TWO NEW SPECIES OF *PERICNEMIS* FROM BORNEO, WITH COMPARATIVE NOTES ON RELATED SPECIES (ZYGOPTERA: COENAGRIONIDAE)

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*Pericnemis triangularis* Laidlaw was described on the basis of a single ♀ from Bettotan in NE Borneo. Specimens from Brunei and neighbouring Sarawak previously referred to this sp. are reappraised with reference to the type and described as *Pericnemis dowi* sp. n. *P. kiautarum* sp. n. from Sabah, N. Borneo is described and figured based on a single ♂ specimen. The new spp. are also compared and discussed in relation to *P. stictica*, the other Sundaland sp. of the genus. Both are distinguished by their ♂ caudal appendages and by the form of a well developed horn on the hindlobe of the pronotum. The form of the appendages suggests a closer relationship between *P. dowi* and *P. kiautarum* than *P. stictica*. Both *P. dowi* and *P. stictica* breed in phytotelmata and it is conjectured that *P. kiautarum* probably does likewise. The potential hazards of describing spp. from the ♀ sex only are discussed.

INTRODUCTION

The genus *Pericnemis* Hagen in Selys, 1863 (in most publications incorrectly credited to ‘Selys, 1863’) currently includes seven described species occurring in Sundaland and the Philippines with many Philippine forms still awaiting description. At present two species of the genus are known from Borneo: *P. stictica* Hagen in Selys, 1863 (the type species of the genus), and *P. triangularis* Laidlaw, 1931.

The genus has had a somewhat chequered history with respect to what species should be included. Originally five new *Pericnemis* species from the Philippines were described by NEEDHAM & GYGER (1939) who also transferred *Amphicnemis glauca* Brauer, 1868 and *A. lestoides* Brauer, 1868 to *Pericnemis*. LIEF-
TINCK (1940, 1957) disagreed and considered all Philippine *Pericnemis* taxa to belong to the genus *Amphicnemis* Selys, 1863. Recently VILLANUEVA (2012) redefined all Philippine *Amphicnemis* (sensu Lieftinck) and *Pericnemis* (sensu Needham & Gyger) taxa, placing them into four distinct genera: *Luzonobasis* (nov.), *Pandanobasis* (nov.), *Sangabasis* (nov.) and *Pericnemis*; no species were retained in *Amphicnemis* which was considered endemic to Sundaland. VILLANUEVA et al. (2013) described *Pericnemis melansoni* from Mindanao and several new Philippine *Pericnemis* species are expected to be described by VILLANUEVA & DOW (in preparation). None of the Philippine species are known to breed in phytotelmata.

*P. stictica*, originally described from Java, is widespread in Sundaland. Its range extends from southern Thailand (Trang) to Peninsular Malaysia, Sumatra and Borneo. *P. triangularis* is so far known only from a single female specimen described by LAIDLAW (1931) from Bettotan on the north-east coast of the island. In a series of ecological studies of phytotelmata in Brunei (ORR, 1994, 1997, 2006; KITCHING & ORR, 1996) described the life history and discussed the role in the foodweb of a *Pericnemis* species which was referred to as *P. triangularis* based on a determination made at the then RMNH, Leiden. The male was described as *P. triangularis* by ORR (2001) based on bred specimens and a single mature wild male. Since that time we have examined photographs of the type of *P. triangularis*, held in the Natural History Museum, London and it has become clear that the Brunei specimens are not conspecific. It is therefore described here as *P. dowi* sp. n.

In 2002 the second author (MH) received from Haruki Karube a selection of Bornean Zygoptera for identification. This material included an interesting *Pericnemis* specimen from Poring (Sabah), which was forwarded to the first author (AGO) for further study. The existence of an undescribed Bornean *Pericnemis* species was briefly mentioned in ORR (2003, p. 87). It is described here as *P. kiautarum* sp. n. The prothoracic structures of *P. stictica* and details of the pterostigma of *P. stictica* and *P. triangularis* are figured here for the first time, while the male appendages of *P. stictica*, and *P. dowi*, figured respectively by VILLANUEVA (2012) and ORR (2001) are refigured for ease of comparison.

