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Two new species of *Pyrrhargiolestes*, with a key to the males (Odonata: Argiolestidae)

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Two new species belonging to the endemic New Guinea genus *Pyrrhargiolestes* are described from Papua New Guinea: *P. lamington* sp. nov. (holotype: Mount Lamington, Oro Province, dep. in RMNH) and *P. yela* sp. nov. (holotype: Rossel Island, Milne Bay Province, dep. in USNM). The presumed male of *P. aulicus* is described for the first time. New records and remarks are provided for *P. angulatus*, *P. kula*, *P. sidonia* and *P. tenuispinus*. A key to the males of all species of *Pyrrhargiolestes*, information on habitat and a map of the known distributions are given.

Keywords: Odonata; dragonfly; Zygoptera; Argiolestidae; *Pyrrhargiolestes*; taxonomy; New Guinea; Papua New Guinea

Introduction

In their revision of Argiolestidae Kalkman & Theischinger (2012) divided up the species previously included in *Argiolestes* into seven genera. For four of these genera new names were established; for the others names were already available. Among the newly established genera is the genus *Pyrrhargiolestes*, currently containing five species: *P. angulatus* (Theischinger & Richards, 2007), *P. aulicus* (Lieftinck, 1949), *P. kula* (Englund & Polhemus, 2007), *P. sidonia* (Martin, 1909) and *P. tenuispinus* (Lieftinck, 1938). In the present paper two new species are introduced, and the putative male of *P. aulicus* is described for the first time. A key to the males is given, new distributional records are provided, and the distribution of all species is mapped and discussed.

Material and methods

All specimens of the discussed species present in RMNH have been studied for this revision, as well as specimens from the collections listed below, but details on the material are given only for new records. New material listed here for the first time is deposited in RMNH unless otherwise

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noted. Geographic coordinates are given only when present on original labels. Acronyms for material repositories are as follows:

BPBM: Bernice P. Bishop Museum, Honolulu, Hawaii, USA; **MNHN**: Muséum National d'Histoire Naturelle, Paris, France; **MSNG**: Museo Civico di Storia Naturale "Giacomo Doria", Genoa, Italy; **RMNH**: Netherlands Centre for Biodiversity Naturalis, former Leiden Zoology collections, Leiden, the Netherlands; **NTM**: Museum and Art Gallery of the Northern Territory, Darwin, Australia; **USNM**: National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Systematic part

Recognition of Pyrrhargiolestes *Kalkman & Theischinger, 2012*

In the field species of *Pyrrhargiolestes* can readily be distinguished from all New Guinean damselflies by the following combination of characters: (1) wings spread while at rest; (2) legs and thorax with orange to red colouration; (3) labrum completely metallic; (4) spines on dorsum or hind rim of S10 absent. In preserved specimens the orange to red colours on the legs and thorax fade to a dull yellow to pale brown colour. As a result, specimens in museum collections can best be distinguished from other New Guinean damselfly genera based on the combination of the following characters: (1) IR2 originating near the subnodus, starting clearly closer to nodus than to arculus; (2) supplementary sectors between IR1 and RP2 and between RP2 and IR2 present; (3) labrum completely metallic; and (4) spines on dorsum or hind rim of S10 absent.

The genital ligulae of all species except *P. angulatus* were studied and scanning electron microscope (SEM) images of *P sidonia* (Figure 4) and *P. kula* (see illustration in Kalkman & Theischinger, 2012) were produced. The shape of the genital ligula is similar among the species, variation being restricted to slight differences in the width of the two apical lobes. However this character is difficult to quantify because the lobes are slightly flexible, so the genital ligula is not useful for species identification in this group.

Pyrrhargiolestes angulatus (Theischinger & Richards, 2007)
(Figures 1a, 7)

New records

Papua New Guinea, Simbu Province: 1 ♂: Crater Mountain Biological Research Station, Wara Sera, G16 creek, 100 m upstream in sunny clearing, 2004, leg. S. Oppel. – 2 ♂, 1 ♀, Crater Mountain Biological Research Station, Wara Sera, Creek next to Wara Oo, 25 July 2004, leg. S. Oppel. – 1 ♀: Herowana village, Wara Enome, 20 November 1998, leg. S. Richards.

