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Isoperla berthelemyi and *Protonemura phoenicia* spp. n., two new species of stoneflies from Lebanon [Insecta : Plecoptera]

by Ignac SIVEC* & Aref DIA**[1]

* Slovenian Museum of Natural History, Presernova 20, 1000 Ljubljana, Slovenia
** Faculty of Sciences 1, Lebanese University and National Council for Scientific Research, Beirut - Lebanon

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Keywords : Plecoptera, Perlodidae, *Isoperla berthelemyi*, Nemouridae, *Protonemura phoenicia*, imagines, ecology, Lebanon.

During ecological studies on stoneflies of Lebanon, two new and undescribed species were discovered. A detailed description of the male and female imagines of *Isoperla berthelemyi* sp. n., and *Protonemura phoenicia* sp. n. is given. *I. berthelemyi* larvae live in stony bottoms rich in silt from crenal to hyporhithral. *P. phoenicia* is a cold stenotherm species restricted to headwaters and streams near to their springs (crenal and epirhithral).

***Isoperla berthelemyi* sp. n. et *Protonemura phoenicia* sp. n., deux espèces nouvelles de Plécoptères du Liban [Insecta : Plecoptera]**

Mots-clés : Plecoptera, Perlodidae, *Isoperla berthelemyi,* Nemouridae, *Protonemura phoenicia*, imagos, écologie, Liban.

Au cours d'études écologiques sur les Plécoptères du Liban, deux espèces nouvelles et non décrites ont été découvertes. Une description détaillée des adultes mâles et femelles d'*Isoperla berthelemyi* sp. n. et de *Protonemura phoenicia* sp. n. est présentée. Les larves d'*I. berthelemyi* vivent sur substrats pierreux riches en sédiments fins depuis le crénal jusqu'à l'hyporhithral. *P. phoenicia* est une espèce sténotherme d'eaux froides dont la répartition est limitée aux sources et aux émissaires de sources (crénal and épirhithral).

1. Introduction

Stonefly fauna in the territory of Lebanon is still incompletely known. Only 15 taxa belonging to 7 genera were recorded so far (BERTHÉLEMY & DIA 1982 ; ALOUF 1991). The first species from this area, described by NAVAS (1909), was *Marthamea beraudi*. The next contribution, presented by AUBERT (1964), was based on material preserved in the Natural History Museum in Vienna. Among them there were two species in the genus *Protonemura*, and one species in the genus *Isoperla*. Several additional species were described by ZWICK (1972), BERTHÉLEMY & DIA (1982) and ALOUF (1992).

From the recent ecological studies in the last years we found out the faunistical picture of Lebanese stonefly fauna is still not complete. In this paper we present two additional new species.

2. *Isoperla berthelemyi* sp. n. : description

STUDY MATERIAL

1) Oronte River catchment, North Bekaa

Male holotype : Aïn Zarka, 660 m elevation, 14.7.1985 ; paratypes : Aïn Zarka, 14.7.1985, 1 F ; 28.9.1984, 1 M, 4 F ; 28.10.1984, 2 M ; Oronte at jisr Hermel (= Abdel Hadi), 610 m elevation, 21.9.1984, 1 M ; 29.9.1984, 1 M ; 16.11.1986, 1 F ; Oronte near Chwaghir village (= Zouitini), 570 m elevation, 26.5.1985, 1 M, 1 F ; 28.9.1984, 1 F.

2) Aouali River catchment, Southern Lebanon

Ras el-Aîn (= st. 14 in Dia 1983), 805 m elevation, 3.4.1982, 1 F ; Nabaa Abou Kharma (= st. 16 in Dia 1983), 850 m elevation, 5.3.1980, 2 N.

The male holotype and some paratypes are deposited in the Slovenian Museum of Natural History in Ljubljana, Slovenia. Other paratypes (2 M, 2 F) are temporarily housed in the personal collection of the junior author (Lebanon University, Faculty of Sciences 1, Beirut).

Medium sized, pale yellowish coloured species. Length of fore wings : male, 9 mm ; female, 10 mm.

Head pattern indistinct (Fig. 1), slightly darkened in the ocellar triangle. Pronotum (Fig. 1) pale with brown rugosity. Basal segment of antennae brown, further segments pale, distally brown. Palpi and legs pale.

