

***Phoenicagrion trilobum*, a new species of damselfly from Peru (Odonata: Coenagrionidae)**

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Three species of *Phoenicagrion* are known from the north-eastern Amazonian part of Peru: *P. flammeum*, *P. paulsoni*, and a third undescribed species. In 2009 and 2010 several specimens of this third species were collected in Loreto, making it possible to describe this species, here named *Phoenicagrion trilobum* (holotype ♂: Peru, Loreto department, Tahuayo River, 18 km E of the Amazon River, 4°24'18" S, 73°14'38" W, in RMNH collection).

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Introduction

For years *Phoenicagrion flammeum* (Selys, 1876) was a species that did not seem to fit properly in existing genera. When Selys Longchamps described it, he placed it in *Leptagrion*. Later Williamson (1917) erected the genus *Aeolagrion* in which he grouped the species with *Aeolagrion dorsale* (Burmeister, 1839) and *Telebasis demarara* (Williamson, 1917). Recently von Ellenrieder (2008) erected a new genus *Phoenicagrion* in which she placed *P. flammeum* together with a newly described species, *Phoenicagrion paulsoni* (von Ellenrieder, 2008). She diagnosed the genus from all other known New World Coenagrionidae by its unique pterothoracic coloration, orange lacking black stripes, with a complete pale blue antehumeral stripe and a pair of pale blue oblique stripes on the sides, and male genital ligula with two pairs of lateral lobes with sclerotized apices. In 2010 Machado added four more species to this genus, all originating from Brazil: *P. flavescens*, *P. ibseni*, *P. karaja* and *P. megalobos* (Machado, 2010).

In this article another Peruvian species is described, which until recently was only known from a single female collected by the German naturalist Guillermo G. Klug in 1939 (in RWG collection, mentioned in von Ellenrieder, 2008, p. 86). Like *P. paulsoni*, this species was found in the NE Amazonian region of Peru and it appears related to *P. flammeum*.

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Materials and methods

Specimens of *Phoenicagrion trilobum* examined are listed under the species account. For comparison several specimens of *Phoenicagrion flammeum* were also examined, all from Tamshiyacu-Tahuayo Reserve.

Measurements are in millimetres, abdominal length excludes appendages. Abbreviations used are as follows: CuP = cubitus posterior; RP2 = radius posterior, second branch; S1–10 = abdominal segments 1 to 10.

Acronyms for collections are as follows: RWG = Rosser W. Garrison collection, Sacramento, CA, USA; RMNH = National Museum of Natural History Naturalis, Leiden (formerly Rijks Museum van Natuurlijke Historie).

Phoenicagrion trilobum sp. nov.

Etymology

The posterior lobe of prothorax of the female of this species differs clearly from all other species in the genus by being trilobate. For this reason the species is named *trilobum*, a Latinized neuter adjective, from the Greek “tri”, meaning three, and the Greek “lobos”, meaning lobe.

Specimens examined

Total: 5 ♂ 4 ♀. – Holotype ♂, Peru, Loreto department, Tamshiyacu-Tahuayo Reserve, near Río Tahuayo in Aguajal Forest (Aguaje palm swamp) 4°24'18" S, 73°14'38" W (25 February 2010), leg. T. Faasen [RMNH]. – Paratypes ♂ all leg. T. Faasen [RMNH] and all from Aguaje palm swamp in Tamshiyacu-Tahuayo Reserve, but from different dates and slightly different coordinates: 1 ♂ 4°23'51" S, 73°14'36" W (27 July 2009); 1 ♂ 4°24'6" S, 73°14'35" W (25 February 2010); 1 ♂ 4°24'1" S, 73°14'29" W (27 February 2010) and 1 ♂ 4°23'52" S, 73°14'19" W (27 February 2010). – Paratypes ♀, Peru Loreto department, Tamshiyacu-Tahuayo Reserve, near Río Tahuayo in Aguajal Forest (Aguaje palm swamp): 1 ♀ 4°23'47" S, 73°14'49" W (27 July 2009), leg. T. Faasen [RMNH]; 2 ♀ same data but 4°23'44" S, 73°14'13" W (27 February 2010), leg. T. Faasen [RMNH]; 1 ♀, from Loreto Department, Iquitos, Río Amazonas 3°51'0" S, 73°13'0" W (July 1939), leg. G.G. Klug [RWG].