The records from Crater Mountain Biological Research Station, Simbu Province, Herowana, Eastern Highlands and Aseki, Morobe Province were originally published as *Argiolestes sidonia* (Michalski, 1995; Oppel, 2005a, 2005b, 2006). Re-examination indicates that the material in fact represents the recently described *P. angulatus* (J. Michalski, pers. comm.). Not all the material collected at Crater Mountain Biological Research Station and Herowana was studied, but it is likely that the remainder also belongs to *P. angulatus*, and *P. sidonia* probably does not occur at these sites.

Pyrrhargiolestes aulicus (Lieftinck, 1949)
(Figures 1b, 2a, 3, 7)

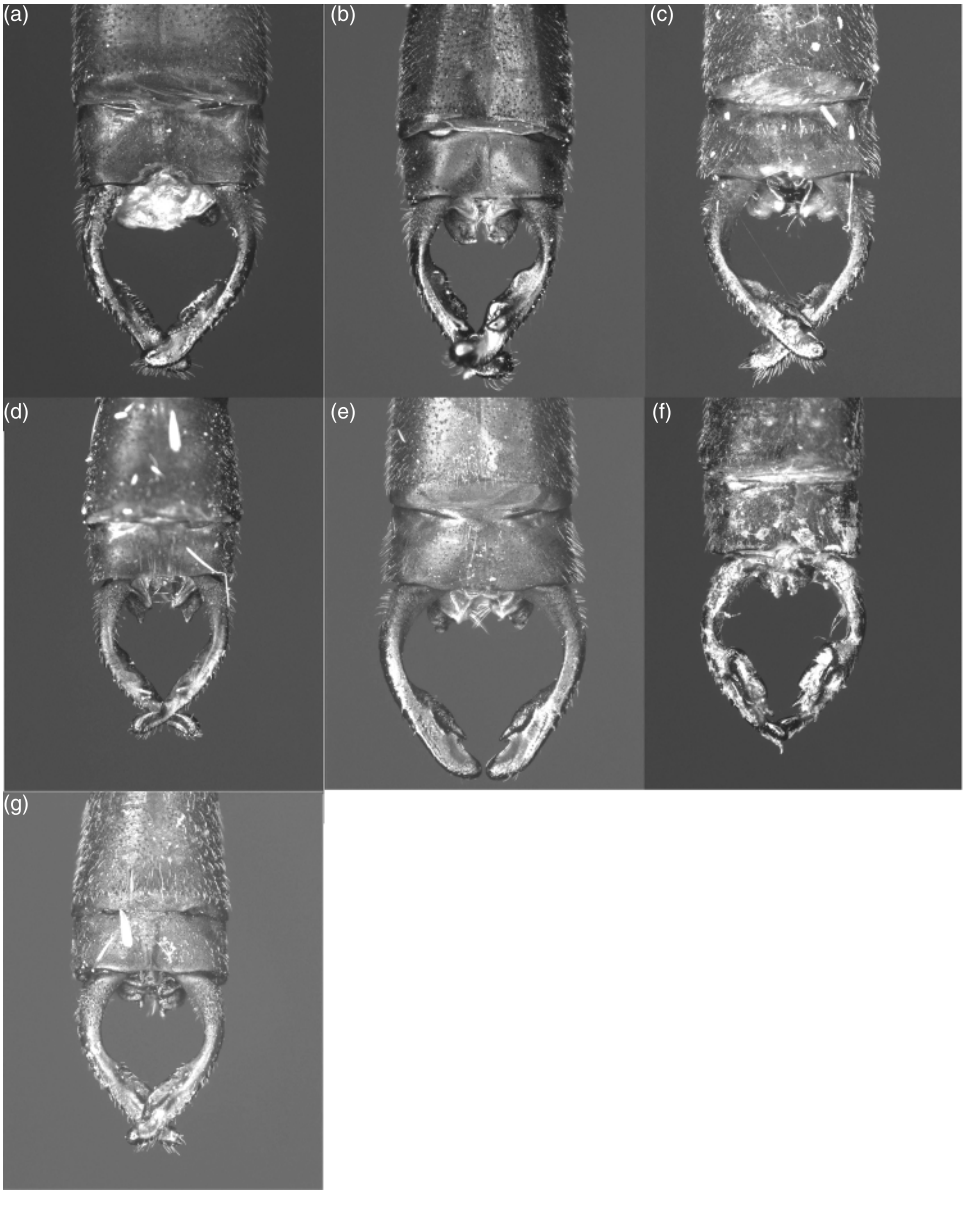

Figure 1. Cerci of male *Pyrrhargiolestes* in dorsal view: (a) *P. angulatus*; (b) *P. aulicus*; (c) *P. kula*; (d) *P. lamington* (holotype); (e) *P. sidonia*; (f) *P. tenuispinus*; (g) *P. yela* (paratype).

