Stark, B.P. & R.W. Baumann. 2011. Records of *Anacroneuria* (Plecoptera: Perlidae) from Bolivia and Paraguay with descriptions of three new species.
Illiesia, 7(19):182-191. Available online: http://www2.pms-lj.si/illiesia/papers/Illiesia07-19.pdf

RECORDS OF *ANACRONEURIA* (PLECOPTERA: PERLIDAE) FROM BOLIVIA AND PARAGUAY WITH DESCRIPTIONS OF THREE NEW SPECIES

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ABSTRACT

Anacroneuria clarki sp. n. and *A. vagante* sp. n. are described from Bolivian specimens, and *A. ypane* sp. n. from a Paraguayan specimen. Records of six additional *Anacroneuria* species are also presented for Bolivia and three unassociated Paraguayan females are described under informal designation. One species, *A. lupaca* Stark & Sivec, represents a new Bolivian record. An updated checklist for the 21 known Bolivian *Anacroneuria* species is included.

Keywords: Plecoptera, stoneflies, Bolivia, Paraguay, *Anacroneuria,* new records, new species

INTRODUCTION

Stark & Sivec (1998) updated the status of *Anacroneuria* species in Peru and Bolivia and recognized 39 species for the two countries including 11 for Bolivia. Stark (2004) added 14 for the two countries combined and eight of these were for Bolivia, consequently 18 *Anacroneuria* species are currently recognized for Bolivia. However, most Bolivian records are based on single locations and often on single specimens, indicating the need for additional collecting in order to more fully evaluate the Bolivian stonefly fauna. The situation is also dire for Paraguay where only two *Anacroneuria* species records exist for the entire country (Froehlich 2002). The current report is based on a small series of Bolivian *Anacroneuria* collected by S.M. Clark and colleagues in 2004-2009, and a few Paraguayan specimens collected by C.J.D. Brown in 1956. Males of eight Bolivian and one Paraguayan species were found in the samples along with several unassociated females described under informal designations. Three males represent previously unrecognized species which are described below, and another is the first Bolivian record of *A. lupaca* Stark & Sivec. Holotypes of the new species are deposited in the United States National Museum of Natural History (USNM), Washington, D.C., other specimens are deposited in the Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah (BYUC).

RESULTS AND DISCUSSION

Anacroneuria amaru Stark

Anacroneuria amaru Stark, 2004:67. Holotype ♂ (temporary repository American Museum of Natural History), Park Nacional Amboró, Caballero Province, Santa Cruz Dept., Bolivia

Material examined. BOLIVIA: Santa Cruz Department, La Siberia, 17.820° S, 64.678° W, 2550 m, 20 April 2005, S.M. Clark, R.L. Johnson, 1♂ (BYUC).

Comments. This species is known from more than 120 males all from Santa Cruz Department, Bolivia. The female and larva remain unknown (Stark 2004).

Anacroneuria clarki sp. n.
(Figs. 1-5)

Material examined. Holotype ♂, **BOLIVIA, La Paz Department**, Province Nor Yungus, Huarinilla, Rio Selva Resort, 16.20198° S, 67.79363° W, 3821′, 28 April 2006, R.L. Johnson, V.J. Anderson, S.M. Clark (USNM).

Adult habitus. General color brown, patterned with pale brown or yellow. Head mostly yellow but with a pair of dark brown curved bars extending from between ocelli and curved forward and laterad of ocelli; a pair of pale brown diagonal bars located on occiput behind ocelli and dark brown lappets and a pair of small dark triangles occur near anterior of frons (Fig. 1). Pronotum mostly brown but with pale area located near anterolateral margin. Wing membrane and veins brown except for pale costa and pale spot near cord. Fore and mid femora with dark brown dorsoapical band which is much reduced on hind femora; fore and mid tibiae dark brown along outer margin but pale along inner margin. Antennae dark brown.

Male. Forewing length 9 mm. Hammer thimble shaped (Fig. 2). Aedeagal apex trilobed in ventral and dorsal aspect (Figs. 3, 5); pale mesal lobe projecting beyond lateral lobes and dark along lateral margins in basal half; lateral lobes strongly sclerotized and divergent from mesal lobe giving an ear-like appearance in lateral aspect (Fig. 4). Dorsal edge of aedeagal apex bearing a strong keel with short basal arms (Fig. 5). Hooks slender.

Female. Unknown.

Larva. Unknown.

Etymology. The patronym honors Dr. Shawn Clark, Coleopterist of Brigham Young University. In addition to his expertise in the Coleoptera family Chrysomelidae, Shawn is well known to students of Plecoptera as an outstanding stonefly collector.

