



The Plecoptera of Panama. II. Two new species, one new country record, and additional locality records of *Anacroneuria* (Perlidae) from western Panama

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Abstract

Two new species of *Anacroneuria* (*A. chiriqui* sp. n. and *A. ngabe* sp. n.) are described from Chiriqui Province, Panama, and compared with related species. One new country record, *A. divisa* (Navás), is herein recorded and new locality records are presented for several species previously reported from Panama. Three unassociated females, including one species from Bocas del Toro province are described under informal designations. There are now 25 described species of Plecoptera known from Panama.

Key words: Plecoptera, Perlidae, *Anacroneuria*, Panama, new species, new records

Introduction

Stark (1998) reported 10 species of *Anacroneuria* from Panama and gave a brief historical account of the Panamanian stonefly fauna. Subsequently, (Stark 2014) provided a checklist that included 14 *Anacroneuria* species and colleagues have recently described new Panamanian species, or provided new records, for previously described ones (Gutiérrez-Fonseca 2015; Gutiérrez-Fonseca *et al.* 2015; Armitage and Stark 2017; Castillo Sánchez *et al.* 2018). The current list of *Anacroneuria* known to occur in Panama includes 21 species. Both Gutiérrez-Fonseca (2015) and Armitage and Stark (2017) included *A. litura* (Pictet, 1841) on their lists, as did Harper (1992). This species may be found in Panama at some point, however as Stark and Kondratieff (2004) noted, “Panamanian specimens listed by Harper (1992) should be referred to as *A. uatsi* (Stark, 1998).” The species name omitted in the quotation from Stark and Kondratieff (2004) in the previous line is *A. crenulata* Jewett, 1958. This species was placed by Stark and Kondratieff (2004) as a junior synonym of *A. litura*.

Recently, one of us (BA) and wife (TA) collected several samples of stoneflies at UV light and Malaise traps primarily in Chiriqui Province. These samples include two new species, a new country record, and records of a few previously described species. Female specimens unassociated with a male in this sample are given informal designations. The holotypes, paratypes and specimens are deposited in the Colección Zoológica Dr. Eustorgio Méndez (COZEM) of the Instituto Commemorativo Gorgas de Estudio de la Salud (Gorgas Institute) and in the working collection of the first author (BPSC) as indicated.

Materials and methods

Single-night collections were made during 2014–2018, in general, using UV light and alcohol traps (Calor and Mariano 2012). Multiple-night collections were made with this same method or employing Malaise traps, as indicated below. The abdomens of adult stoneflies were removed, placed in 10% KOH, and processed as indicated in Stark (1998).

The sample locations (see Maps 1 and 2) were located at altitudes of 133 m (Quebrada Rambala), 159 m (afluente Quebrada Rambala, 908 m (nr Fortuna Cabins), 1,122 m (Quebrada Hondo), 1,128 m (afluente Río Guabo), 1,300 m (Quebrada Jaramillo), 1,653 m (afluente Río Palo Alto), 1,692 m (Río Colorado and Quebrada Norte; both upstream of the confluence), 1782 m (Quebrada La Velo), 1,922 m (afluente de Río Colorado; approximately midway between the source and the confluence with the Río Colorado), and 2,189 (afluente Río Chiriqui Viejo). The Reserva Forestal de Fortuna sampling location is immediately inside of Chiriqui Province, west-southwest of the Fortuna Cabins location and north-northeast of Fortuna Dam. Although most of the Reserva and Chiriqui Province are within the Río Chiriqui drainage, the closest streams adjacent to this sample site are several unnamed tributaries of the Río Guabo, a Caribbean drainage which flows through the Ngäbe Buglé Comarca.

Results

One hundred seven stonefly specimens representing eleven species of *Anacroneuria* were collected in this survey of selected localities primarily in Chiriqui Province, Panama. Two species, represented by male and female specimens, are undescribed. Descriptions for these species are given below along with records of four previously described species. Three species represented by unidentified females are recognized by informal designation.

Anacroneuria annulipalpis Klapálek

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:1688>

Anacroneuria annulipalpis Klapálek, 1922: 91. Lectotype ♀ (National Museum of Natural History, Prague), Chiriqui, Panama
Anacroneuria quadriloba Jewett, 1958: 166. (in part, specimens listed by Harper (1992) from Panama are considered by Stark (1998) to be *A. annulipalpis*)

Material examined. PANAMA: Chiriqui Province: Cuenca 102 (Río Chiriqui Viejo), afluente Río Colorado, Mount Totumas Biological Reserve, 8.884717°N, 82.684077°W, 1 January 2015, B. Armitage, 2 ♀ (**COZEM**); same except, 3–9 June 2016, 1 ♂, 1 ♀ (**COZEM**); same except, 31 August 2016, 1 ♂, 2 ♀ (**COZEM**); same except, Malaise trap, 5–10 July 2016, J. Dietrich, 1 ♀ (**COZEM**); same except, Río Colorado, 8.873556°N, 82.689993°W, 31 August 2016, B. Armitage, 1 ♂, 1 ♀ (**COZEM**); same except, 1 September 2016, 2 ♂ (**COZEM**); same except, Quebrada Norte, 8.873613°N, 82.690512°W, 26 June 2016, B. Armitage, 1 ♀ (**COZEM**); same except, Cuenca 108 (Río Chiriqui), afluente Río Palo Alto, Tree Trek Lodge, 8.81029°N, 82.396471°W, 1653 m, UV light, 6 June 2016, T. Armitage, 1 ♀ (**COZEM**).

Comments. This species is relatively common in Costa Rica and has also been reported from Chiriqui Province in Panama (Klapálek 1922; Stark 1998; 2014; Armitage and Stark 2017).

Anacroneuria benedettoi Stark

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:1964>

Anacroneuria benedettoi Stark, 1998: 557. Holotype ♂ (United States National Museum), Río Los Ahogados, Guanacaste, Costa Rica

Material examined. PANAMA: Bocas del Toro Province: Quebrada Rambala, Rambala Jungle Lodge, 3.74 km SSE Rambala, 8.91543°N, 82.15527°W, Malaise trap, 6–12 February 2017, E. Carlson, 1 ♂ (**COZEM**).

Comments. This species was previously reported from Bocas del Toro province by Stark (1998) and from the Caldera River, Chiriqui Province by Castillo Sánchez *et al.* (2018).

Anacroneuria chiriqui sp. n.