Specimens studied

Holotype 1 ♀: Indonesia, Papua province, Waterfall at Bernhard Camp B, 150m, 13 April 1939, leg. J. Olthof, RMNH.

1 ♂: (NTM I008602); Papua New Guinea, West Sepik Province, Ok Binai Camp, 4.900S 141.8216E, 425 m, 19 February 2010, leg. S. Richards.

Lieftinck (1949) described this species based on a single female remarking that "This interesting species has no near allies but resembles the members of the *sidonia* group [= *Pyrrhargiolestes* in the present sense] in some respects, especially in the shape of its wings, the narrow pterostigma

Figure 2. *Pyrrhargiolestes* males: (a) *P. aulicus* (male described in this paper); (b) *P. lamington* (holotype).

Figure 3. *Pyrrhargiolestes aulicus* male, West Sepik Province, PNG. Photo: S.J. Richards.

and in details of venation". The uniformly pale legs, which are probably orange to red in life, and the largely orange-yellow synthorax of the female holotype are other indications that this species should be placed in *Pyrrhargiolestes*. The male from West Sepik Province matches the holotype female in wing venation, size and proportions, and in having the legs and sides of the synthorax reddish throughout. The main difference is that in the male the front of synthorax is completely dark, whereas in the holotype female the posterior portion is dark while the anterior portion is pale and probably reddish in life. We therefore tentatively assume that the male from West Sepik

Province is the hitherto unknown male of *P. aulicus*, but validation of this hypothesis will require a series of properly associated males and females from the same locality.

Differential diagnosis of male

This taxon can easily be differentiated from the other species of *Pyrrhargiolestes*, except *P. lamington*, by the completely orange sides of the thorax. Although similar in colouration, *P. lamington* has a large dorsal tubercle lying at about two-thirds the distance from base to apex of the cerci which is absent in *P. aulicus*.

Description of male

Head. Labium pale brown throughout; wider than long. Labrum metallic black with blue gloss; mandibles and genae shining black. Anteclypeus cream-white; postclypeus metallic black except for posterolateral corners which are yellow-brown, from there a dirty yellow line runs to the eye margins; remainder of head including antennae matte black.

Thorax. Prothorax reddish brown but orange in life; synthorax orange with a black dorsum. – Legs including coxae and trochanters yellow-orange (bright orange in life); traces of black near knees, spines orange-brown. Inner side of femora clearly flattened. Femora of first, second, and third pair of legs with 8, 9, and 13 spines on their outer sides respectively. Tibiae of first pair of legs with 5 large and 5 small spines on outer sides; tibiae of second and third pairs of legs with 11 and 10 spines on their outer sides respectively; these spines near the knees c.3 times as long as the space between spines basally but becoming increasingly shorter towards tarsus. – Wings hyaline, venation brown to black. Fw and Hw of equal length and with 2 Ax; Fw with 18–19 Px; Hw with 16–17 Px. Arculus slightly distal to level of Ax2; discoidal cell in Fw long, costal side about 1.2 times as long distal side. Ac at or slightly distal to Ax1. Two cells between discoidal cell and subnodus. Pt brown. No cells beyond Pt divided. Mostly one cell row between CuA and hind margin of Hw. Supplementary sectors between IR1 and RP2 and between RP2 and IR2 present.

Abdomen. S1–3 orange-brown with posterior black ring; S4 with black dorsum but ventrolaterally orange-brown; S5–10 black. S9 and S10 broad and flattened; hind margin of S10 without spines, mid-dorsal posterior half of S10 slightly depressed. Both cerci and paraprocts black. Cerci as in Figure 1b without large spines but with a series of small spines on the outside; tip bent inward with, on the inner side, a pale brown membrane. Paraprocts about one quarter the length of cerci, ending in an inward and slightly upward pointing tooth. Shape of genital ligula strongly resembling that of *P. sidonia*, not showing any clearly definable differences.

Measurements (mm). Total length 42, abdomen 33, Fw 28; Pt in Fw 1.2 (costal length), 1.8 (greatest length); Pt in Hw 1.2 (costal length), 1.9 (greatest length).