Diagnosis. *Anacroneuria clarki* is part of a small Andean complex of species which includes *A. cayapa* Stark (Ecuador), *A. marta* Zúñiga & Stark (Colombia), *A. tejon* Baena & Stark (Colombia), *A. x-nigrum* Klapálek (Peru) and *A. zwicki* Stark & Sivec (Bolivia, Peru) (Stark 2001; Stark & Sivec 1998; Stark et al. 1999; Zúñiga & Stark 2002). The aedeagus of the new species is similar to *A. cayapa* and *A. x-nigrum* in having the apex tri-lobed with a slender, mostly membranous mesoapical lobe projecting beyond the lateral lobes, and it further resembles *A. x-nigrum* in having a well developed dorsal keel along the entire length of the mesal lobe (Stark 2001; Stark & Sivec 1998). The two may be sister species within this complex and they are distinguished by the dark interocellar pigment, said to form an X-pattern in *A. x-nigrum* (Klapálek 1921; Stark & Sivec 1998), and also by details of the aedeagal apex. In *A. x-nigrum* the mesoapical lobe is gradually narrowed from base to apex and does not have dark sclerotized edges whereas in *A. clarki* the mesoapical lobe is constricted near midlength and has dark lateral margins in the basal half.

Anacroneuria cusi Stark

Anacroneuria cusi Stark, 2004:71. Holotype ♂ (temporary repository American Museum of Natural History), Park Nacional Amboró, Caballero Province, Santa Cruz Dept., Bolivia

Material examined. BOLIVIA, Cochabamba Department, Province Chapare, Incachaca, 17° 14′ S, 65° 49′ W, 7340′, 8 December 2008, S.M. Clark, 1♂ (BYUC). **La Paz Department,** Province Nor Yungas, Rio Huarinilla, Huarinilla, 16° 12′ S, 67° 47′ W, 3750′, 11 November 2009, S.M. Clark, H.R. Hinkson, 1♂ (BYUC).

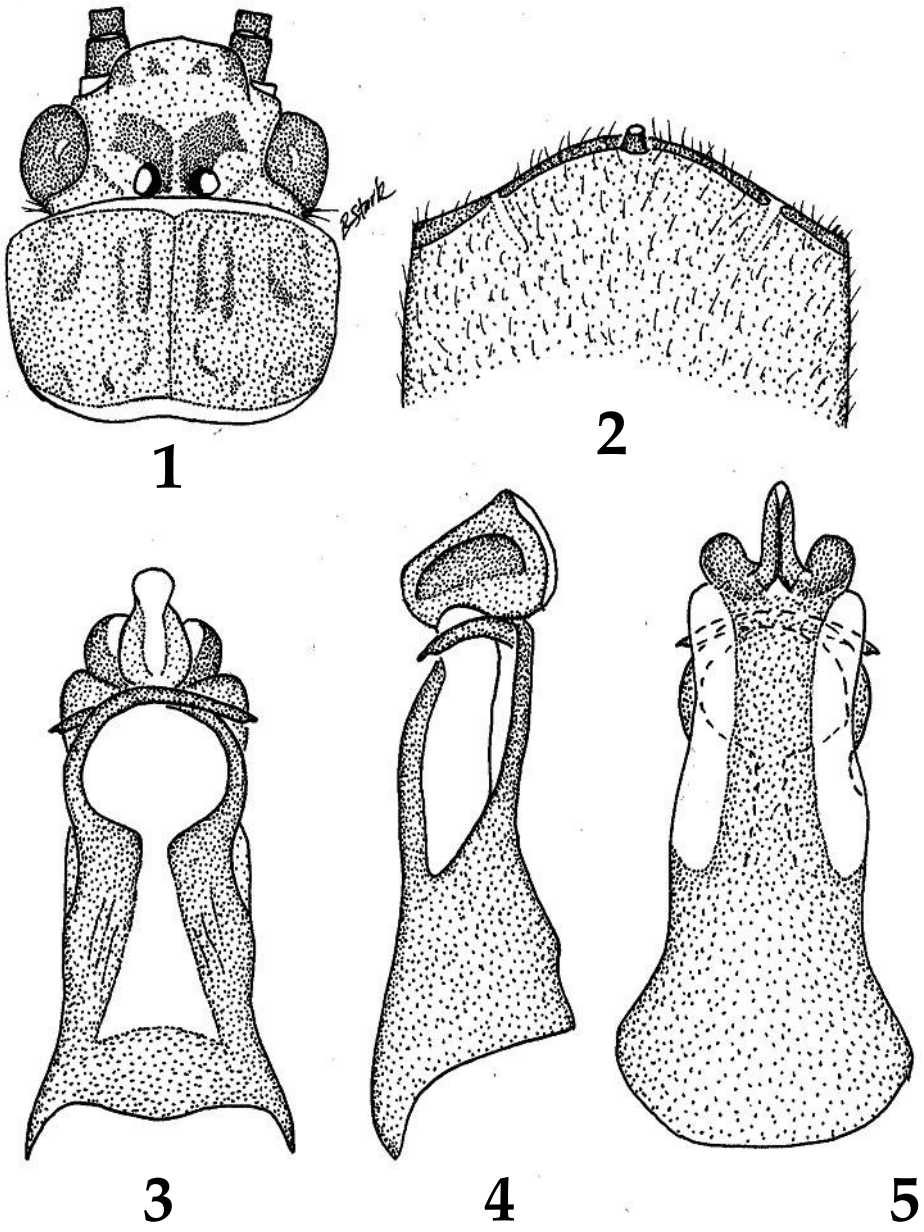
Comments. All known previous records of this species are from, or near the type locality in Santa Cruz Department. (Stark 2004).

