some Anisoptera the extent of larval spines can vary depending on environmental conditions (specifically being longer in the presence of fish cues) (Arnqvist and Johannson 1998). The source localities of the New Zealand *H. armstrongi* exuviae examined all had fish present. Winstanley's Norfolk Island site and Rowe's cattle troughs in Townsville lacked fish.

With the possible recognition of *H. australiae* in New Zealand, the larval keys presented in Rowe (2006) require modification. In *Hemicordulia* two species might occur: in *H. armstrongi* there is a weak mid-dorsal ridge on the abdomen, while in *H. australiae* there is a distinct ridge of blunt mid-dorsal spines on at least segments 4 to 8 (sometimes 3 to 9). If both species are present in Australia equivalent modifications will need to be made to Australian keys.

Implications

Now two sibling species are recognised, which might overlap in one or both Australia and New Zealand, it is profitable to ask questions about distribution, microhabitat selection, interactions and barriers to mating. It is likely that the dragonflies have much less difficulty distinguishing each other visually than do taxonomists. *Orthetrum sabina* (Drury, 1773) and *O. serapia* Watson, 1984 were first noticed by Watson (1984) when males of this otherwise extremely aggressive putative species were regularly ignoring close passes by some other males, seemingly of the same species. One might anticipate a similar capability in *H. armstrongi* and *H. australiae*. The yellow terminal colouring of *H. australiae* is very prominent in living insects and the wing saffronation in *H. australiae* females is likely to be a very strong signal in the UV. The rôles of these differences are now questions.

Acknowledgements

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