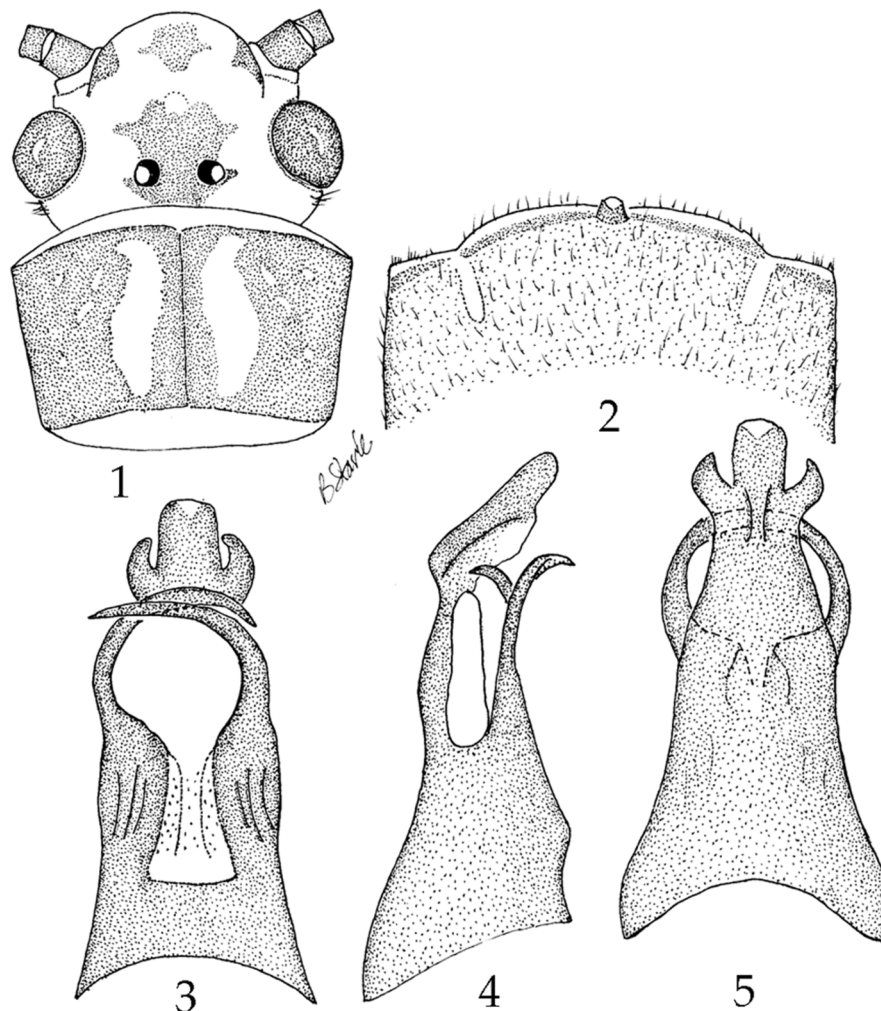
(Figs. 1–5, 11)

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:503255>

<urn:lsid:zoobank.org:act:2CD3F215-02F9-492D-8786-3D291B03DC80>

Material examined. Holotype ♂, 2 ♂, 4 ♀ paratypes from Panama, Chiriqui Province, Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam, nr. Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, B. and T. Armitage, 18 February 2018 (Holotype: **COZEM**; Paratypes: **COZEM**). Additional paratypes, Panama, Chiriqui Province, Cuenca 108 (Río Chiriqui), Quebrada Hondo, NNE Fortuna Dam, 8.75003°N, 82.23884°W, 1128 m, 18 February 2018, UV light, B. and T. Armitage, 1 ♂ (**BPSC**); same except, Quebrada Jaramillo upstream, Collier Property, 8.76320°N, 82.41383°W, Malaise trap, 20–25 April 2018, B. Armitage and T. Armitage, 1 ♀ (**BPSC**); same except, 8–12 May 2018, B. Armitage and K. Collier, 3 ♀ (**COZEM**).

Adult habitus. General body color yellow with patches of brown and black pigment. Ocellar area of head bearing a diffuse brown area of pigment (Fig. 1). Median pronotal stripe dark, separated from wide, lateral stripe by an irregular yellow area; a few small yellowish areas are interspersed in the dark lateral bands. Femora banded; apical third dark and basal two thirds yellow; tibiae and tarsi dark brown. Wings brown, most veins darker, but costa and subcosta pale brown; r-crossvein on each wing darker than other veins.



FIGURES 1–5. *Anacroneuria chiriqui* male, afluyente Río Guabo, Chiriqui Province, Panama. 1. Head and pronotum. 2. Male sternum 9 with hammer. 3. Aedeagus, ventral. 4. Aedeagus, lateral. 5. Aedeagus, dorsal.

Male. Forewing length 11–12 mm. Hammer thimble-shaped, height less than basal width (Fig. 2). Aedeagal apex trilobed in dorsal and ventral aspect (Figs. 3–4) and without subapical membranous lobes; median lobe much

wider than lateral ones and bearing an obscure, median triangular notch. Aedeagal hooks slender; ventral keel obscure, consisting of a pair of short, thin ridges about twice as wide as the aedeagal hooks. Apex of aedeagus in lateral aspect somewhat foot-shaped (Fig. 5).

Female. Forewing length 15–16 mm. Subgenital plate 4-lobed, outer lobes longer and wider than inner lobes (Fig. 11); median notch deeper and wider than small lateral notches separating inner and outer lobes. Ninth sternum with a large posterior membranous area; sclerotized region of sternum 9 with a V-shaped posterior margin.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, is based on the Panamanian province in which it was collected.

Diagnosis. The new species keys to *A. planicollis* (Klapálek, 1923) in Stark (1998) but the ventral keel for that species consists of a single, more prominent median ridge, and the aedeagal apex for that species bears prominent membranous lobes. It is also similar in size and color pattern to *A. lineata* (Navás, 1924) and might key to that species if the apicolateral aedeagal lobes are interpreted as being no more than “minute” (Stark 1998).

Anacroneuria divisa (Navás)

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:1910>

Forquilla divisa Navás, 1924: 74. Syntype ♀ (Museum National d’Histoire Naturelle, Paris), Costa Rica.

Material examined. PANAMA: Chiriqui Province, Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam, nr. Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, B. and T. Armitage, 21 January 2017, 1 ♂ and 1 ♀ (COZEM).