Anacroneuria handlirschi Klapálek

Anacroneuria handlirschi Klapálek, 1922:94. Lectotype ♂ (Hofmuseum), Coroico, Bolivia, designated by Zwick (1973)

Anacroneuria handlirschi: Stark & Sivec, 1998:28

Material examined. BOLIVIA: Cochabamba Department, Province Chapare: Rio Vinchuta, Shineota, 17.008° S,



Figs. 1-5. *Anacroneuria clarki* structures. 1. Head and pronotum. 2. Male sternum 9. 3. Aedeagus, ventral. 4. Aedeagus, lateral. 5. Aedeagus, dorsal.

65.309° W, 255 m, 22 April 2005, S.M. Clark, R.L. Johnson, 1♂ (BYUC). Rio Espiritu Santo, Villa Tunare, 22 April 2005, S.M. Clark, R.L. Johnson, 1♂ (BYUC). **La Paz Department**, Province Nor Yungus: Mun. Coroico, Vagante, 2 December 2004, R.L. Johnson, V.J. Anderson, 1♂ (BYUC). Vagante, nr Coroico, 16.17854° S, 67.69071° W, 1110 m, 30 April 2006, R.L. Johnson, V.J. Anderson, S.M. Clark, 1♂ (BYUC). Rio Vagante, Vagante, 16° 11′ S, 67° 41′W, 3650′, 12 November 2009, S.M. Clark, H.R. Hinkson,

1♂, 2♀ (BYUC). Rio Huarinilla, Huarinilla, 16° 12′ S, 67° 48′ W, 3750′, 11 November 2009, S.M. Clark, H.R. Hinkson, 2♂ (BYUC).

Comments. Zwick (1973) selected the male lectotype from a surviving Bolivian syntype from Klapálek's (1922) type series. Stark & Sivec (1998) noted this species was quite common at Woytkowski's "Hacienda Maria" site in Peru where it represented about half the catch of stonefly specimens. They also reported the species from two sites in Cochabamba which are the only previous records from Bolivia.

Anacroneuria lupaca Stark & Sivec

Anacroneuria lupaca Stark & Sivec, 1998:35. Holotype ♂ (United States National Museum), Manu, Pakitza, Madre de Dios, Peru

Material examined. BOLIVIA: Cochabamba Department, Province Chapare, Rio Coni, Shineota, 17.012° S, 65.219° W, 240 m, 22 April 2005, S.M. Clark, R.L. Johnson, 1♂ (BYUC).

Comments. This species was described from a single Peruvian male specimen (Stark & Sivec 1998) and has not been reported since the original description.

Anacroneuria pachacuti Stark & Sivec

Anacroneuria pachacuti Stark & Sivec, 1998:45. Holotype ♂ (United States National Museum), pte. San Pedro, Paucartambo, Cuzco, Peru

Material examined. BOLIVIA: La Paz Department, Nor Yungus Province: Mun. Coroico, Vagante, 21 December 2004, R.L. Johnson, V.J. Anderson, 1♂ (BYUC). Vagante, nr. Coroico, 16.17854° S, 67.69071° W, 1110 m, 30 April 2006, R.L. Johnson, V.J. Anderson, S.M. Clark, 1♂ (BYUC). Huarinilla, Rio Selva Resort, 16° 202′ S, 67° 494′ W, 29 October 2007, R.L. Johnson, V.J. Anderson, 1♂ (BYUC). Rio Huarinilla, Huarinilla, 16° 12′ S, 67° 48′ W, 3830′, 10 December 2008, R.L. Mower, 1♂ (BYUC). Same site but 3750′, 11 November 2009, S.M. Clark, H.R. Hinkson, 7♂ (BYUC).

Comments. Bolivian and Peruvian records are available in Stark & Sivec (1998). The Bolivian records are from two sites including one from "Yungas Las Paz".

Anacroneuria spectori Stark

Anacroneuria spectori Stark, 2004:74. Holotype ♂ (American Museum of Natural History), Park Nacional Amboró, Caballero Prov., Santa Cruz Dept., Bolivia

Material examined. BOLIVIA: Santa Cruz Department, La Siberia, 17.820° S, 64.678° W, 2550 m, 20 April 2005, S.M. Clark, R.L. Johnson, 1♂ (BYUC).

Comments. This species was previously known from five specimens all collected in Santa Cruz Department, Bolivia.

Anacroneuria vagante sp. n.

(Figs. 6-10)

Material examined. Holotype ♂, **BOLIVIA: La Paz Department**, Province Nor Yungas, Rio Vagante, Vagante, 16° 11′ S, 67° 41′ W, 3650′, 12 November 2009, S.M. Clark, H.R. Hinkson (USNM).

