

Cloeodes incus (Waltz & McCafferty) (Ephemeroptera: Baetidae): first record for Argentina, hydrologic and environmental remarks

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***Cloeodes incus* (Waltz & McCafferty) (Ephemeroptera: Baetidae): primer registro de Argentina, características hidrológicas y ambientales**

RESUMEN. *Cloeodes incus* se cita por primera vez para la Argentina. Se recolectaron ninfas mediante red Surber y red de arrastre en los Ríos Pircas y Ajedrez (Jujuy: Rinconada) en altitudes superiores a los 4000 msnm. Se realizaron dos campañas anuales: fin de estación lluviosa (abril) y fin de estación seca (noviembre), durante los años 2011 y 2012. Este estudio permite ampliar la distribución de *C. incus* en los Andes Centrales e incorporar información hidrológica y ambiental de los sitios seleccionados. Los mayores valores de densidad se obtuvieron al final de la estación seca, con escasa cantidad de agua y con un pH de 7,1 – 8,1. Su presencia también fue registrada, aguas abajo de actividades mineras, con un pH de 3,7.

PALABRAS CLAVE. Ephemeroptera. Baetidae. *Cloeodes*. Argentina.

ABSTRACT. *Cloeodes incus* is recorded for the first time for Argentina. Nymphs were collected using Surber net and kick sampling in Pircas and Ajedrez rivers (Jujuy: Rinconada) at altitudes above 4000 masl. There were two annual field trips: at the end of the rainy season (April) and at the end of the dry season (November), during the years 2011 and 2012. This study allows extending the distribution of *C. incus* in the Central Andes and incorporates environmental and hydrological information of the selected sites. The highest values of density were obtained at the end of the dry season, with little amount of water and a pH of 7.1 to 8.1. Their presence was also recorded downstream of mining activities, with a pH of 3.7.

KEY WORDS. Ephemeroptera. Baetidae. *Cloeodes*. Argentina.

The genus *Cloeodes* Traver, 1938 (Ephemeroptera: Baetidae) has a widespread pantropical distribution in North America, Central and South America, Africa, Madagascar and Southeast Asia (Massariol & Salles, 2011). Specimens of this genus can be found in a wide diversity of habitats (Domínguez *et al.*, 2006). In South America *Cloeodes* includes

16 known species: eight from nymphs and six from adults and nymphs (Nieto & Emmerich, 2011). *C. stelzneri* (Weyenbergh) and *C. nocturnus* (Navás) were not included following Nieto & Barton (2008) who proposed both species as *nomen dubia*.

South American species are distributed in Argentina, Bolivia, Brazil, Guyana, Paraguay,

Peru, Uruguay and Venezuela (Hubbard *et al.*, 1992; Nieto & Barton, 2008; Nieto & Emmerich, 2011; Massariol & Salles, 2011).

In 1987, Waltz & McCafferty described the monotypic genus *Bernerius* from Peru. It was described based on the species *Bernerius incus* previously placed in *Baetis* (?) sp. B by Berner (1980). This genus was considered as the sister group of *Cloeodes*. However, after examining the type material and based on cladistics analysis, Nieto & Barton (2008) synonymized *Bernerius* with *Cloeodes*.

The purpose of this note is to mention *Cloeodes incus* for the first time for Argentina and to analyze hydrological and environmental characteristics of the sites where it was collected to improve the knowledge of the geographic distribution of *Cloeodes incus*.

A total of 1127 nymphs were collected in the rivers Pircas and Ajedrez (Argentina: Jujuy: Rinconada). Two samplings were performed annually (end of rainy season and end of dry season) during the years 2011 and 2012, at three sites in two rivers in Jujuy: Pircas river: 1) at the headwaters and 2) downstream; and in the Ajedrez river. The specimens were collected using Surber net: three replicates (quantitative sampling) and kick sampling (qualitative sampling), both with a 250 micron pore diameter network.

Climate dates, pH values, flow measurements (Table I) were provided by Mina Pirquitas Company from their water quality monitoring program.