Comments. This represents a new country record for Panama. The male syntype is missing, but L. Benedetto provided notes on the female syntype (Stark 1998). Illies (1966) placed this species in the genus *Anacroneuria*. Stark (1998) redescribed the male and female, and figured the head, thorax, and genitalia.

Anacroneuria lineata (Navás)

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:2027>

Neoperla lineata Navás, 1924: 73. Holotype ♂ (Museum National d’Histoire Naturelle, Paris), Costa Rica

Material examined. PANAMA: Chiriqui Province, Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam, nr. Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, B. and T. Armitage, 21 January 2017, 2 ♂ (COZEM).

Comments. Stark (1998) redescribed this species and produced new figures. Stark and Kondratieff (2004) described the female of this species, figured the head and male genitalia, and compared it with other species (DeWalt *et al.*, 2018). They note that this species appears to be widespread and common, especially in Mexico.

Anacroneuria marca Stark

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:1838>

Anacroneuria marca Stark, 1998: 575. Holotype ♂ (United States National Museum), Costa Rica, Heredia Province, Río Peje, Parque Nacional Braulio Carrillo

Anacroneuria marca: Gutiérrez-Fonseca and Springer, 2011: 29

Material examined. PANAMA: Chiriqui Province: Cuenca 102, (Río Chiriqui Viejo), afluyente Río Chiriqui Viejo, 8.89307°N, 82.59969°W, 2189 m, Las Nubes dentro del PILA, 19 September 2016, C. Nieto, M. Molinar, and A. Tuñón, 1 ♀ (COZEM); same except, Río Colorado, Mount Totumas Biological Reserve, 8.873556°N, 82.689993°W, 26 June 2016, B. Armitage, 3 ♂ (COZEM); same except, 1 September 2016, 2 ♂; Chiriqui Province: Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam, nr Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, 21 January 2017, B. and T. Armitage, 10 ♂ (COZEM); same except, 18 February

2018, 22 ♀ (**COZEM**); Chiriqui Province: Cuenca 108 (Río Chiriqui), Quebrada Hondo, NNE Fortuna Dam, 8.75003°N, 82.23884°W, 1128 m, B. and T. Armitage, 2 ♂ (**COZEM**).

Comments. Stark (2014) and Armitage & Stark (2017) reported this species from Chiriqui Province. The species appears more common in Costa Rica (Stark 1998) than in Panama.

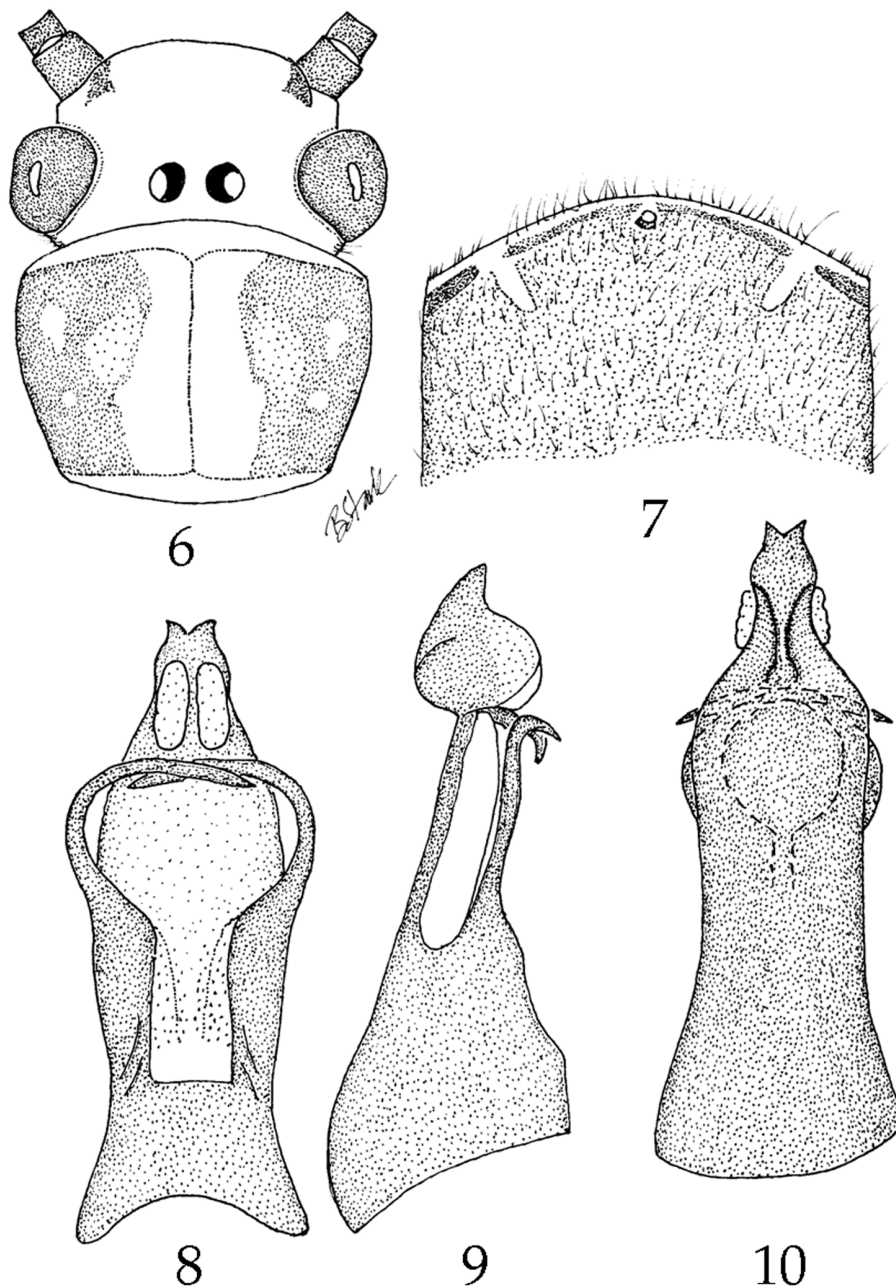
Anacroneuria ngabe sp. n.

(Figs. 6–10, 12)

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:503256>

<urn:lsid:zoobank.org:act:7D889D39-6654-4C3D-89A7-14F52746853B>

Material examined. Holotype ♂, 4 ♀ paratypes from Panama, Chiriqui Province, Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam nr. Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, 18 February 2018, B. and T. Armitage (Holotype ♂ **COZEM**; paratype ♀ **COZEM**, **BPSC**).