Adult habitus. General color brown, patterned with areas of dark brown and pale brown or yellow. Head with a large area of dark pigment covering ocellar region and extending forward and laterad over much of frons (Fig. 6); lappets dark brown and occiput with area of dark pigment outlining a pair of triangles with pale centers; antennae and palpi brown. Mid and fore femora banded with dark pigment in apical third, tibiae uniformly dark brown (hind legs missing). Wings membranes brown, veins dark brown.

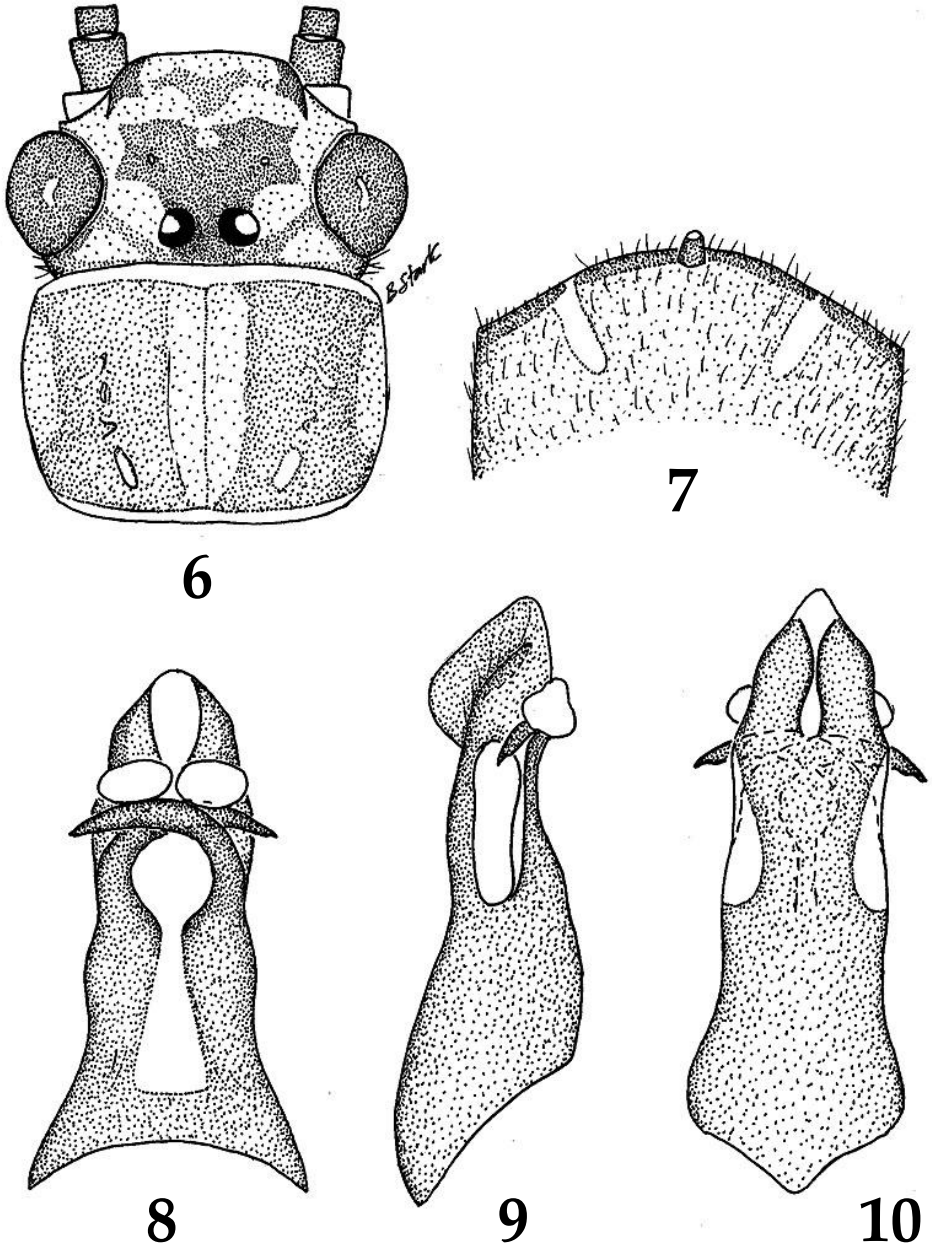
Male. Forewing length 8.5 mm. Hammer thimble shaped (Fig. 7). Aedeagal apex simple, scoop shaped (Figs. 8-10), but with heavily sclerotized lateral margins, a prominent dorsal keel which forms an X-pattern (Fig. 10), and a pair of prominent membranous ventral lobes; lateral margins in dorsal aspect somewhat scalloped. Hooks slightly wider than in most species.

Female. Unknown.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, is based on the type locality of Rio Vagante.