Male holotype

Head. Labium and base of mandibles pale; labrum, genae and anteclypeus greenish yellow; postclypeus, frons and dorsal part of head dark reddish brown, almost black; back of head reddish brown dorsally and pale ventrally. Antennae reddish brown. Eyes dark reddish brown dorsally and ventrally, with a sharply defined black band in between. Frons rounded.

Thorax. Prothorax reddish brown; posterior lobe projected posteriorly and rounded. Mesepisternal plates flat and about twice as wide as long (Figure 1e). Pterothorax dark reddish brown with an oblique pale grey stripe extending from posterior part of mesepimeron and metepisternum to anterior part of metepimeron and a triangular pale grey spot on posterior part of metepisternum and metepimeron (Figure 3h). Venter of thorax including metacoxa pale; legs pale with black longitudinal stripe on dorsal surface of femora and black spurs on femora, tibia, and tarsi; claws with well-developed supplementary tooth, black at tip; remainder of claws reddish.

Wings slightly yellowish, especially around the veins; pterostigma covering one cell, dark brown; CuP at end of petiolation about halfway between antenodals 1 and 2. Postnodals: 16 in

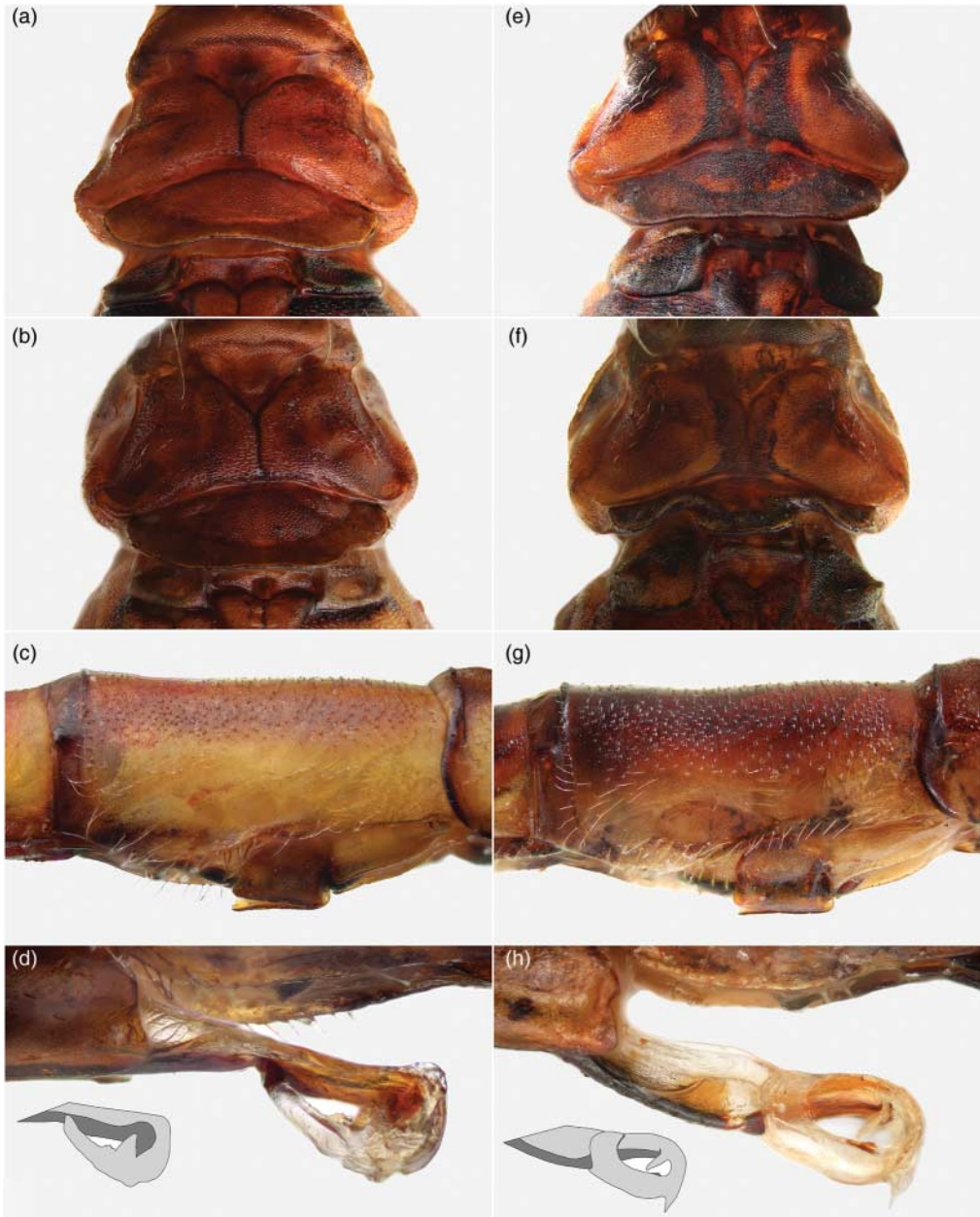


Figure 1. *Phoenicagrion flammeum*: (a) prothorax and mesostigmal plates of male; (b) prothorax and mesostigmal plates of female; (c) lateral view of S2 and anterior hamule of male; (d) lateral view of genital ligula of male. *Phoenicagrion trilobum*: (e) prothorax and mesostigmal plates of male (holotype); (f) prothorax and mesostigmal plates of female (paratype); (g) lateral view of S2 and anterior hamule of male (holotype); (h) lateral view of genital ligula of male (holotype).

forewings, 12 in hind wings. RP2 branching at postnodal 7 in left forewing, slightly distal to postnodal 7 in right forewing, slightly proximal to postnodal 6 in hind wings (Figure 2d).

Abdomen. S1–2 dark reddish brown; dorsum of S3–6 black; S7 black basally, gradually becoming orange posteriorly; S8–10 bright orange (Figure 3h). Genital ligula with well-developed inner