FIGURES 6–10. *Anacroneuria ngabe* male, afluyente Río Guabo, Chiriqui Province, Panama. 6. Head and pronotum. 7. Male sternum 8 with hammer. 8. Aedeagus, ventral. 9. Aedeagus, lateral. 10. Aedeagus, dorsal.

Adult habitus. General body color yellow with brown patches. Head yellow except for dark brown lappets and antennae; ocellar area with obscure darker yellow brown pigment spot. Median half of pronotal disc yellow, lateral areas brown (Fig. 6). Wings brown, veins darker except pale costa. Femora mostly yellow but with a small, dark brown distal area; tibiae banded, dark brown distally and proximally, and with a yellow median band.

Male. Forewing length 11 mm. Hammer absent, or at most a low membranous disc (Fig. 7). Aedeagal apex simple but lateral margins curved outward near tip, and apex with a small notch; ventral keel conspicuous, consisting of a pair of long, curved ridges that form an X-pattern beyond the hooks; a pair of prominent membranous lobes present subapically. Hooks very slender (Figs. 8–10).

Female. Forewing length 12–13 mm. Subgenital pate bilobed, lobes separated by a V-shaped notch (Fig. 12).

Larva. Unknown.

Etymology. The species name is proposed in honor of the Ngäbe people of Chiriqui province and adjacent areas of Panama.

Diagnosis. The general body color is yellow patterned with dark brown and the median yellow pronotal band is relatively wide and the dark area near the ocelli is obscure. This general head/pronotal color pattern is shared by at least nine other *Anacroneuria* species known to occur in Panama and Costa Rica, therefore the color pattern is not considered distinctive. Males of this species will key to *A. varilla* Stark, 1998 and the aedeagal apices of the two are somewhat similar, but in *A. varilla* the aedeagal apex is truncate and has parallel lateral margins and the dorsal keel of *A. varilla* is obscure. Female subgenital plates of the two species are also quite similar.

Anacroneuria plutonis (Banks)

<http://lsid.speciesfile.org/urn:lsid:Plecoptera.speciesfile.org:TaxonName:1777>

Neoperla plutonis Banks, 1914: 610. Lectotype ♀ (Museum of Comparative Zoology), La Trinidad, Costa Rica
Forquilla tristani Navás, 1932: 29. Synonymy (Stark 1998)

Material examined. PANAMA: Chiriqui Province: Cuenca 102 (Río Chiriqui Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, 26–28 December 2017, B. Armitage, 1 ♂ (**COZEM**); same except, Malaise trap, 28 January–2 February 2018, B. Armitage, 1 ♂, 2 ♀ (**COZEM**); same except, afluyente Río Colorado, 8.883717°N, 82.684077°W, 2 January 2015, B. Armitage, 1 ♂ (**COZEM**); same except, 31 August 2016, 1 ♂ (**COZEM**); same except, Río Colorado, 8.873556°N, 82.689993°W, 15 April 2015, B. Armitage, 1 ♂ (**COZEM**); same except, 13 February, 2017, B. Armitage, 1 ♀ (**COZEM**); Chiriqui Province: Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam, nr. Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, 21 January 2017, B. and T. Armitage, 10 ♂ (**COZEM**); same except, 18 February 2018, 1 ♂, 1 ♀ (**COZEM**).

Comments. Stark (1998) reported the species from several sites in Costa Rica, and recently Armitage and Stark (2017) reported it from Panama for the first time.

Anacroneuria sp. PA-1

(Figs. 13–14)

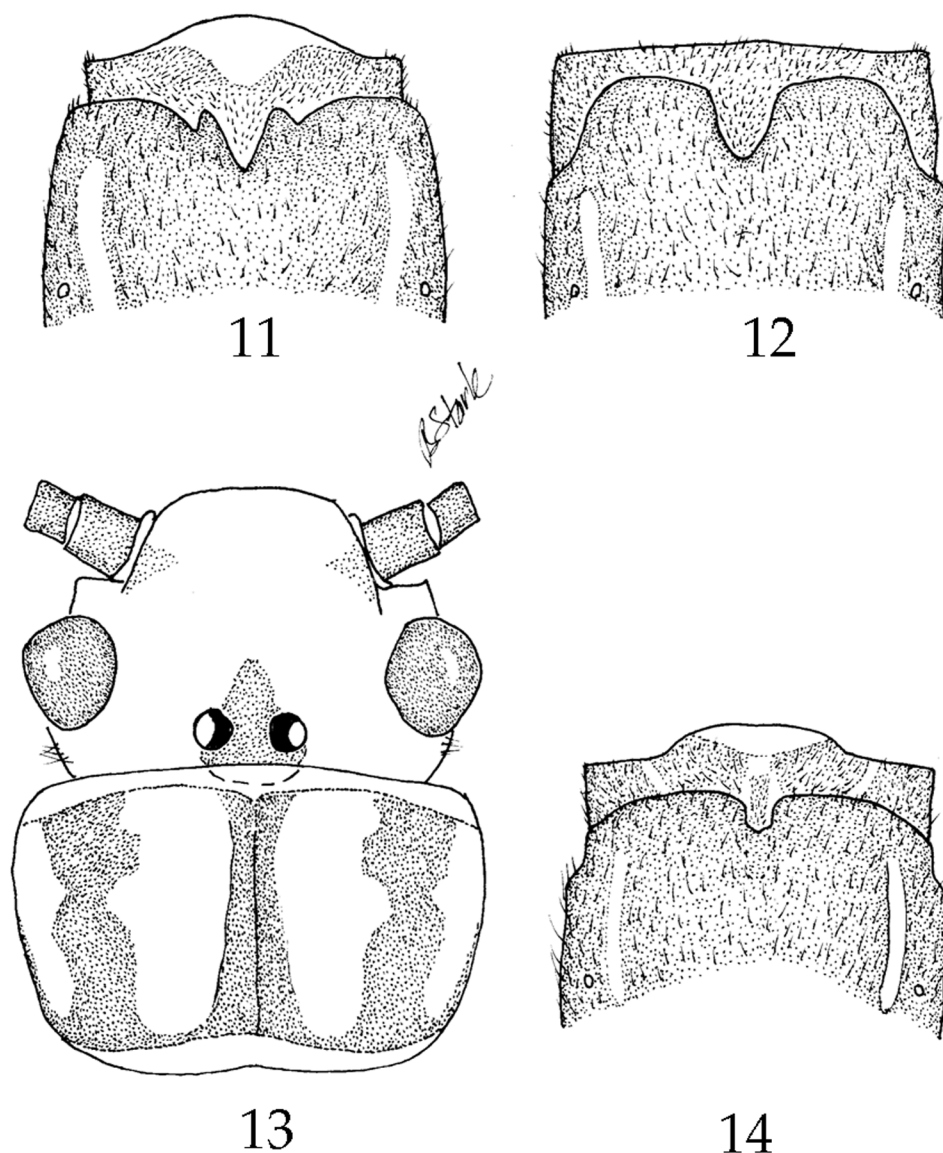
Material examined. PANAMA: Chiriqui Province: Cuenca 108 (Río Chiriqui), Quebrada La Velo, Alto Quiel Rd., E of Finca Lerida, 8.82043°N, 82.48429°W, 1782 m, Malaise trap, 5–10 May 2017, B. and T. Armitage, 3 ♀ (**COZEM, BPSC**).