Diagnosis. The aedeagus of *A. vagante* is most similar to that of *A. karina* Stark, known from Venezuela (Stark 1999), however that species lacks the distinctive head and pronotal pattern of *A. vagante*; in



Figs. 6-10. *Anacroneuria vagante* structures. 6. Head and pronotum. 7. Male sternum 9. 8. Aedeagus, ventral. 9. Aedeagus, lateral. 10. Aedeagus, dorsal.

addition the bases of the aedeagal hooks in *A. karina* are more swollen, the dorsal keel is shorter, and the ventral membranous lobes smaller in that species than in *A. vagante*. The aedeagus of the new species is also generally similar to that of *A. manauensis* Ribeiro-Ferreira, described from Brazil (Ribeiro-

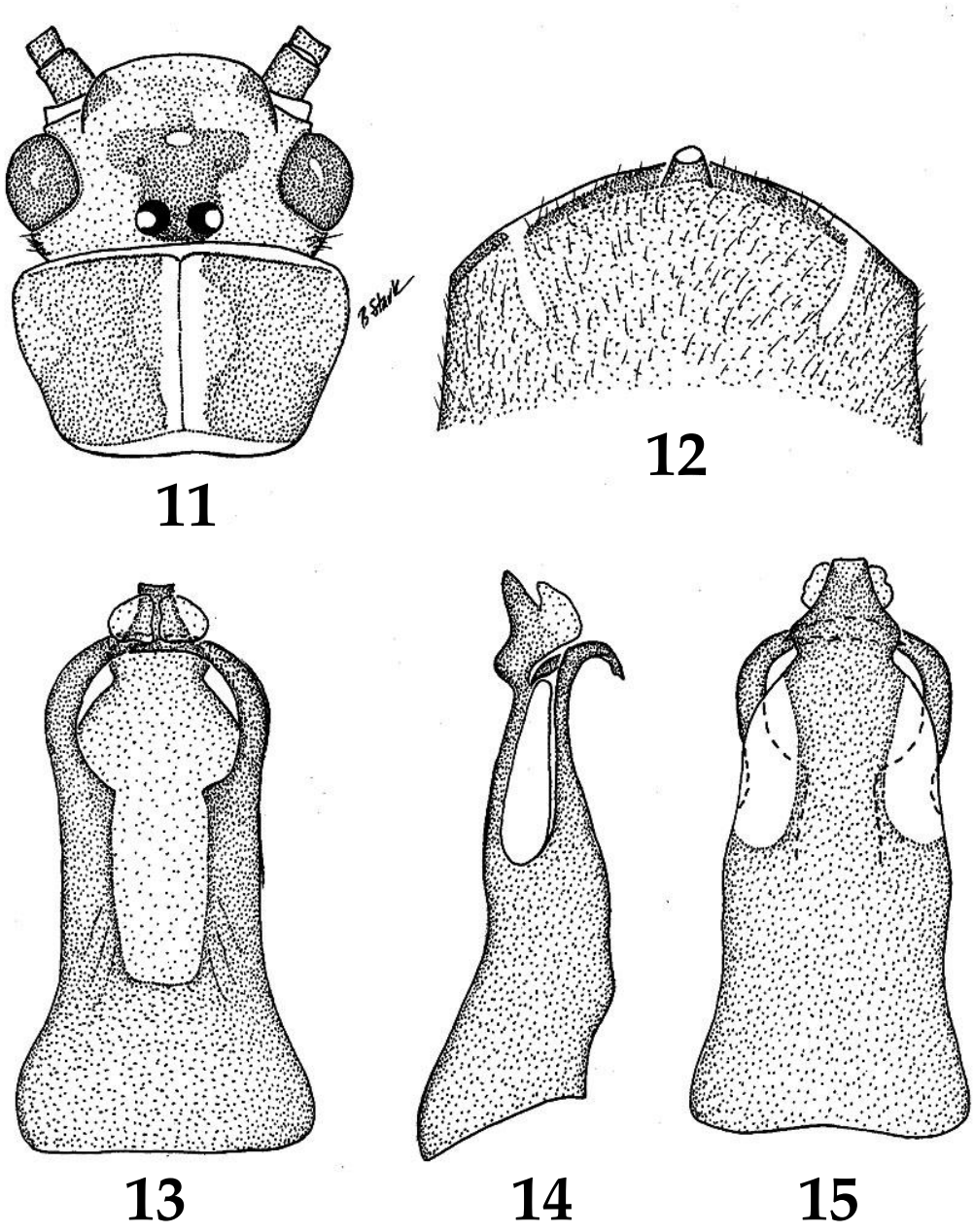
Ferreira & Froehlich 2001), *A. puna* Stark, described from Ecuador (Stark 2001), and *A. taylori* Stark, described from Bolivia (Stark 2004). The new species differs from the latter two in having a much broader area of dark pigment on the frons, but also differs from the former two species in having a prominent pair of membranous lobes on the aedeagal apex. It differs from the latter species in lacking subchelate aedeagal hooks and in having larger membranous lobes on the aedeagal apex.