**PERICNEMIS DOWI** SP. NOV.

Figures 1a,c, 2a, 3a,b, 4a,b


*Pericnemis triangularis* [nec. Laidlaw, 1931]: ORR, 2003: 19, 87, 115, 138-139 (pl. 1, fig. f), 142-143 (pl. 3, fig. f).

**Material.** – **Holotype** ♀: BORNEO, Brunei, Kuala Belalong Field Studies Centre (KBFSC), near Pondok Tikus, 12-VIII-1994, A.G Orr leg., deposited in Queensland Museum, Brisbane, Australia. QM registration number T189609. – **Paratypes**: 1 ♀ BORNEO, Sarawak, Miri division, Gunung Mulu, Gunung Mulu National Park, Trailside on summit trail between camp 1 and camp 2 in...

Etymology. — The specific epithet dowi: a noun in the genitive case, named in honour of Dr Rory Dow who first recognised the species as being distinct from P. triangularis and who has made numerous and important recent contributions to the systematics and faunistics of Bornean Odonata.

Fig. 1. Males of Pericnemis spp.: (a-b) head and thorax of (a) holotype of P. dowi sp. n., (b) holotype of P. kiautarum sp. n.; (c-e) lateral view of prothorax of (c) P. dowi sp. n., (d) P. kiautarum sp. n., (e) P. stictica [a specimen from Sarawak, Teng Bukap, 4-V-1987, K. Maruyama leg. In Coll. Haruki Karube].
DIAGNOSIS – A moderately large coenagrionid with bifid superior appendages and very short inferiors. It may be distinguished from its closest relatives *P. stictica* and *P. kiautarum* sp. n. by the form of the anal appendages, with the upper branch strongly recurved and the lower branch similar in length. The spine on the hindlobe of the prothorax has a distinct shoulder at its base and bent sharply upwards.

**MALE (holotype).** – Head (Fig. 1a). – Labium golden ochre, slightly darker towards extremities; labrum light ochre with slight marginal infuscation; frons strongly angulated; entire front of head up to level of frontal angle pale ochre, except for postclypeus which is black anteriorly and laterally with broad ochre ‘horned’ shape basally (Fig. 1a). Upper surface of the head black with slight metallic green cast, with small elongate-oval ochre flecks between the ocelli and the antennal base. Antennal S1, S2 light brown; S3 ochreous with light brown line along anterior surface and brownish apex; remaining segments light brown.

Thorax (Figs 1a,c). – Prothorax (Fig. 1a) mainly pale ochre with brown-black markings on dorsum of anterior and median lobe, most of posterior lobe dark with pale margins. Anterior lobe swollen cephalad but contracted caudad to form a narrow saddle between anterior and domed median lobe. Posterior lobe (Fig. 1c) produced into a spine with distinct basal shoulders, turned up abruptly at about its midpoint. Ratio of length of spine (from base to apex) to dorsum of median+anterior lobes = 0.96. Synthorax (Fig. 1a) pale ochre with metallic black markings as follows: mesepisternum with broad bands reaching from the well de-

![Wings](image_url)

Fig. 2. Wings of: (a) holotype male of *Pericnemis dowi* sp. n. and – (b) holotype male of *P. kiautarum* sp. n.
fined median carina almost to well short of the humeral suture; small patch on shoulder of mesepimeron. Legs uniformly ochre with short, light brown spines.

Wings (Fig. 2a). – Long and narrow; Px 20: 17/20: 17; M3 and Rs arising at subnodus and in forewing fused for two thirds of a cell breadth. Pt ochre with brownish centre; broad rounded trapezoidal shape in both wings, strongly convex apically, with anterior margin about two thirds length of posterior margin; only one row of cells beyond Pt in all wings (Fig. 3a).

A b d o m e n. – Long and gracile; S1 ochreous with dorso-apical brown smudge; S2-7 with upper half brown, lower ochreous except at apex, faint, ochreous sub-apical, dorsal transverse bar; S8, S9 mainly brown with ventral margin broadly ochreous; S10 brown, laterally ochreous.