Distribution and ecological notes

The two collecting locations are about 330 km apart, so *P. aulicus* seemingly has a large range. It is remarkable that although extensive collecting of Odonata was done at both sites where the species has been recorded, in both cases only a single specimen was collected. This species has striking colours and it therefore seems that it occurs either in very low densities or behaves in a way which makes it less likely to be noticed.

Pyrrhargiolestes kula (Englund & Polhemus, 2007)
(Figures 1c, 7)

New records

Papua New Guinea: 1 ♂, 1 ♀ (copula): Central Province, Mamai Estate, near Port Glasgow, 22 January 1965, leg. unknown. – 1 ♂: Milne Bay Province, Goodenough Island, E slopes, 900 m, 27 October 1953, leg. unknown. – 5 ♂, 8 ♀: Milne Bay Province, Modewa Bay, 25 miles west of Samarai, Camp 17, 10.65S 150.35E, 15–21 December 1956, leg. 5th Archbold Expedition. The material from Modewa Bay is labelled with a number which refers to the camp-site and information on the locality is taken from Brass (1959).

The specimen from Goodenough Island was originally published as *P. sidonia* by Lieftinck (1956) but Englund & Polhemus (2007) corrected this to *P. kula*, which is confirmed here.

Pyrrhargiolestes lamington sp. nov.
(Figures 1d, 2b, 7)

Etymology

Named after the mountain where the species occurs. Used as a noun in apposition to the generic name.

Specimens studied

Papua New Guinea: Holotype ♂: Oro Province, Popondetta, Mount Lamington, 25 m, June 1966, leg. G. Lippert & P. Shenahan, deposited in RMNH. Written on envelope: "♂, sp. n. sidonia group, Mt. Lamington, Popondetta, BISH". Printed labels: (1) "New Guinea, SE, Popondetta, 25 m, VI.66"; (2) "G. Lippert, collector BISHOP"; (3) "P. Shanahan, Collector BISHOP".

Differential diagnosis of male

This species can easily be differentiated from the other species of *Pyrrhargiolestes*, except for *P. aulicus*, by the completely orange sides of the thorax. The male of *Pyrrhargiolestes lamington* has a large dorsal tubercle at about two-thirds of the distance from the base to the apex of the cerci, which is absent in *P. aulicus*.

Description of holotype male

Head. Labium pale brown throughout; wider (1.3 mm) than long (1.0 mm), median cleft about one quarter of length of labium and slightly deeper than wide. Labrum metallic black with blue gloss; mandibles and genae shining black. Anteclypeus cream-white; postclypeus metallic black with green-blue gloss; sides of face up to sockets of antennae glossy brown-black, this glossy area running up along the eyes to dorsum of the head; frons and remainder of head including antennae matt black.

Thorax. Sides of prothorax brown, median lobe of pronotum dark brown, anterior and posterior lobe black; synthorax orange with front black. – Legs including coxae and trochanters yellow-orange but probably bright orange in life; traces of black near knees, spines orange-brown. Inner side of femora clearly flattened. Femora of first, second and third pair of legs with 8–9, 8 and 10

Figure 4. Genital ligula of *Pyrrhargiolestes sidonia*.

spines on their outer sides, respectively. Tibiae of first pair of legs with 6 large and 8 small spines on outer side; tibiae of second and third pairs of legs with 9 and 10–11 spines on the outer side, respectively; spines near the knees c.3 times as long as space between spines basally, becoming increasingly shorter towards tarsus. – Wings hyaline, venation brown to black. Fw and Hw of equal length. Fw and Hw with 2 Ax; Fw with 18–19 Px; Hw with 16 Px. Arculus slightly distal to level of Ax2; discoidal cell in Fw long, costal side almost 1.3 times as long as distal side. Ac at or slightly distal to Ax1. Two cells between discoidal cell and subnodus. Pt brown. At most one cell beyond Pt divided. One row of cells between CuA and hind margin of Hw. Supplementary sectors between IR1 and RP2 and between RP2 and IR2 present.