Adult habitus. General color yellow patterned with dark brown. Head almost entirely yellow but with a small dark area over the ocelli; lappets pale, antennae and palpi dark brown. Median band of pronotum narrow and dark brown, sublateral bands on disk dark brown; posterolateral angles of pronotal margin dark brown (Fig. 13). Femora of all legs with a distal, dorsoapical, small, dark area with most of femora yellow; tibiae of all legs dark brown. Wing membrane brown, veins darker except for pale costa.

Male. Unknown.

Female. Forewing length 12–15 mm. Subgenital plate bilobed; lobes almost truncate, notch small (Fig. 14). Sternum 9 with a narrow, median stick-like sclerite that continues under subgenital plate notch.

Larva. Unknown.



FIGURES 11–14. *Anacroneuria* spp. Head and pronotum, or female subgenital plate. 11. *A. chiriqui*, subgenital plate. 12. *A. ngabe*, subgenital plate. 13. *Anacroneuria* sp. PA-1, head and pronotum. 14. *Anacroneuria* sp. PA-1, subgenital plate.

Diagnosis. Six known species of *Anacroneuria* from Costa Rica–Panama share the above described pronotal color pattern of this taxon. The females for two of these [*A. lineata* (Navás, 1924) and *A. tornada* Stark, 1998] are undescribed and the female subgenital plates for two others (*A. chiriqui* sp.n. and *A. divisa* (Navás, 1924) are 4-lobed. Thus these females may represent either of the two species whose females are unknown, either of the two known species with bilobed subgenital plates [*A. maritza* Stark, 1998 and *A. planicollis* (Klapálek, 1923)], or they may represent a previously unknown species. Because all these species have relatively dark lappets on the dorsolateral margins of the frons, and the lappets are pale on these three females, we consider the possibility that these specimens represent an undescribed species to be the most suitable hypothesis.

Comments. Stark (1995) adopted the practice of Zwick (1986) in designating female stonefly specimens unassociated with males by an informal method that is used above to designate the present species. DeWalt *et al.* (2018) list some of these as “temporary names” on the Plecoptera Species File website; reference to this list suggests no previous PA (Panamanian) *Anacroneuria* have been recognized in this fashion, however, other authors (e.g. Castillo Sánchez *et al.* 2018) have designated samples of *Anacroneuria* as “sp. 1”, etc., but without providing characters or figures that would allow other workers to recognize the taxon. As indicated in the diagnosis section *Anacroneuria* sp. PA-1 is one of seven known Costa Rican and/or Panamanian *Anacroneuria* (*A. divisa*, *A. lineata*,

A. maritza, *A. planicollis*, *A. tornada*, *A. chiriqui* sp. n.) to share a similar pronotal color pattern that includes a narrow, median brown band, and a pair of sublateral, broader dark bands. Comparison of the ocellar area pigment patterns, lappet patterns, leg patterns, forewing length and other features indicate these three specimens do not appear to represent any of the already described *Anacroneuria* species with the distinctive pronotal color pattern described above. We encourage an intensified effort be made to collect males of this species in order to determine the identity of this species. Armitage and Stark (2017) note seven Panamanian species have unknown females and several have unknown larvae.

***Anacroneuria* sp. PA-2**

(Figs. 15–16)

Material examined. PANAMA: Bocas del Toro Province: Cuenca 93 (Río Margarita) afluyente Quebrada Rambala, Rambala Jungle Lodge, 8.91543°N, 82.15527°W, 3.74 km SE Rambala, 28 November 2014, E. Carlson, 2 ♀ (**COZEM**). Same site, 13 March 2015, E. Carlson, 1 ♀ (**BPSC**); Chiriqui Province, Cuenca 93 (Río Guabo), afluyente Río Guabo, NNE Fortuna Dam, nr. Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, B. and T. Armitage, 21 January 2017, 4 ♀ (**COZEM**).

Adult habitus. General color yellow patterned with dark brown. Head mostly yellow but slightly darker yellow-brown on frons anterior to ocelli; lappets brown, antennae dark brown. Pronotum pale along median line, sublateral pigment bands brown with scattered rugosities (Fig. 15). Femora almost entirely yellow, but a narrow distal band dark brown. Tibiae yellow. Wing membrane pale amber brown except for paler costal band extending from wing base almost to cord, and except for a transparent circular “window” extending beyond cord and posterior to R-vein but not reaching posterior margin of wing.

Male. Unknown.

Female. Forewing length 14 mm. Subgenital plate 4-lobed, inner lobes slightly smaller than lateral lobes (Fig. 16). Abdominal sternum 9 bears a prominent T-shaped median setal patch.

Larva. Unknown.

Diagnosis. Only two species (*A. exquisita* Stark, 1998; *A. ventana* Stark, 1998), currently known from Mesoamerica, have a transparent “window” in the apical region of the wings, but another species known from Colombia (*A. albimacula* Klapálek) also shares this feature. The females of *Anacroneuria exquisita* and *A. ventana* are unknown and males of these species have a dark ocellar marking absent from these Bocas del Toro females. *Anacroneuria albimacula* also has a dark ocellar marking, slightly different subgenital plate shape, and the species is currently known from a neotype ♂ and an additional female specimen from Antioquia Province in Colombia (Stark *et al.* 1999).