Anal appendages (Figs 4a,b). – Superior appendages bifid; in lateral view upper branch dark brown, finger-like and smoothly but strongly recurved apically; tips with inner-posterior subapical swelling associated with a slight internal concavity; overall substantially longer than S10. Lower branch pale ochreous, fine and gently up-curved apically ending in a small darkened pointed tip; almost reaching upper branch apex. In dorsal view upper branches broad basally with robust inner tooth ca 4/5th of distance from base; lower branch barely visible in dorsal view. Inferior appendages very short and broad in lateral view; barely visible in dorsal view.

Me a su r e m e n ts (mm). – Hw 31.5; abdomen + appendages 48.

V A R I A T I O N. – The male paratype is significantly larger than the holotype. Hw 35 mm, abd + apps 58.5 mm. Its facial markings are darker and slightly more extensive.

F E M A L E. – H e a d. – Almost identical to male with some variation in dark coloration of postclypeus, this being entirely dark in one specimen.

T h o r a x. – Prothorax with posterior lobe rounded with a very slightly elevated rim. Coloration of entire thorax similar to that of male. Wings similar to male but in all cases M3 arising at subnodus; Rs arising just proximal to subnodus. Pt of variable form but always moderately broadly trapezoidal, even in one wing where oblique axillary vein meets posterior margin; Px of three female paratypes 19:15/16:20, 17:15/18:16 and 19:16/16:19.

A b d o m e n. – S1 pale basally with broad dark dorsal saddle apically; remaining segments dark above with venter ochre, becoming progressively darker posteriorly. Ovipositor reaching to end of S10. Anal appendages about 2/3rd length of S10, pale.

Me a su r e m e n ts (mm). – Hw 32-36; abd+apps 46-54.

R E M A R K S. – The present species was originally discovered during surveys of phytotelmat in Brunei and its early stages and ecology have been well documented (ORR, 1994). In addition to the type series a number of bred specimens and wild caught females are in the collections of Naturalis Biodiversity Centre, Leiden but cannot at present be located. All were collected and examined by AGO and it can
be stated with confidence that the form of the male appendages are like those of the holotype, and the range in variation in the pterostigma did not exceed that found in the paratype series. No known specimens from this population exhibit the narrow sub-triangular pterostigma of *P. triangularis*, which gives it its name, nor the supplementary vein meeting the outer margin of the pterostigma as in *P. triangularis* and *P. stictica*. One large female (hw 36 mm) has an oblique supplementary vein in the right left forewing, but the pterostigma remains set further back from the wing tip. The holotype female of *P. triangularis* is a small specimen (hw 31 mm) and hence its complex post-pterostigma venation is unlikely to result from allometric development. The venation is generally denser in *P. dowi* specimens. The upper branch of the superior appendage differs markedly from that of *P. stictica* in dorsal view, being much thicker basally with a post-median inner tooth, as opposed to a small subapical tooth. A specimen from Kubah National Park, Sarawak, in the collection of R.A. Dow has very similar, but not identical, appendages and differs in the markings of the thorax and the shape of the posterior horn on the prothorax (DOW & REELS, 2010). Similar variation in the shape of this structure occurs in *P. stictica* (R.A. Dow, pers. comm.) and thus it is possible this specimen also belongs to *P. dowi*, but until more comparative material becomes available we treat this specimen as *incertae sedis*. The same policy is adopted for a similar specimen recorded from Semenggoh Nature Reserve, Sarawak (see DOW & REELS, 2013).

**PERICNEMIS KYAUTARUM** SP. NOV.

Figures 1b,d, 2b, 3c, 4c,d


**ETYMOLOGY.** – The specific epithet *kiautarum*, a plural noun in the genitive case, named jointly in honour of Professor Dr Bastiaan Kiauta and Mrs Marianne Kiauta, who, working as a well oiled team, edited, published and circulated *Odonatologica* for 42 years; year in year out this quarterly journal has always appeared punctually and in good order — surely an unparalleled achievement in the history of entomological publication.