Abdomen. S1–3 orange-brown with posterior black ring; S4–5 with brown-black dorsum but ventrolaterally brown; S6–10 black. S9 and S10 laterally depressed; hind margin of S10 without spines, mid-dorsal posterior half of S10 slightly depressed. Paraprocts black, cerci black with distal half brown-black. Cerci as in Figure 1d, without large spines but with outer border bearing 4 to 6 small spines; small but characteristic dorsal tubercle present at two-thirds distance from base. Cerci S-shaped in lateral view, with base straight, bending down at halfway point and then curving upwards at apex. Paraprocts black, about one quarter the length of cerci; curving gently downward when viewed laterally. Shape of genital ligula strongly resembling that of *P. sidonia*, not showing any clearly definable differences.

Measurements (mm). Total length 41, abdomen 34, Fw 27; Pt in Fw 1.6 (costal length), 1.9 (greatest length); Pt in Hw 1.6 (costal length), 1.9 (greatest length).

Pyrrhargiolestes sidonia (Martin, 1909)
(Figures 1e, 4, 7)

New records

Papua New Guinea: 1 ♂: Central Province, Brown River, NW of Port Moresby, 11 November 1970, leg. R. Straatman. – 1 ♂: Central Province, Owen Stanley Range, Goilaia, Tapini, Tororo, 5200 ft., 22 February 1958, leg. H.H. Brandt. – 6 ♂, 1 ♀: Central Province, Owen Stanley Range, Goilaia, Tapini, Kiambavi, 5000 ft., February 1958 (?), leg. H.H. Brandt. – 1 ♂, 1 ♀: Morobe Province, Wau, 1200 m, 22 July 1962, leg. J.H. Sedlacek, ex. col. Bishop. – 2 ♂: Morobe Province,

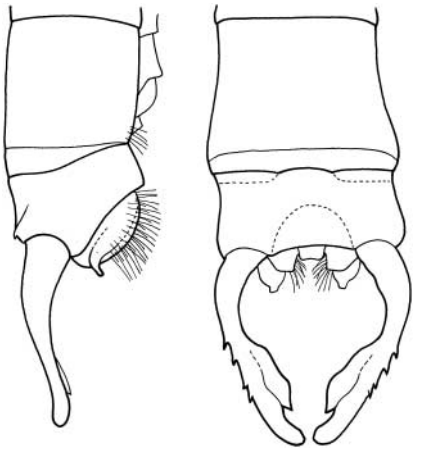

Figure 5. Anal appendages of male *Pyrrhargiolestes yela* from lateral (left) and dorsal (right). Drawing: D.A. Polhemus.

Wau, 1300 m, 23 October 1963, leg. G. – 1 ♂: Morobe Province, Bulolo, 1984, leg. unknown, coll. J. Michalski. – ♂, 1 ♀: Oro Province, Popondetta, Mount Lamington, 25 m, June 1966, leg. G. Lippert & P. Shenahan. – 1 ♂: Finisterre Range, Naych, 3000–6000 ft, May 1958, leg. H.H. Brandt.

We have been unable to find a locality named Naych in the Finisterre Range. All other collection localities for *P. sidonia* are from south of the Ramu and Markham valleys, making the record from the Finisterre Range remarkable and suggesting that either a different very closely related species is involved, or that the specimen is mislabelled.

Pyrrhargiolestes tenuispinus (Lieftinck, 1938)
(Figures 1f, 7)

This species is known from a small series of males and females collected in July and September 1893 at 1300 m at Moroka, Astrolabe Range, Papua New Guinea, by L. Loria and sent by him to the MSNG (Lieftinck, 1938, 1956). It seems likely that one male and one female of this series were taken by René Martin who used them incorrectly as the basis for a redescription of *Metagrion obscurum* (Selys, 1878) (Martin, 1909), a synonym of *Metagrion ornatum* (Selys, 1878) (Lieftinck, 1935). The RMNH has one male and one female labelled "ex Mus. Paris" (handwriting Lieftinck) and "*Argiolestes obscura* S., Nouvelle Guinée". It seems likely that these are the specimens used by Martin (1909) for his redescription of *M. obscurum* and that these were later taken by Lieftinck and deposited in the RMNH. In addition to these specimens the RMNH has two males (including the holotype) and one female which were sent to M. Lieftinck from the MSNG (Lieftinck, 1938). The remainder of the original series (four males and one female) is probably still in the MSNG.

In both the holotype and the paratype male available for study the lower apical flange of the cercus ends in a spine. This spine is lacking in the male labelled "*Argiolestes obscura* S., Nouvelle Guinée". This could be due to intraspecific variation, or it could be that these specimens (male and female) are not from the type locality and represent an undescribed species. In the absence of further information it is considered better to regard them as *P. tenuispinus* for the present.