Anacroneuria ypane sp. n.
(Figs. 11-15)

Material examined. Holotype ♂, **PARAGUAY: Amambay Department**, Rio Ypane, cerca Pedro Juan Caballero, 25 November 1956, C.J.D. Brown (USNM).
Adult habitus. General color brown, patterned with areas of pale pigment. Head with a large area of dark pigment extending from ocellar region over central frons (Fig. 11); dark pigment area expanded laterally in central frons where a small oval pale area is located; lappets and antennae dark brown. Pronotum mostly dark but with a narrow pale median stripe and pale lateral areas. Hind femora dark brown in apical third but pale basally; hind tibia with small dark bands basally and apically but pale for most of length. Wing membrane brown, veins (particularly R vein) dark brown.
Male. Forewing length 10 mm. Hammer thimble shaped, apical diameter less than height (Fig. 12). Aedeagal apex a short, simple, truncate scoop bearing a ventral pair of prominent membranous lobes (Fig. 13); dorsal margin of apical area expanded into a pair of small rounded lateral lobes near point where hooks cross (Fig. 15); dorsal keel lines absent, apex bent strongly dorsad, giving a foot-like shape in lateral aspect (Fig. 14). Hooks slender.
Female. Unknown.
Larva. Unknown.
Etymology. The species name, used as a noun in apposition, is based on the type locality of Rio Ypane.
Diagnosis. This species is related to the *Anacroneuria atrifrons* Klapálek group of species (Froehlich 2008) which includes at least *A. azul* Rojas & Baena (Stark et al. 1999), *A. canchi* Stark & Sivec (Stark & Sivec 1998) and *A. pastaza* Stark (Stark 2001). Of these species, the aedeagus of *A. ypane* is most similar to that of the Colombian species, *A. azul*, but the membranous lobes in that species are smaller and a small transverse dorsal keel is present. The latter species also differs from *A. ypane* in having a much smaller area of dark head pigment.
Comments. Froehlich (2002) reported *A. debilis* (Pictet) from a single male collected in Parque Nacional Ybycui and *A. trimacula* Jewett from a single female collected at the same locality. Thus, *Anacroneuria ypane* becomes only the third member of the genus to be confirmed for Paraguay, and the first to be described from a Paraguayan specimen.

Anacroneuria PA-1
(Figs. 16-18)

Material examined. PARAGUAY: Hernandarias, near Acaray River, 3 November 1956, C.J.D. Brown, 7♀ (BYUC).
Adult habitus. General color pale brown, patterned with darker brown pigment. Head with a dark V connecting ocelli and extending toward bases of antennae (Fig. 16); lappets and antennae dark brown, palpi pale. Pronotum pale brown with darker, slender rugosities scattered over disk; median suture with a narrow dark band on either side. Hind femora darker in apical third, hind tibia uniformly brown. Wings tinted pale brown, veins darker.
Male. Unknown.
Female. Forewing length 10-11 mm. Subgenital plate weakly four lobed; inner lobes separated by a shallow V-shaped notch (Fig. 18) and outer lobes by a very shallow, wide notch. Sternum 9 posterior sclerite long, slender and sparsely setose; median sclerite covered basally and through median zone with fine, short setae, and bearing a few scattered longer, thicker setae near sclerite and laterally.
Egg. Spindle shaped, long, slender and darker on anterior pole (Fig. 17).
Larva. Unknown.
Comments. We are unable to associate these females with any of the species known from the region. Certainly they are distinct from *A. debilis* and *A. trimacula* (Froehlich 2002) and they are also distinct in egg morphology and subgenital plate shape from *A. fuscicosta* (Enderlein) and *A. stanjewetti* Froehlich, two regional species which have similar head patterns (Zwick 1973; Froehlich 2002).



Figs. 11-15. *Anacroneuria ypane* structures. 11. Head and pronotum. 12. Male sternum 9. 13. Aedeagus, ventral. 14. Aedeagus, lateral. 15. Aedeagus, dorsal.

***Anacroneuria* PA-2**
(Figs. 19-21)

Material examined. PARAGUAY: Amambay Department, Rio Ypane, cerca Pedro Juan Caballero, 25 November 1956, C.J.D. Brown, 1♀ (BYUC).

Adult habitus. General color pale brown, patterned with brown pigment. Head with a brown V-shaped pattern over ocelli and curving outwards toward anterior margins of eyes (Fig. 19). Lappets and antennae pale brown, palpi paler. Hind femora entirely pale, tibiae pale except for small brown areas

on distal and proximal ends. Wings transparent, veins pale brown.

Male. Unknown.

Female. Forewing length 15.5 mm. Subgenital plate four lobed; inner lobes separated by a wide, shallow notch (Fig. 21), lateral lobes separated by shallow notches. Sternum 9 with obscure posterior sclerite; median sclerite covered laterally and along posterior margin with long setae, basal, median area covered with fine, short setae.

Egg. Spindle shaped, long, slender and bearing a small, membranous cap (Fig. 20).

Larva. Unknown.

Comments. This female was collected with the holotype of *A. ypane* and appears distinct from it on the basis of color pattern, and from others known from Paraguay (Froehlich 2002). We are also not able to match it with others known from the region.

Anacroneuria PA-3

(Figs. 22-24)

Material examined. PARAGUAY: cerca Hernandarias, Boca de Rio Acaray, 4 November 1956, C.J.D. Brown, 2♀ (BYUC).