**DIAGNOSIS.** – A large, moderately dark coenagrionid with bifid superior appendages and very short inferiors. It may be distinguished from its closest relatives *P. stictica* and *P. dowi* sp. n. by the form of the anal appendages, with the lower branch of the superior relatively short, and the exceptionally well developed erect spine on the posterior lobe of the prothorax, longer than the dorsum of the median and anterior lobes combined.

**MALE (HOLOTYPE).** – Head. (Fig. 1b). – Labium pale ochre, slightly darker towards extremities; labrum light ochre with small, dark, mid-basal mark and infuscation laterally; frons strongly angulated; entire front of head up to level of frontal angle pale ochre, except for postclypeus which is black with small, paired, sub-
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basal transversely elongate ochre spots and small black intrusions from the antennal bases. Upper surface of the head black with slight metallic green cast, with small triangular ochre flecks between the ocelli and the antennal base. Antennal S1, S2 light brown; S3 ochreous with light brown line along anterior surface and brownish apex; remaining segments light brown.

Thorax (Figs 1b, d). – Prothorax (Fig. 1b) mainly pale ochre with brown-black markings on dorsum of median lobe and small brown streaks on either side of anterior lobe; most of posterior lobe dark, fading apically. Anterior lobe swollen cephalad but contracted caudad to form a narrow saddle between anterior and domed median lobe. Posterior lobe produced into a long semi-erect spine curving gently upwards from its base (Fig. 1d). Ratio of length of spine (along dorsal margin) to dorsum of median+anterior lobes = 1.52. Synthorax (Fig. 1b) pale ochre with metallic greenish black markings as follows: mesepisternum with broad bands reaching from the well defined median carina almost to the humeral suture; well developed patch on mesinfraepisternum and another at base of mesepimeron. Legs uniformly ochre with short, light brown spines.

Wings (Fig. 2b). – Long and narrow; Px 16: 14/16: 14; M3 arising at subnodus; Rs arising just proximal to subnodus. Pt bright ochre; broad slightly rounded trapzoidal shape in both wings, with anterior margin about half length of posterior margin; more than one row of cells beyond Pt in left wings and in right forewing (Fig. 3c).

Abdomen. – Long and gracile; S1 ochreous with dorso-apical brown smudge; S2 upper half brown, lower ochreous except at apex; faint, ochreous, subapical, dorsal transverse bar; S3-7 similar but with basal ochreous ring and successive segments progressively darker and with subapical ochreous mark fainter; S8, S9 mainly brown with ventral margin broadly ochreous; S10 ochre with brown marking on dorsum and laterally along apical margin.
Anal appendages (Figs 4c, d). – Superior appendages bifid; in lateral view upper branch dark brown, broad finger-like, down-curved at about 45° at 4/5th of distance from base; tips slightly expanded and spatulate; substantially longer than S10. Lower branch pale ochreous, fine and gently up-curved apically ending in a small darkened pointed tip; approximately one half total length of upper branch with tip well short of upper branch apex. In dorsal view upper branches strongly swollen basally with robust inner tooth ca 2/5th of distance from base; lower branch barely visible in dorsal view. Inferior appendages very short and broad in lateral view, markedly hirsute; barely visible in dorsal view.

Measurements (mm). – Hw 35.5; abdomen + appendages 58.5.

FEMALE unknown.

REMARKS. – Although very similar in size, stature and venation to *P. stictica* this species is clearly distinct from it. The structure of the upper branch of the superior anal appendages seen in dorsal view suggests a closer affinity with *P. dowi* (Fig 4b) than *P. stictica* (Fig. 4f). The spine arising from the posterior lobe of