The material examined is housed in INBIAL (Instituto de Biología de la Altura, Universidad Nacional de Jujuy, Argentina) and IFML (Instituto Miguel Lillo, Tucumán, Argentina).

All the material was preserved in ethyl alcohol 70%. Dissected parts of the specimens studied were mounted on microscope slides using Canada Balsam as mounting media.

Cloeodes incus (Waltz & McCafferty).

Baetis (?) sp. B. Berner, 1980:190

Bernerius incus Waltz & McCafferty, 1987: 181; Nieto & Barton 2008: 11.

Material Examined. ARGENTINA. Jujuy:

Pircas river headwaters, 22° 40'46.5" S, 66° 33'39.6" W, 4402masl, 16-XI-2011, 13 nymphs (INBIAL), De Paul col.; 16-IV-2012, 1 nymph

(INBIAL); 20-XI-2012, 32 nymphs same locality (20, 2 slides, INBIAL) (10, IFML), Ortiz col. Pircas river downstream, 22° 42'10.1" S, 66° 28'17.7" W, 4021masl, 20-XI-2012, 1 nymph (INBIAL), Ortiz col. Ajedrez river, 22° 41'40.3" S, 66° 24'16.3" W, 4072masl, 16-XI-2011, 9 nymphs (INBIAL), Ortiz col.

Geographical distribution. Argentina:

Jujuy: Rinconada: Pircas river, Ajedrez river; **Bolivia:** La Paz: trib. Rio Umalo o Grande, below Calamarca on La Paz - Oruro Rd; **Perú:** Puno: Llave River at Llave.

Remarks. The altitude is an important factor to determine the distributional patterns of species (Alvial *et al.*, 2013a). Only the presence of one species of Ephemeroptera: *Meridialaris tintinnabula* Pescador & Peters (Leptophlebiidae) is known for the Argentinean Northwest with a distribution up to 4300 masl (Domínguez *et al.*, 2006).

All *Cloeodes incus* (Baetidae) registered in the Central Andes were obtained in sites located at altitudes above 4000 masl.

The Argentinian rivers studied are localized at the Puna plateau. This region is characterized by a dry and cold climate, with daily thermal amplitudes that can reach 30°C, and high evaporation, infiltration and solar radiation. The average rainfall is 350 mm/year, concentrated in summer and scarce snow or hail in winter.

In semi-arid regions of northern Chile and Bolivia the association between altitudinal gradient, mining activities and low pH determines the pattern of distribution of the macroinvertebrates (Alvial *et al.* 2013b, Van Damme *et al.* 2008).

The highest density values were obtained in November 2011 and 2012 (end of dry season) with 70 ind/m² and 2478 ind/m² respectively, at headwaters of Pircas river with very low flow rates and depths (Table II) and Ajedrez river (237 ind/m²), in the same month in 2011, when the flow does not exceed 87.6 l/s and 0.18m depth. The pH of the water of these sites was neutral- alkaline (7.1- 8.1).

Also *C. incus* was collected in Pircas River, downstream mining activities (14 ind/m²) in acidic water (pH 3.7). At the end of the rainy season, *C. incus* was only recorded in 2012 in Pircas River, at 4402 masl with flow values of

Tabla I. Hydrological and environmental features of the sites. D: depth; Q: caudal; T°: temperature average

	Pircas river						Ajedrez River			Region	
	Headwaters (4402masl)			Downstream (4021masl)			(4072masl)			Environmental data	
	Q	Depth	pH	Q	Depth	pH	Q	Depth	pH	T°	Rainfall
	(l/s)	(m)		(l/s)	(m)		(l/s)	(m)		(°C)	(mm)
IV/6/2011	<0.3	< 0.05	7.1	69.2	-	3.5	<0.3	< 0.05	7.2	-	-
XI/16/2011	<0.3	< 0.05	7.4	3.9	-	3.6	87.6	0.18	8.1	9.42	2.2
IV/5/2012	6.6	0.12	7.7	144.8	-	2.6	<0.3	< 0.05	6.3	6.91	0.4
XI/20/2012	<0.3	< 0.05	7.1	0.3	0.18	3.7	<0.3	< 0.05	8.0	9.82	0.1