***Anacroneuria* sp. PA-3**

(Figs. 17–18)

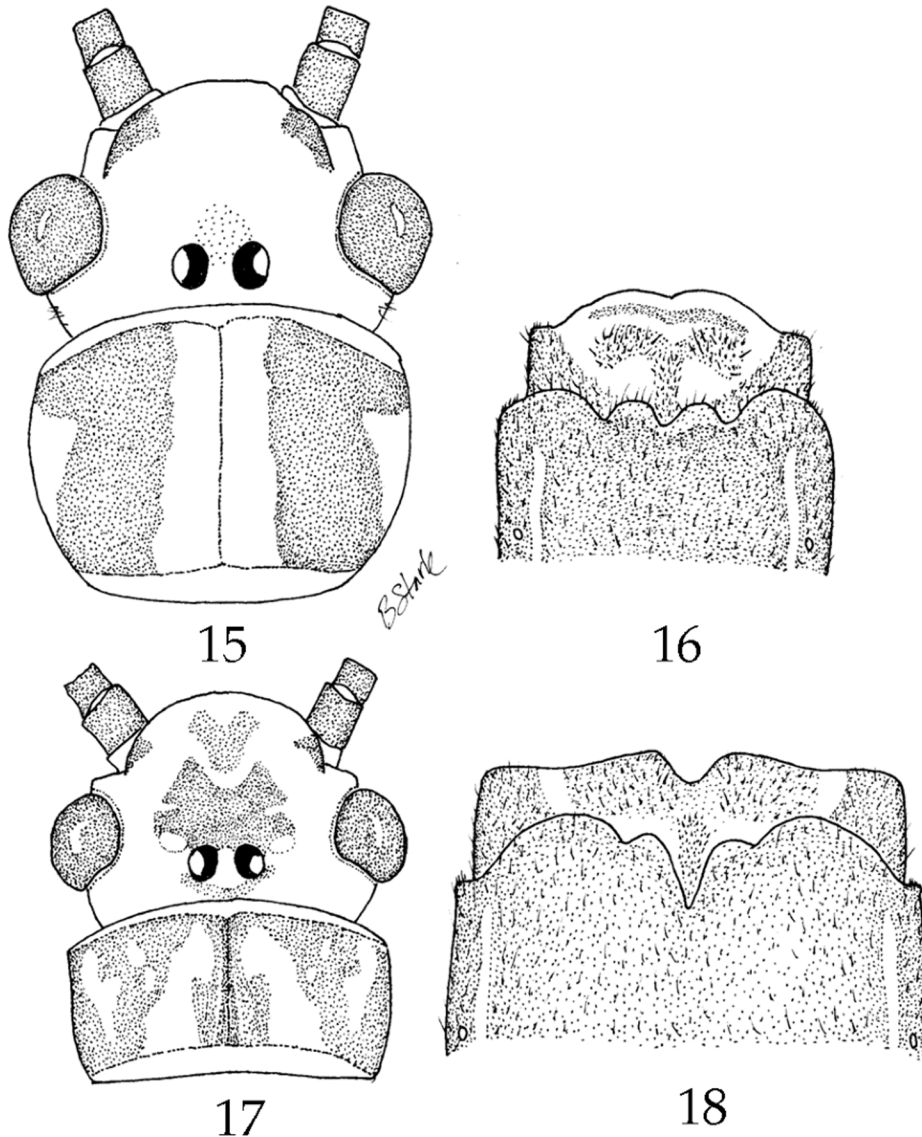
Material examined. PANAMA: Chiriqui Province: Cuenca 93 (Río Guabo), afluyente of Río Guabo, NNE Fortuna Dam near Fortuna Cabins, 8.77806°N, 82.19359°W, 1128 m, UV light, 18 February 2018, B. and T. Armitage. 1 ♀ (**BPSC**).

Adult habitus. General color yellow patterned with brown. Head mostly yellow around margins and dark brown over most of central frons (Fig. 17); lappets and antennae brown. Pronotum with mesal band dark brown and lateral and sublateral areas of disk mostly dark brown. Femora banded with basal half yellow and apical half dark brown; tibiae with distal and proximal areas dark brown, median tibial sections yellow. Wings transparent or tinted pale brown; most veins slightly darker except subcostal and apical half of costa pale.

Male. Unknown.

Female. Forewing length 20 mm. Subgenital plate 4-lobed; outer lobes slightly longer and about equal in width to inner lobes (Fig. 18). Sternum 9 bearing a T-shaped sclerite armed with setae; mediobasal setae short but numerous, longer setae set on apical part of T-shaped sclerite.

Larva. Unknown.



FIGURES 15–18. *Anacroneuria* spp. Head and pronotum, or female subgenital plate. 15. *Anacroneuria* sp. PA-2, head and pronotum. 16. *Anacroneuria* sp. PA-2, subgenital plate. 17. *Anacroneuria* sp. PA-3, head and pronotum. 18. *Anacroneuria* sp. PA-3, subgenital plate.

Diagnosis. The only known *Anacroneuria* female from Panama and Costa Rica with a 20 mm forewing length and a dark median pronotal band is *A. divisa*. This female is similar to *A. divisa* but the pronotal disc has significantly more diffuse brown pigment along the median band than other species that share this pattern.