Fig. 4. Male anal appendages of *Pericnemis* spp., lateral and dorsal views: (a-b) holotype of *P. dowi* sp. n.; – (c-d) holotype of *P. kiautarum* sp. n.; – (e-f) *P. stictica* [cf. Fig. 1e].
the prothorax (Fig. 1b) is considerably longer, straighter and more erect than in either P. stictica (Fig. 1c) or P. dowi (Fig. 1a). The shape of both wings resembles that of P. stictica but the venation is less dense, with the latter having 2-3 more Px in both wings, and although in three wings of P. kiautarum supplementary veins are present beyond the pterostigma, none connect to the pterostigma, as is usually the case in P. stictica (Fig. 3d) and in the unique P. triangularis female (Fig. 3e). Presumably for this reason the pterostigma is pentagonal in P. stictica and P. triangularis but rounded or rounded-trapezoidal in P. kiautarum (Fig. 3c), and also in P. dowi (Fig. 3a, b). There is in the collection of R.A. Dow a female from Poring Hot Springs which may belong to this species, but as there is no certain evidence to associate the two it is not included in the type series. In this case however the pterostigma, as in the male P. kiautarum, is relatively broad on the costal margin and no supplementary veins connect to it. An additional male specimen in collection R.A. Dow from Kalimantan Tengah exhibits anal appendages and pterostigmata very like those of P. kiautarum. The anteriorly broad pterostigma of P. kiautarum and differences in venation suggest it is unlikely to be the male of P. triangularis.

DISCUSSION

The genera Amphicnemis and Pericnemis were separated by SELYS LONGCHAMPS (1863) on the basis of venational characters and the pentagonal pterostigma of the latter, found in P. stictica, at that time the only known species of Pericnemis. The validity of these venational characters has since been challenged (VILLANUEVA, 2012), and at present the only character separating the two genera would seem to be the presence or absence of a tubercle or ridge present in the distal portion of the base of the penis. We have not confirmed this character for either P. dowi or P. kiautarum as the material available is too limited to risk destructive examination, and therefore we include the new species in Pericnemis because of their obvious affinity with P. stictica, and P. triangularis. Otherwise the three taxa are separated from Amphicnemis by characteristics such as general facies, colouration and stature. The longer lower branch of the superior appendage is also noted as characteristic of Pericnemis (VILLANUEVA, 2012), but P. kiautarum, which must be placed in the same genus as P. dowi, and P. stictica does not conform in this respect.

In describing these two new species we are aware that there is a remote chance one may in fact be a synonym of P. triangularis. However this may be impossible to prove. The type locality of P. triangularis is now heavily deforested and planted with oil palm, and even were specimens found, the range of variation in venation and shape of the pterostigma may make it impossible to associate them with P. triangularis. The form of the pterostigma in the holotype is narrowly pentagonal and this is the case on all four wings. The pterostigma is placed very near the
apex. There is a small supplementary vein meeting the outer margin of the pterostigma in all wings. As it is a rather small specimen (Hw 31 mm) this is unlikely to an allometric effect associated with larger size (a similar, but more oblique vein is present in one wing of a large specimen of *P. dowi*). In these characters it also seems to fall well outside the range of variation found in *P. dowi*. The single male specimen of *P. kiautarum* differs even more in the shape of the pterostigma, which is strongly trapezoidal. The type localities of *P. triangularis* and *P. kiautarum* are relatively near to each other (ca 150 km apart) but they almost certainly originate from different forest types and as *P. kiautarum*, or a species very like it, known from a distant locality in Kalimantan Tengah it is likely that species is actually widespread, but elusive. The conundrum we have been faced with does however signal a cautionary note. New species should not be described from the female sex only unless the specimens exhibit outstanding distinguishing characters.

Both *P. dowi* and *P. stictica* are recorded as breeding only in phytotelmata such as buttress pans, rot holes in trees and broken bamboo stumps (LIEFTINCK, 1934, 1941; ORR, 1994, 1997, 2001; NGIAM & LEONG, 2012). It seems likely that *P. kiautarum* and *P. triangularis* breed in similar situations. The variation in size observed is likely to be associated with this habit with some evidence that, counter-intuitively, large containers produce several smaller individuals due to the effects of inter- and intra-specific competition, whereas small containers with adequate nutrients produce a single large individual (A.G. Orr, unpublished).

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REFERENCES

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