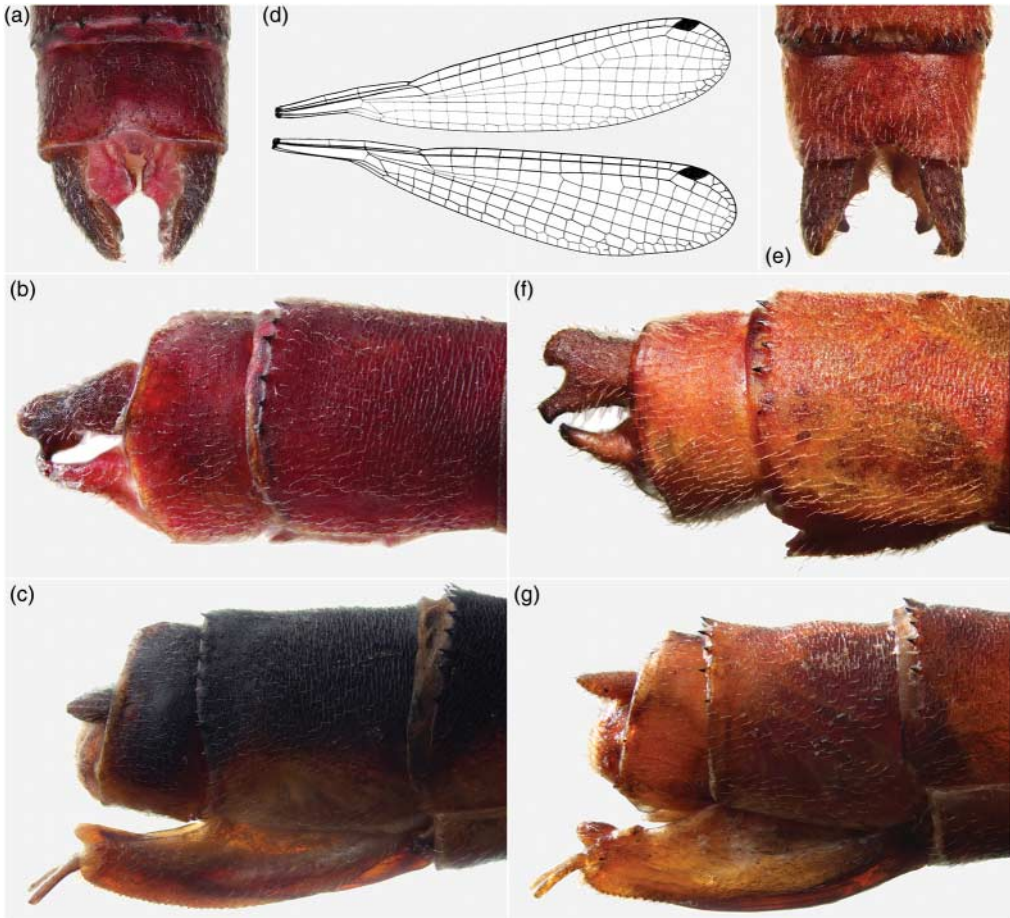


Figure 2. *Phoenicagrion flammeum*: (a) dorsal view of S10 and cerci of male; (b) lateral view of S9–10, cercus and paraproct of male; (c) lateral view of S9–10 and ovipositor of female. *Phoenicagrion trilobum*: (d) forewing and hind wing of male (holotype); (e) dorsal view of S10 and cerci of male (holotype); (f) lateral view of S9–10, cercus and paraproct of male (holotype); (g) lateral view of S9–10 and ovipositor of female (paratype).

fold and terminal fold; a pair of low lateral lobes with sclerotized apices; apex of ligula bifid with blunt lobes slightly bent backward (Figure 1h). Cerci orange, short and broad, slightly shorter than S10, with a large, truncated tooth projecting posteroventrally and slightly medially, reaching as far as tips of cerci posteriorly. Paraprocts entire, orange with black tip pointing medially (Figure 2e–f).

Dimensions. Total length 40.5 mm; abdominal length 33 mm; forewing 22.5 mm; hind wing 21.5 mm.

Female paratype

Head. As in holotype, but slightly brighter reddish brown and with triangular blue spot between base of antenna and eye. Eyes with a dark reddish brown band.

Thorax. Coloration of thorax as in holotype, though slightly brighter, with a narrow grey area on either side of the middorsal carina. Prothorax with posterior lobe distinctly trilobed. Mesostigmal plates less than twice as wide as long and with a short transverse rim on the lateral half (Figure 1f).

Wings with 20 postnodals in left forewing, 19 in right forewing and 15 in hind wings. RP2 branching at postnodal 8 in forewings, slightly proximal to postnodal 7 in hind wings.