Discussion

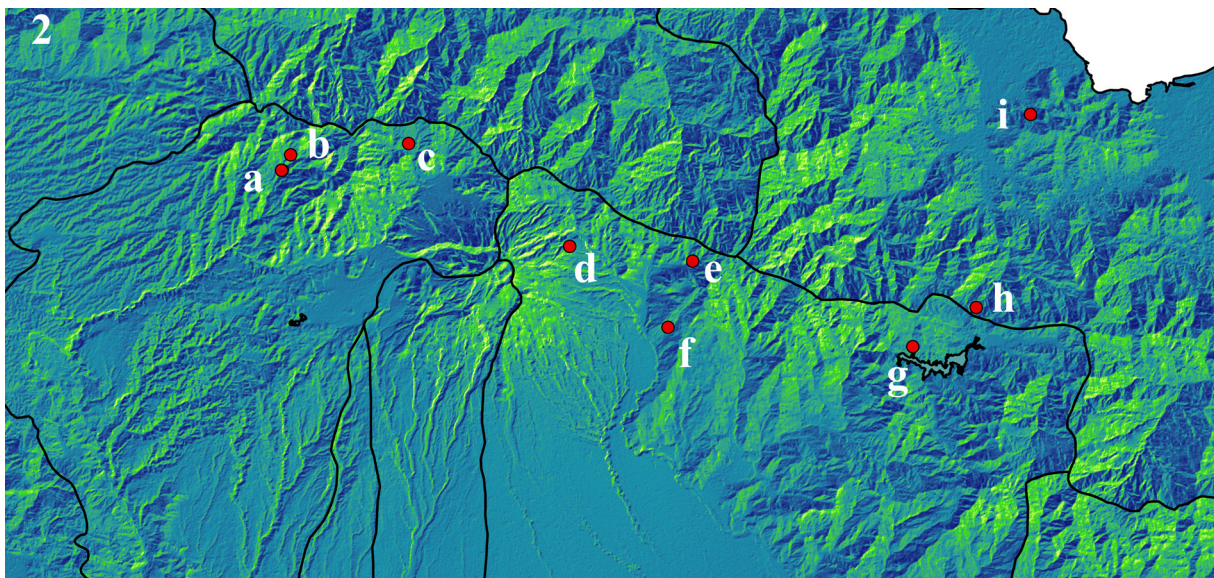
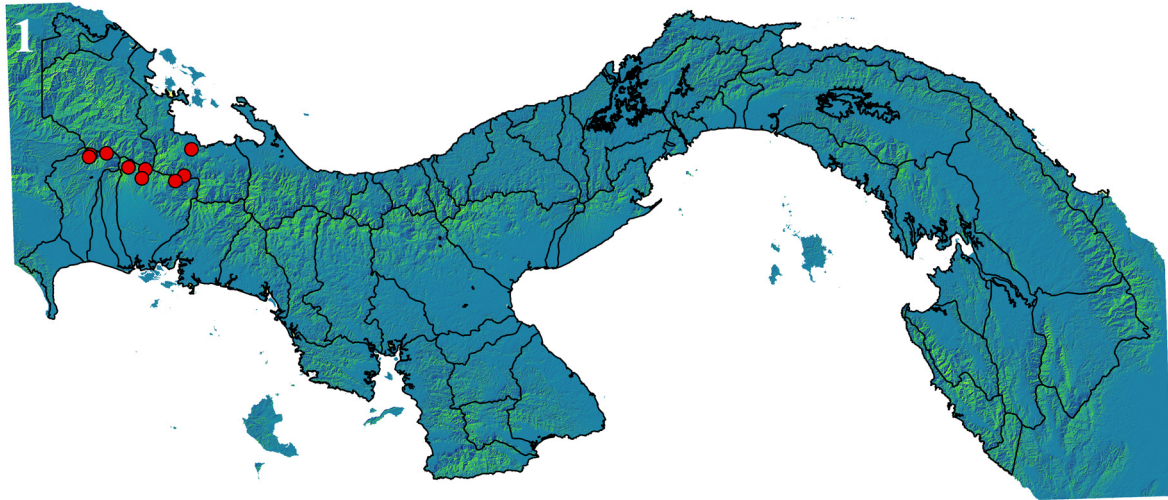
The studies by Gutiérrez-Fonseca (2015), Gutiérrez-Fonseca *et al.* (2015), Armitage and Stark (2017), Castillo Sánchez *et al.* (2018), and this current study demonstrate that there is still much to discover about Plecoptera in Panama. Based on the results reported herein, there are now 25 described species of Plecoptera known from Panama (Table 1), and three additional species described under provisional designations. The on-going work of Dr. Juan Bernal and his students at the Universidad Autónoma de Chiriquí (UNACHI) and of COZEM (Gorgas Institute) through their biodiversity surveys of Panama’s national parks (funded through the Ministerio de Ambiente), will undoubtedly reveal more information about the systematics and distribution of this important group of insects.

TABLE 1. List of known *Anacroneuria* (Plecoptera: Perlidae) from Panama. Modified from Gutiérrez-Fonseca (2015) and Armitage and Stark (2017).

Species	Male	Female	Nymph
<i>A. acutipennis</i> Klapálek, 1923	Stark, 1998	Stark, 1998	Unknown
<i>A. annulipalpis</i> Klapálek, 1922	Stark, 1998	Stark, 1998	Unknown
<i>A. azul</i> Rojas & Baena, 1999	Rojas & Baena in Stark <i>et al.</i> , 1999	Unknown	Unknown
<i>A. benedettoi</i> Stark, 1998	Stark, 1998	Stark, 1998	Gutiérrez-Fonseca & Springer, 2011
<i>A. blanda</i> Needham & Broughton, 1927	Stark, 1998	Stark, 1998	Unknown
<i>A. chiriqui</i> Stark & Armitage, 2018	Stark & Armitage, 2018	Stark & Armitage, 2018	Unknown
<i>A. choco</i> Stark & Bersosa, 2006	Stark & Bersosa, 2006	Unknown	Unknown
<i>A. costana</i> (Navás, 1924)	Navás, 1924	Unknown	Unknown
<i>A. curiosa</i> Stark, 1998	Stark, 1998	Unknown	Unknown
<i>A. darien</i> Gutiérrez-Fonseca, 2015	Gutiérrez-Fonseca, 2015	Gutiérrez-Fonseca, 2015	Unknown
<i>A. embera</i> Gutiérrez-Fonseca, 2015	Gutiérrez-Fonseca, 2015	Unknown	Unknown
<i>A. harperi</i> Stark, 1998	Stark, 1998	Stark, 1998	Unknown
<i>A. laru</i> Gutiérrez-Fonseca, 2015	Gutiérrez-Fonseca, 2015	Gutiérrez-Fonseca, 2015	Unknown
<i>A. lineata</i> (Navás, 1924)	Stark, 1998	Stark & Kondratieff, 2004	Gutiérrez-Fonseca & Springer, 2011
<i>A. magnirufa</i> Jewett, 1958	Stark, 1998	Stark, 1998	Unknown
<i>A. marca</i> Stark, 1998	Stark, 1998	Stark, 1998	Gutiérrez-Fonseca & Springer, 2011
<i>A. ngabe</i> Stark and Armitage, 2018	Stark and Armitage, 2018	Stark and Armitage, 2018	Unknown
<i>A. PA-1</i>	Unknown	Stark and Armitage, 2018	Unknown
<i>A. PA-2</i>	Unknown	Stark and Armitage, 2018	Unknown
<i>A. PA-3</i>	Unknown	Stark and Armitage, 2018	Unknown
<i>A. planicollis</i> Klapálek, 1923	Stark, 1998	Stark, 1998	Unknown
<i>A. plutonis</i> (Banks, 1914)	Stark, 1998	Stark, 1998	Unknown
<i>A. quetzali</i> Gutiérrez-Fonseca & Springer, 2015	Gutiérrez-Fonseca & Springer, 2015	Unknown	Unknown
<i>A. talamanca</i> Stark, 1998	Stark, 1998	Stark, 1998	Fenoglio, 2007
<i>A. totumas</i> Stark, 2014	Stark, 2014	Unknown	Unknown
<i>A. uatsi</i> Stark, 1998	Stark, 1998	Stark, 1998	Stark, 1998
<i>A. varilla</i> Stark, 1998	Stark, 1998	Stark, 1998	Gutiérrez-Fonseca & Springer, 2011
<i>A. zarpa</i> Stark, 1998	Stark, 1998	Unknown	Unknown