The genital ligula is visible in one of the specimens present in the RMNH and its general shape corresponds with that of *P. sidonia*.

Pyrrhargiolestes yela sp. nov.
(Figures 1g, 5, 7)

Etymology

The name "yela" is derived from the traditional Melanesian name for Rossel Island and is used as a noun in apposition to the generic name.

Specimens studied

Papua New Guinea: Holotype ♂: Milne Bay Province, Rossel Island, Woa River and rocky tributaries, from head of estuary to 4 km upstream (11.3435S 154.1184E, 0–150 m), 31 August–1 September 2002, leg. D. A. Polhemus, deposited in USNM.

Paratypes: 2 ♂: Milne Bay Prov., Rossel Island, south slopes of Mount Rossel (11.36S 154.23E), 16 October 1956, leg. 5th Archbold Expedition. Written on envelope: "B, 2 ♂, Argiolestes sp. n., Camp 13, 16.x.1956, Rossel I.". Information on locality is taken from Brass (1959).

Differential diagnosis of male

Closely related to *P. kula* and *P. sidonia* and like these has a dark pattern on the sides of the thorax and a lower apical flange on the cercus which is smoothly curved and ends in a spine. Separated from *P. kula* and *P. sidonia* by having only one row of cells between the CuA and the hind border of Hw and in having the posterior three-fourths of the labium pale (yellow-brown).

Description of holotype male

Head. Labium pale orange-brown throughout; wider than long, median cleft slightly deeper than wide. Labrum metallic black with blue gloss; mandibles and genae shining black. Anteclypeus cream-white; postclypeus metallic black with green gloss; sides of face up to sockets of antennae glossy black, this glossy area running up along the eyes to dorsum of the head; frons and remainder of head including antennae matt black.

Thorax. Prothorax black with pale brown area on median and anterior lobe of pronotum; synthorax with mesepisternum, mesepimeron and metepisternum matt black with a narrow pale orange band running just above the intersegmental suture from near the hind border of the synthorax to just past the metastigma. Lower half of metepimeron dull orange, upper half dirty brown. Legs including coxae and trochanters yellow-orange but probably bright orange in life; some traces of black near knees. Inner sides of femora clearly flattened. Spines orange-brown. Femora of first, second, and third pair of legs with 9, 10 and 12 spines on their outer sides respectively. Fore tibiae with 4 large and 9 small spines on outer sides; middle and hind tibiae with 10 and 10 spines on their outer sides respectively; spines near the knees c.3 times as long as space between spines basally, becoming increasingly shorter towards tarsus. – Wings hyaline, venation brown to black. Fw and Hw of equal length. Fw and Hw with 2 Ax; Fw with 19 Px; Hw with 16–17 Px. Arculus at or slightly distal to level of Ax2; discoidal cell in Fw long, costal side almost 1.2 times as long as distal side. Ac slightly distal to Ax1. Three cells between discoidal cell and subnodus. Pt brown. No cells beyond Pt divided. Mostly one row of cells between CuA and hind margin of Hw. Supplementary sectors present between IR1 and RP2 and between RP2 and IR2.

Abdomen. S1–5 brown; S6–10 dark brown to black; S9 and S10 laterally depressed; hind margin of S10 without spines. Cerci black; paraprocts brown-black. Cerci as in Figures 1g and 5, elongate and slender, when viewed laterally, strongly bowed in basal half in dorsal view then nearly straight in distal half, with 4–6 small spines on the outer side. Lower apical flange well developed and

Figure 6. Habitat where holotype of *Pyrrhargiolestes yela* was collected. Photo: D.A. Polhemus.

ending in apical pointed spine, upper apical flange small and rudimentary, apex of cercus itself broadly rounded (Figures 1g, 5). Paraprocts about one quarter the length of cerci and, seen dorsally, ending in distinct apically pointed denticle; this denticle gently curved down when viewed laterally. Shape of genital ligula strongly resembling that of *P. sidonia*, not showing any clearly definable differences.

Measurements (mm). Total length 39, abdomen 31, Fw 27.

Variation

The two paratypes match closely with the type. Both have a faint white spot along the eyes at the height of the clypeus suggesting that in younger specimens a pale line runs from the eyes to the clypeus.