Abdomen. Coloration as in holotype. S8 without a vulvar spine. Tergum of S10 with a very small, narrow triangular cleft in the caudal margin. Cerci reddish, conical and shorter than S10. Outer valve of ovipositor with a single row of indistinct teeth on caudal half. Tip of ovipositor extending as far as paraprocts, not reaching tips of cerci (Figure 2g).

Dimensions. Total length 40 mm; abdominal length 32 mm; forewing 24 mm; hind wing 22.5 mm.

Variation in male paratypes

Coloration. Ontogenetic variation exists in coloration of head and thorax. Younger specimens have bluish spots between antenna and eye and narrow blue-grey stripes bordering the middorsal carina. These areas darken and become obscure in older specimens. The band over the eyes and the rear of the head is reddish in younger males, turning black later in life.

Measurements. Postnodals in forewing usually 16 ($n = 8$), sometimes 15 ($n = 1$) or 17 ($n = 1$) in one wing. Postnodals in hind wing 12 ($n = 4$), 13 ($n = 3$) or 14 ($n = 3$). RP2 branches at postnodal 7 ($n = 4$) or 8 ($n = 4$) in forewings, sometimes slightly proximal to 7 ($n = 1$) or distal to 7 ($n = 1$). In hind wings RP2 branches proximal to postnodal 6 ($n = 6$), at postnodal 6 ($n = 2$) or proximal to postnodal 7 ($n = 2$). Total length of the specimens varies from 38 to 40.5 mm ($n = 5$ including holotype, mean = 39.3 mm). Abdominal length varies from 31.5 to 33 mm ($n = 5$ including holotype, mean = 32 mm). Forewing length varies from 21 to 22.5 mm ($n = 5$ including holotype, mean = 21.9 mm). Hind wing length varies from 20 to 21.5 mm ($n = 5$ including holotype, mean = 20.9 mm).

Variation in female paratypes

Coloration. The same coloration differences occur as described in the males. Teneral specimens (only female tenerals were observed) have the dorsum of S3–6 largely orange instead of black.