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MAPS. 1. Map of Panama with its 52 major cuencas (watersheds) outlined in black. Sample locations indicated by red dots. 2. Close up of the individual sample locations (a. Río Colorado and Quebrada Norte; b. afluente Río Colorado; c. afluente Río Colorado Viejo; d. Quebrada La Velo; e. afluente Río Palo Alto; f. Quebrada Jaramillo; g. Quebrada Hondo; h. afluente Río Guabo; i. Quebrada Rambala).

Literature cited

- Armitage, B.J. & Stark, B.P. (2017) The Plecoptera of Panama. I. The stonefly fauna of Mount Totumas Cloud Forest and Biological Reserve, including a new country record. *Insecta Mundi*, 0537, 1–7.
- Banks, N. (1914) New neuropteroid insects, native and exotic. *Proceedings of the Academy of Natural Science of Philadelphia*, 66, 608–632. Available from: <https://www.biodiversitylibrary.org/part/16691> (Accessed 14 Aug. 2018)
- Calor, A.R. & Mariano, R. (2012) UV light pan traps for collecting aquatic insects. *EntomoBrasilis*, 5, 164–166. <https://doi.org/10.12741/ebrasilis.v5i2.187>
- Castillo Sánchez, K.N., Aquirre E, Y.P., Ríos González, T.A. & Bernal Vega, J.A. (2018) *Anacroneuria* (Plecoptera: Perlidae) del río Csaldera, Chiriquí, Panama: nuevos registros de distribución altitudinal y variación estacional. *Revista de Biología Tropical*, 66 (1), 164–177.
- DeWalt, R.E., Maehr, M.D., Neu-Becker, U. & Stueber, G. (2018) Plecoptera Species File Online. Version 5.0/5.0. Available from: <http://Plecoptera.SpeciesFile.org> (accessed 25 May 2018)
- Gutiérrez-Fonseca, P.E. (2015) Three new species of *Anacroneuria* Klapálek (Plecoptera: Perlidae) from Panama. *Zootaxa*,

3957 (3), 69–76.

<https://doi.org/10.11646/zootaxa.3957.1.5>

- Gutiérrez-Fonseca, P.E. & Springer, M. (2011) Description of the final instar nymphs of seven species from *Anacroneuria* Klapálek (Plecoptera: Perlidae) in Costa Rica, and first record for an additional genus in Central America. *Zootaxa*, 2965, 16–38.
- Gutiérrez-Fonseca, P.E., Alonso-Rodríguez, A.M., Cornejo, A., Bailey, A.C., Maes, J.M. & Ramírez, A. (2015) New records of *Anacroneuria* Klapálek, 1909 (Plecoptera:Perlidae) for Central America. *Zootaxa*, 3994 (3), 445–448.
<https://doi.org/10.11646/zootaxa.3994.3.9>
- Harper, P.P. (1992) Stoneflies of Panama (Plecoptera). In: Quintero, D. & Aiello, A. (Eds.), *Insects of Panama and Mesoamerica, Selected Studies*. Oxford University Press, New York, pp. 114–121.
- Illies, J. (1966) *Katalog der rezenten Plecoptera*. Das Tierreich, Lieferung 82. Walter de Gruyter & Co., Berlin, xxx + 632 pp.
- Jewett, S.G. Jr. (1958) Stoneflies of the genus *Anacroneuria* from Mexico and Central America (Plecoptera). *The American Midland Naturalist*, 60 (1), 159–175.
<https://doi.org/10.2307/2422473>
- Klapálek, F. (1922) Pléoptères nouveaux. Quatrième partie. *Annales de la Société Entomologique de Belgique*, 62, 89–95.
- Klapálek, F. (1923) Pléoptères nouveaux. Cinquième partie. *Annales de la Société Entomologique de Belgique*, 63, 21–29.
- Navás, L. (1924) Insectos de la América Central. *Brotéria: Série Zoológica*, 21, 55–86.
- Navás, L. (1932) Alcuni insetti del Museo di Zoologia della Reale Università di Torino. *Bolletino della Reale Università di Torino, Museo di Zoologia e Anatomia Comparata*, 42 (3), 1–38.
- Pictet, F.J. (1841) *Histoire naturelle générale et particulière des insectes Névroptères. Famille des Perlides. 1 partie*. J. Kessmann et A. Cherbuliez, Genève, 423 pp.
- Stark, B.P. (1995) New species and records of *Anacroneuria* (Klapálek) from Venezuela. *Spixiana*, 18 (3), 211–249.
- Stark, B.P. (1998) The *Anacroneuria* of Costa Rica and Panama (Insecta: Plecoptera: Perlidae) *Proceedings of the Biological Society of Washington*, 111 (3), 551–603.
- Stark, B.P. (2014) Records of Mesoamerican *Anacroneuria* (Plecoptera: Perlidae), with descriptions of four new species. *Illiesia*, 10 (2), 6–16. [<http://www2.pms-lj.si/illiesia/Illiesia10-02.pdf>]
- Stark, B.P. & Kondratieff, B.C. (2004) *Anacroneuria* from Mexico and upper Mesoamerica (Plecoptera: Perlidae). *Monographs of the Western North American Naturalist*, 2, 1–64.
<https://doi.org/10.3398/1545-0228-2.1.1>
- Stark, B.P., Zúñiga, M. del C., Rojas, A.M. & Baena, M.L. (1999) Colombian *Anacroneuria*: Descriptions of new and old species (Insecta, Plecoptera, Perlidae). *Spixiana*, 22 (1), 13–46.
- Zwick, P. (1986) The Bornean species of the stonefly genus *Neoperla* (Plecoptera: Perlidae). *Aquatic Insects*, 8 (1), 1–53.
<https://doi.org/10.1080/01650428609361227>