Measurements (mm). Fw 29; Pt in Fw 1.5 (costal length), 1.8 (greatest length); Pt in Hw 1.6 (costal length), 2.0 (greatest length).

Distribution and ecological notes

Argiolestes yela is endemic to the island of Rossel, also known to the local Melanesian people of the region as Yela, the easternmost island in the Louisiade Archipelago.

The Woa River at the type locality is a broad, clear river with a rocky bed (Figure 6), flowing down from the eastern slopes of Mt Mbo through primary lowland rain forest. The river was reached above the head of its estuary via a trail from an anchorage in Yonga Bay, and then followed upstream for several kilometres, to a point where it became confined between bedrock

walls, with alternating small rapids and deep pools. The holotype male of *P. yela* was taken perching next to a seep along this upper reach of the Woa River.

Key to the males of Pyrrhargiolestes

1. Sides of synthorax completely orange 2
1′. Sides of synthorax brown to black with brown-orange or orange stripes 3
2. Small dorsal tubercle present on cerci at two-thirds length from base; cerci S-shaped when viewed laterally, with base straight, then bending downward near midpoint before curving upward at the apex . . . . . *P. lamington*
2′. No small dorsal tubercle present on cerci at two-thirds length from base; cerci straight when viewed laterally, with only the apex clearly bent upward . . . . . *P. aulicus*
3. Apical two-fifths of cerci strongly modified with large, roughly rectangular lower flange (with or without an apical spine) and strongly developed, dorsally raised crest . . . . . *P. tenuispinus*
3′. Cerci without large rectangular inner flange and without strong and dorsally raised crest 4
4. Lower apical flange of cerci ending with a spine, inner margin of the lower apical flange not smooth, having a slight but distinct angle at base of apical spine . . . . . *P. angulatus*
4′. Lower apical flange of cerci ending with spine, inner margin of the lower apical flange smooth 5
5. Typically with one row of cells between CuA and hind margin of Hw; posterior three-fourths of labium pale (yellow-brown); pale stripe on side of thorax less than a third as broad as the metanepisternum; upper apical flange of cerci never ending in a spine . . . . . *P. yela*
5′. Typically with 2 to 3 rows of cells between CuA and hind margin of Hw; labium dark (brown to black); pale stripe on side of thorax almost half as broad as the metanepisternum; upper apical flange of cerci either ending in a spine or rounded 6
6. Only lower apical flange of cerci ending in short spine, end of upper apical flange rounded without clear spine (see Englund & Polhemus, 2007, figure 5). Cerci more elongate and curved mostly in basal third. On average larger (Hw 30–32 mm). Has red colours in life . . . . . *P. kula*
6′. Both upper and lower apical flanges of cerci ending in short spine (see Englund & Polhemus, 2007, figure 3). Cerci stouter and more uniformly curved throughout. On average smaller (Hw 27–29 mm). Has reddish-orange colours in life . . . . . *P. sidonia*

Discussion

The seven known species of *Pyrrhargiolestes* are endemic to New Guinea and are confined to the eastern half of the island (Figure 7), occurring primarily on the Papuan Peninsula and proximal archipelagoes. *Pyrrhargiolestes aulicus*, a poorly known species found on the northern side of the central mountain range, with one record from Papua New Guinea and one from Papua, Indonesia, is the only exception to this general distributional pattern. Species in the genus are overwhelmingly concentrated on land masses constituting the East Papua Composite Terrane (EPCT) tectonic province as defined by Pigram & Davies (1987). The EPCT existed as a discrete island separate from New Guinea for 25 million years before the two land masses fused in the Late Eocene to Early Miocene, and is a documented area of endemism for aquatic Heteroptera and Coleoptera (D. Polhemus, 2011; D. Polhemus & J. Polhemus, 2004) as well as for some terrestrial groups (Heads, 2002a, 2002b). We therefore hypothesize that *Pyrrhargiolestes* underwent its initial diversification on the EPCT, with limited dispersal to the west within New Guinea subsequent to the Miocene.