Adult habitus. General color brown, patterned with pale areas. Head with a dark quadrate area covering ocelli and extending to M-line; diffuse brown pigment occurs forward of M-line and extending anterolaterally from dark pigment (Fig. 22); lappets and antennae brown, palpi pale brown. Pronotum pale brown with darker rugosities and a pale median band. Hind femora and tibia brown. Wings transparent, veins brown.

Male. Unknown.

Female. Forewing length 16 mm. Subgenital plate four lobed with lobes approximately equal in size (Fig. 24). Sternum 9 with a wide, well developed posterior sclerite which bears prominent setae over most of length but bare mesally; mesal sclerite bearing long setae posterolaterally and fine setae basally and mesally.

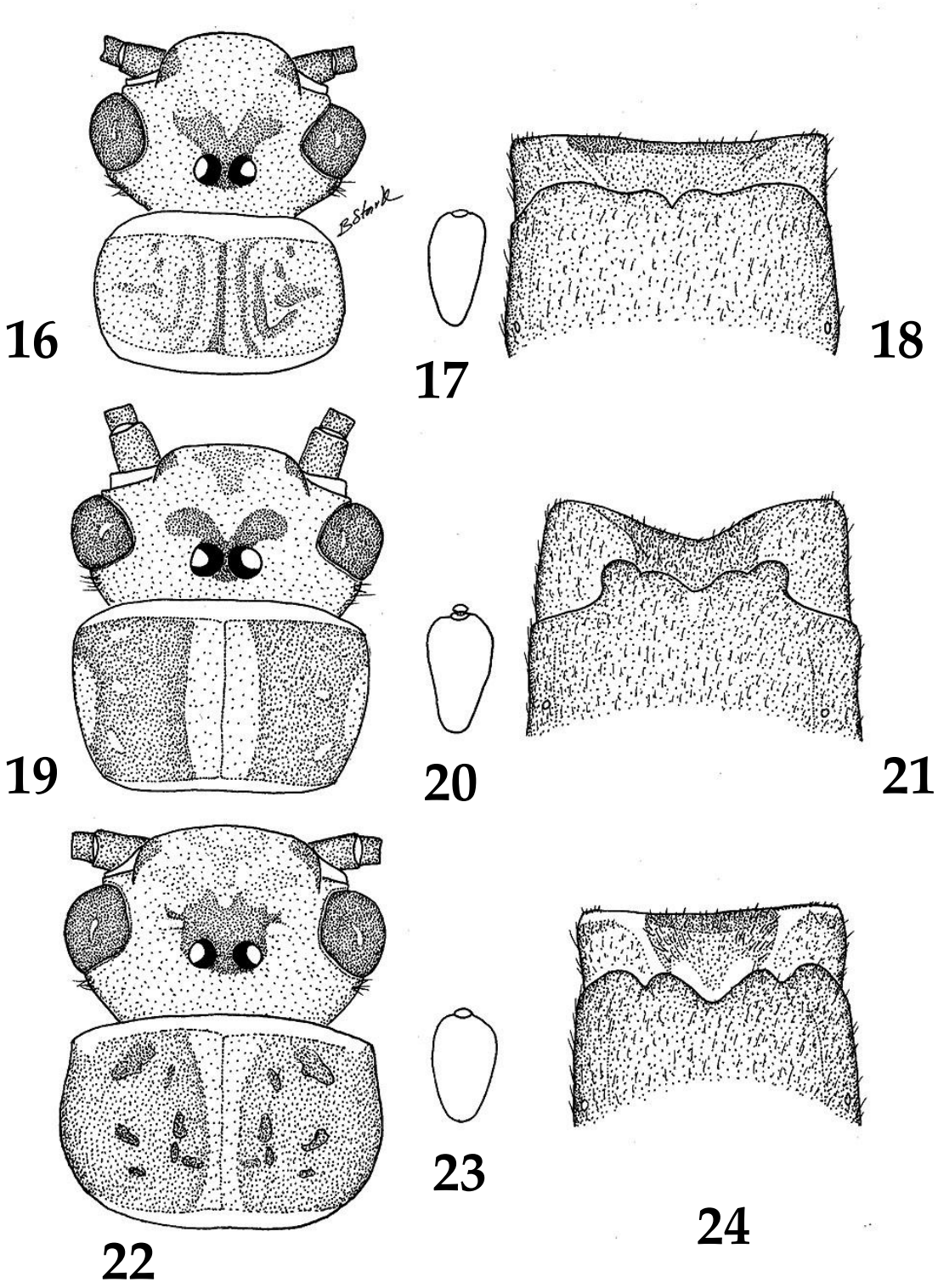
Egg. Spindle shaped moderate in length and broadly rounded at anterior pole. Collar bears a small membranous cap (Fig. 23).

Comments. The subgenital plate of this species is generally similar to that of *A. debilis* (Froehlich 2002) but the egg and color pattern are distinct.

Checklist of Bolivian *Anacroneuria*

The following checklist of 21 Bolivian *Anacroneuria* species is updated from Stark & Sivec (1998) and Stark (2004). Departmental distributions are given if known.