Measurements. Postnodals in forewing 16 ($n = 1$), 17 ($n = 4$), 19 ($n = 2$) or 20 ($n = 1$); in hind wing 14 ($n = 4$) or 15 ($n = 4$). RP2 branches proximal to postnodal 8 ($n = 5$) or at postnodal 8 ($n = 3$) in forewings; proximal to 6 ($n = 2$), at 6 ($n = 3$) or proximal to 7 ($n = 3$) in hind wings. Total length of the specimens varies from 36 to 40 mm ($n = 3$; mean = 38.3 mm; a teneral, not fully developed specimen measuring 34 mm not taken into account). Abdominal length varies from 29.5 to 32 mm ($n = 3$; mean = 30.8 mm). Forewing length varies from 20.5 to 24 mm ($n = 4$; mean = 22.4 mm). Hind wing length varies from 19.5 to 22.5 mm ($n = 4$; mean = 21.1 mm).

Diagnosis

Male specimens of *Phoenicagrion trilobum* can be distinguished from other *Phoenicagrion* species by the shape of the cerci, which possess a relatively large, blunt tooth projecting posteroventrally and slightly medially (Figure 2f). The genital ligula differs from that of all of its congeners by its bifid apex with apical lobes bent backwards (Figure 1h). Female specimens of *P. trilobum* can be distinguished from other species of *Phoenicagrion* by the trilobed shape of the hind lobe of the prothorax (Figure 1f).



Figure 3. *Phoenicagrion flammeum*: (a) habitus, live specimen male with S8–10 red; (b) habitus, live specimen male with S8–10 black; (c) habitus, live specimen female with S8–10 black. *Phoenicagrion trilobum*: (d) habitat; (e) habitus, live specimen dark male (paratype); (f) habitus, live specimen light male (paratype); (g) habitus, live specimen female (paratype); (h) habitus, male holotype in collection; (i) habitus, female paratype in collection.

Remarks

Several specimens were photographed when still alive (Figure 3), making it possible to give some additional information on the coloration of live specimens. Most important differences compared to preserved specimens are: (1) labrum, genae and anteclypeus: light blue (instead of greenish yellow); (2) eyes: blue dorsally, light green ventrally (instead of dark reddish brown), sharply defined dark red or black band in between; (3) pterothorax: with the oblique stripes and stripes on either side of the middorsal carina pale blue (instead of grey).

The distinct three-coloured, horizontally banded eyes seem to be consistently present in all live specimens of *Phoenicagrion trilobum* examined. The live specimens of *Phoenicagrion flammeum* examined regularly had three colours, but never in bands. This might offer some help in the field, where these two species can sometimes be present within the same area.

Biology

The label on the specimen from Klug offers no information on the habitat where it was found. All specimens of *Phoenicagrion trilobum* collected in the Tamshiyacu-Tahuayo Reserve (including a freshly emerged one) were found subcanopy in patches of aguajal within restinga (Figure 3d). Aguajal is a type of tropical primary lowland forest with a high abundance of aguaje palms (*Mauritia flexuosa*). These palms grow at locations which are permanently wet due to poor drainage. The forest floor is swampy and large quantities of water are present between the roots of these palms. According to the literature palm swamps typically occur in terra firme forests, but apparently also closer to the river in lower restinga. This difference is important as terra firme never floods by river water, whereas restinga does seasonally. Within terra firme the water in palm swamps originates from rainfall (Myster, 2009). Within restinga there is some influence of surface water. At the type locality this is surface water from a black water river (Tahuayo River).

Adults of *P. trilobum* were found close to the ground, in the undergrowth, often near small light gaps, which are not rare here, because this type of forest does not have an extremely dense canopy. Within the examined aguajal forests *P. trilobum* was quite common. Its relative *Phoenicagrion flammeum* seemed to prefer other habitats in the area, such as lower restinga with some white water influence and tahuampa. These are both seasonally flooded forests within the river floodplain, but tahuampa has less plant zonation and is dominated by trees with tortuous growth and abundant aerial roots (Myster, 2009).