Tabla II. Density and number of specimens of *Cloeodes incus* collected from three sites of the province of Jujuy, located at different altitudes. δ: density; KS: Kick sampling

	Pircas river				Ajedrez River	
	Headwaters (4402masl)		Downstream (4021masl)		(4072masl)	
	δ	KS	δ	KS	δ	KS
	(ind/ m ²)	(N° ind.)	(ind/ m ²)	(N° ind.)	(ind/ m ²)	(N° ind.)
IV/6/2011	0	0	0	0	0	0
XI/16/2011	70	9	0	0	237	0
IV/5/2012	26	14	0	0	0	0
XI/20/2012	2478	341	14	0	0	0
Total	2574	364	14	0	237	0

6.6 l/s and 0.12m depth.

The mining activities downstream of Pircas River increase caudal values and acidification with strong negative impact in the distribution of *C. incus*.

This species is recorded in Argentina in fall and spring, associated with high rivers with shallow, slow to moderate currents, features also mentioned by Berner (1980) from specimens collected in small streams in the region of Lake Titicaca in Peru and Bolivia in winter (low water season).

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LITERATURE CITED

- ALVIAL I. E., K. ORTH, B. C. DURÁN, E. ÁLVAREZ & F. A. SQUEO. 2013a. Importance of geochemical factors in determining distribution patterns of aquatic invertebrates in mountain streams south of the Atacama Desert, Chile. *Hydrobiologia* 709: 11-25.
- ALVIAL I. E., D. H. TAPIA, M. J. CASTRO, B. C. DURAN & C. A. VERDUGO. 2013b. Analysis of benthic macroinvertebrates and biotic indices to evaluate water quality in rivers impacted by mining activities in northern Chile. *Knowledge and Management of Aquatic Ecosystems* 407: 1-16.
- BERNER, L. 1980. II Ephemeroptera nymphs. pp: 187-194 *En: Roback, S.S.; L. Berner; O.S. Flint Jr; N. Nieser & P.J. Spangler. Results of the Catherwood Bolivian-Peruvian altiplano expedition. Part I Aquatic insects except Diptera. Proceeding of the Academy of Natural Sciences of Philadelphia.* 132: 176-217
- DOMINGUEZ E., C. MOLINERI, M. L. PESCADOR, M. D. HUBBARD & C. NIETO. 2006. Ephemeroptera of South America. *En: Adis, J., J.R. Arias, G. Rueda-Delgado & K.M. Wantzen (eds.), Aquatic Biodiversity in Latin America (ABLA).* Vol. 2. Pensoft. Sofia-Moscow. 646 pp.
- HUBBARD M. D., E. DOMÍNGUEZ & M. L. PESCADOR. 1992 (91). Los Ephemeroptera de la República Argentina: Un Catálogo. *Revista de la Sociedad Entomológica*

- Argentina 50 (1-4): 201-240.
- MASSARIOL F. C. & F. F. SALLES. 2011. Two new species of *Cloeodes* Traver (Ephemeroptera: Baetidae) from Espírito Santo, Southeastern Brazil. *Zootaxa* 3058: 1-21.
- NIETO C. & R. BARTON. 2008. The genus *Cloeodes* (Ephemeroptera: Baetidae) in Argentina with new generic synonymy and new species. *Zootaxa* 1721: 1-21.
- NIETO C. & D. EMMERICH. 2011. Three new species of the genus *Cloeodes* Traver (Ephemeroptera: Baetidae) from Uruguay. *Zootaxa* 2996: 57-65.
- VAN DAMME P. A., C. HAMEL, A. AYALA & L. BERVOETS. 2008. Macroinvertebrate community responses to acid mine drainage in rivers of the High Andes (Bolivia). *Environmental Pollution* 156: 1061-1068.
- WALTZ R. D. & W. P. McCAFFERTY. 1987. Generic Revision of *Cloeodes* and description of two new Genera (Ephemeroptera: Baetidae). *Proceedings of the Entomological Society of Washington* 89 (1): 177-184.