Anacroneuria amaru Stark, 2004	Santa Cruz
Anacroneuria amboro Stark, 2004	Santa Cruz
Anacroneuria boliviensis (Enderlein, 1909)	Santa Cruz
Anacroneuria chipaya Stark & Sivec, 1998	Cochabamba
Anacroneuria clarki sp. n.	La Paz
Anacroneuria cochabamba Stark, 2004	Santa Cruz
Anacroneuria cusi Stark, 2004	Cochabamba, Santa Cruz, La Paz
Anacroneuria cuzco Stark & Sivec, 1998	La Paz, Santa Cruz
Anacroneuria handlirschi Klapálek, 1922	Cochabamba, La Paz
Anacroneuria iridescens Klapáek, 1922	Department unknown
Anacroneuria lupaca Stark & Sivec, 1998	Cochabamba
Anacroneuria pacaje Stark & Sivec, 1998	La Paz
Anacroneuria pachacuti Stark & Sivec, 1998	Cochabamba, La Paz
Anacroneuria pellucida Klapálek, 1922	Department unknown
Anacroneuria spectori Stark, 2004	Santa Cruz
Anacroneuria taylori Stark, 2004	Santa Cruz



Figs. 16-24. *Anacroneuria* sp. unassociated females. 16-18. PA-1. 16. Head and pronotum. 17. Egg. 18. Female sterna 8-9. 19-21. PA-2. 19. Head and pronotum. 20. Egg. 21. Female sterna 8-9. 22-24. PA-3. 22. Head and pronotum. 23. Egg. 24. Female sterna 8-9.

Anacroneuria tiwanaku Stark, 2004	La Paz
Anacroneuria uru Stark & Sivec, 1998	Cochabamba
Anacroneuria vagante sp. n.	La Paz
Anacroneuria yameo Stark & Sivec, 1998	Santa Cruz
Anacroneuria zwicki Stark & Sivec, 1998	Cochabamba

ACKNOWLEDGEMENTS

We are grateful to S.M. Clark and his colleagues and students V.J. Anderson, R.L. Johnson, R.C. Mower and H.L. Hinkson, collectors of the Bolivian material, and to the Monte L. Bean Life Science Museum, Brigham Young University for making these specimens available for study. We also thank C.J.D. Brown, who began his training at Brigham Young University and received his Ph.D. in Ichthyology from the University of Michigan. While at Ann Arbor, "Brownie", as he was known, met "Vangie" the Zoology Department secretary and they became a life long team. He spent most of his teaching career at Montana State University, Bozeman, Montana and upon retirement deeded his books, scientific reprints and miscellaneous aquatic insect specimens to BYU.

REFERENCES

Froehlich, C.G. 2002. *Anacroneuria* mainly from southern Brazil and northeastern Argentina (Plecoptera: Perlidae). Proceedings of the Biological Society of Washington, 115:75-107.

Froehlich, C.G. 2008. Old species of Neotropical Plecoptera. pp. 125-132. *In* Hauer, F.R., J.A. Stanford & R.L. Newell [eds.]. International advances in the ecology, zoogeography and systematics of mayflies and stoneflies. University of California Publications in Entomology. Volume 128. University of California Press, Berkeley. 412 pp.

Klapálek, F. 1921. Plécoptères nouveaux. Troisième partie. Annales de la Societé Entomologique de Belgique, 61:320-327.

Klapálek, F. 1922. Plécoptères nouveaux. Quatrième partie. Annales de la Societé Entomologique de Belgique, 62:89-95.

Ribeiro-Ferreira, A.C. & C.G. Froehlich. 2001. *Anacroneuria* Klapálek, 1909 from Amazonas State, North Brazil (Plecoptera, Perlidae, Acroneuriinae). Aquatic Insects, 23:187-192.

Stark, B.P. 1999. *Anacroneuria* from northeastern South America (Insecta: Plecoptera: Perlidae). Proceedings of the Biological Society of Washington, 112:70-93.

Stark, B.P. 2001. Records and descriptions of *Anacroneuria* from Ecuador (Plecoptera: Perlidae). Scopolia, 46:1-42.

Stark, B.P. 2004. New species and records of Andean *Anacroneuria* (Insecta, Plecoptera, Perlidae). Spixiana, 27:67-81.

Stark, B.P. & I. Sivec. 1998. *Anacroneuria* of Peru and Bolivia (Plecoptera: Perlidae). Scopolia, 40:1-64.

Stark, B.P., M. del C. Zúñiga, A.M. Rojas, & M.L. Baena. 1999. Colombian *Anacroneuria*: Descriptions of new and old species (Insecta, Plecoptera, Perlidae). Spixiana, 22:13-46.

Zúñiga, M. del C. & B.P. Stark. 2002. New species and records of Colombian *Anacroneuria* (Insecta, Plecoptera, Perlidae). Spixiana, 25:209-224.

Zwick, P. 1973. Die Plecopteren-Arten Enderleins (Insecta); Revision der Typen. Annales Zoologici, 30:471-507.

Received 20 May 2011, Accepted 23 June 2011, Published 11 July 2011