In the Tamshiyacu-Tahuayo Reserve *P. trilobum* was found at nine coordinates. Table 1 lists the other species that were present at these locations. It shows that *P. trilobum* was most often accompanied by *Metaleptobasis gabriela* (von Ellenrieder, 2013) and *Uracis infumata* (Rambur, 1842). These species seem to be less specific in their habitat preferences than *P. trilobum* and can also be found in the surrounding forests within the flood plain. *U. infumata* can even be found in terra firme.

Table 1. Other Odonata species present at the locations where *Phoenicagrion trilobum* was found.

	Number of locations in the Tamshiyacu area where the species was found, and total number of specimens collected		Number of locations (with corresponding number of specimens) overlapping with <i>P. trilobum</i>	
	Locations	Specimens	Locations	Specimens
<i>Metaleptobasis gabriela</i> (von Ellenrieder, 2013)	13	16	7	10
<i>Metaleptobasis paludicola</i> (von Ellenrieder, 2013)	7	9	2	3
<i>Metaleptobasis turbinata</i> (von Ellenrieder, 2013)	1	2	1	2
<i>Gynacantha klagesi</i> (Williamson, 1923)	4	7	1	1
<i>Misagria parana</i> (Kirby, 1889)	2	3	1	2
<i>Orthemis cinnamomea</i> (von Ellenrieder, 2009)	2	2	1	1
<i>Uracis infumata</i> (Rambur, 1842)	11	25	4	11
<i>Uracis siemensi</i> (Kirby, 1897)	2	3	2	3

Uracis siemensii (Kirby, 1897) and *Metaleptobasis turbinata* (von Ellenrieder 2013) were also found in the vicinity of *P. trilobum*, but these species were both very rare in the area. Most species found in aguajal forest in this region are still poorly known: five out of nine species were just recently described (since 2008).

Distribution and phenology

Phoenicagrion trilobum is only known from the NE Amazonian part of Peru, from close to the Amazon River near the city of Iquitos to 70 km south of Iquitos in Tamshiyacu-Tahuayo Reserve (Figure 4). Records are known from both the wet season (February) and the dry season (July and August). The records from July and August all comprised relatively young looking specimens, whereas the specimens from February seemed mostly older, though one specimen from February was a freshly emerged female.

Table 2. Number of base pairs of the mitochondrial COI gene differing between combinations of species (light grey shading: intrageneric comparison; dark grey shading: intergeneric comparison).

	<i>P. flammeum</i>	<i>P. nr paulsoni</i>	<i>A. dorsale</i>	<i>A. inca</i>
<i>P. trilobum</i>	62 (9.4%)	58 (8.8%)	102 (15.5%)	102 (15.5%)
<i>P. flammeum</i>	—	54 (8.2%)	86 (13.1%)	101 (15.3%)
<i>P. nr paulsoni</i>	—	—	88 (13.4%)	90 (13.7%)
<i>A. dorsale</i>	—	—	—	34 (5.2%)



Figure 4. Distribution map of *Phoenicagrion trilobum*.

DNA

For use in a large barcoding program started by NCB Naturalis (Leiden, the Netherlands) in 2010 DNA samples were taken from *Phoenicagrion trilobum*, *Phoenicagrion flammeum*, a third species of *Phoenicagrion* that could not be positively identified to species (near *paulsoni*) and also from *Aeolagrion dorsale* and *Aeolagrion inca* (Selys, 1876) that were in the past regarded as congeneric. From each species one sequence of 658 base pairs is available from the mitochondrial COI-gene. Table 2 shows the number of base pairs that are different between each combination of species.

The samples of *P. trilobum* and *P. flammeum* differ in 62 base pairs. The samples of *A. dorsale* and *A. inca* differ in 34 base pairs. Although in itself not definite proof, these results are consistent with specific distinctness between *P. trilobum* and *P. flammeum*. COI divergences between congeneric pairs of animal species are known to range from 0% up to over 50%, but a study covering over 13,000 species pairs belonging to 11 phyla showed that in 95% of the cases the divergences are at least 4% whereas intraspecific divergences are rarely greater than 2%, mostly less than 1% (Hebert, Ratnasingham, & deWaard, 2003).

Furthermore the species within *Phoenicagrion* differ in 86–102 basepairs from the species within *Aeolagrion*, meaning that there is consistently more resemblance within the genera than between the genera. The molecular results, although still only based on a minimal amount of available data, support *Aeolagrion* and *Phoenicagrion* as being distinct, monophyletic groups.

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