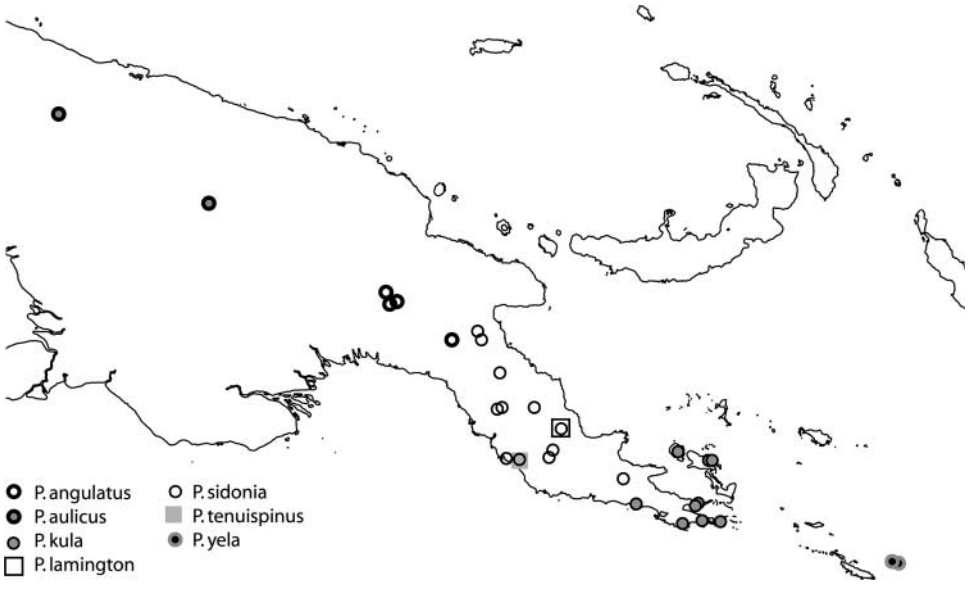

Figure 7. Distribution of the species of *Pyrrhargiolestes*.

Within New Guinea as a whole, the individual species of *Pyrrhargiolestes* also have largely allopatric ranges. The exceptions to this rule are *P. tenuispinus* and *P. lamington*, both of which are known from one location lying within the distributional range of the rather widespread *P. sidonia*. There is even one instance where *P. lamington* and *P. sidonia* have been found at the same locality, although on the whole it is not typical for *Pyrrhargiolestes* to occur in syntopic multi-species assemblages.

The known altitudinal ranges of individual *Pyrrhargiolestes* species are as follows: *P. angulatus*: 850–1300 m; *P. kula*: sea level to 900 m; *P. lamington*: 25 m; *P. sidonia*: 25–1800 m; *P. tenuispinus*: 1300 m; *P. yela*: 0–150 m. From this it can tentatively be concluded that the species of *Pyrrhargiolestes* occupy a broad altitudinal range, but are absent above 2000 m asl.

Pyrrhargiolestes kula and *P. sidonia* not only seem to have the broadest distributional ranges within the genus, but also seem to be much more common within their respective ranges than the other species. These two are apparently more closely related to each other than to any of the other species, with the possible exception of *P. yela*. Englund & Polhemus (2007) remarked that *P. sidonia* "perches conspicuously in the open at places where small rivulets and seeps cross mountain trails, thus likely accounting for the relatively large number of captures over the years". It is possible that such conspicuous behaviour partly accounts for the far higher number of records known for these two species compared to the other five. With the exception of *P. lamington* and *P. tenuispinus*, for which no habitat information is available, all species were found exclusively in association with running waters. *Pyrrhargiolestes kula* appears to prefer closed to moderately open, small, rocky streams, including even some in which flow becomes intermittent at certain seasons of the year, and also seems to favour waterfalls and seep rheocrenes, where the adults may sometimes be encountered in large numbers (Englund & Polhemus, 2007). Oppel (2005b) found *P. angulatus* (as *Argiolestes sidonia*) at "extremely steep, almost waterfall-like streams with a solid rock bed or very coarse gravel". He found the individuals mostly at the more open sections of the creeks in regions with extensive sunny areas and little moss cover on the rocks. The limited information on habitat suggests that the species of *Pyrrhargiolestes* are largely confined to steep, sunny sections of streams, and that more than other Papuan species of the Argiolestidae they are associated with the presence of cascades.

Both *P. kula* and *P. sidonia* have been found perching on plants or rocks, adjacent to or in streams (Englund & Polhemus, 2007; Oppel, 2005b). *Pyrrhargiolestes sidonia* was found "ovipositing on the edges of the cascade face itself" (Englund & Polhemus, 2007). Further information on adult behaviour and information on the larvae is lacking.

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