MALE (Figs 1, 2 ; Photo 1)

Vesicle on sternite VIII widely rounded and short (Fig. 2). Penial sack with complicated structure of several sclerotized folds of a different size without any spines (Photo 1).

FEMALE (Fig. 3)

Nearly without produced subgenital plate (Fig. 3). Eggs oval with distinct collar (Fig. 4).

AFFINITIES

By the structure of penis armature *I. berthelemyi* is completely different from *I. libanica*, of which only the male was described. According to ZWICK (1978), *I. libanica* belongs to the *lesbica* group. However in our material there were two types of females, both without distinct and produced subgenital plate (what should be characteristic of *I. lesbica* group). Contrary to *I. berthelemyi*, eggs of the second type of females are without collar.

There were several larvae in the collection together with the adults. However as far as two species of *Isoperla* are present, and the larva of *I. libanica* is not described as well, we hesitate to present a detailed description of the larval stages.

ETYMOLOGY

The species is named after the late Prof. C. Berthélemy who worked also on stoneflies of Lebanon.

3. *Protonemura phoenicia* sp. n. : description

STUDY MATERIAL

1) Nahr Ibrahim catchment, Central Lebanon

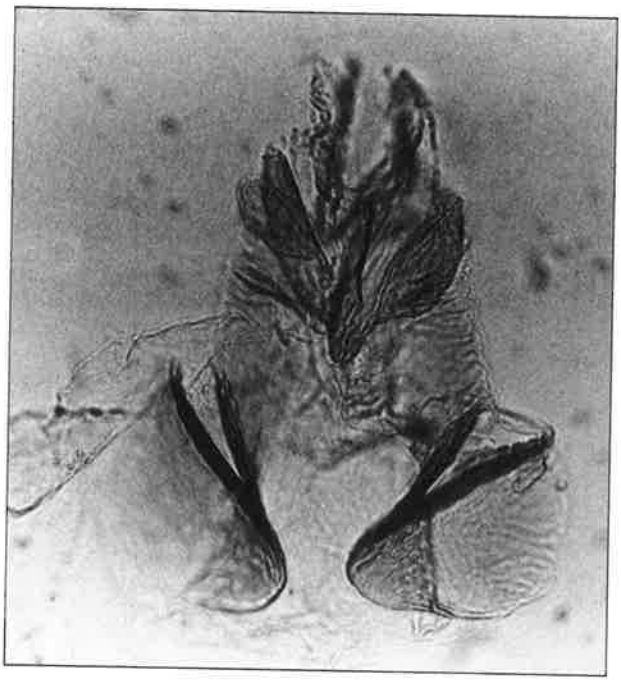


Photo 1. *Isoperla berthelemyi* sp. n. : armature of penial sack.
Photo 1. *Isoperla berthelemyi* sp. n. : armature du sac pénien.

Male holotype : Afqa Spring, downstream of the bridge, near the village Afqa, 1150 m elevation, 6 kilometers southeast of the small town of Qartaba. 6.11.1994 ; paratypes : Afqa Spring, 6.11.1994, 51 M, 26 F ; 23.10.1994, 2 M, 1 F.

2) Nahr Qâdîcha-Abou Aali catchment, Northern Lebanon

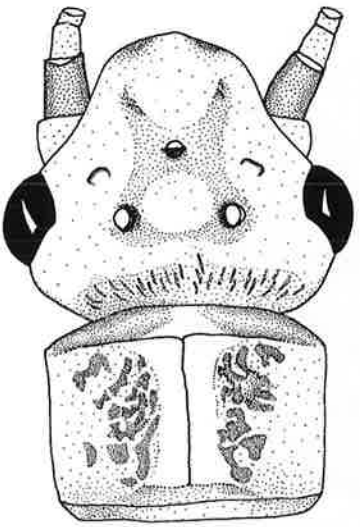
Qâdîcha Spring, 19.11.1995, 1 F ; downstream of the Qâdîcha Spring, about 500 m upstream of Bcherré village, about 1500 m elevation, near the famous Cedars of Lebanon, 19.11.1995, 1 M ; 10.10.1995, 5 M, 3 F.

The male holotype and some paratypes are deposited in the Slovenian Museum of Natural History in Ljubljana, Slovenia. Other paratypes (5 M, 5 F from the holotype locality) are temporarily housed in the personal collection of the junior author (Lebanon University, Faculty of Sciences 1, Beirut).

Brownish coloured species. Length of fore wings : males, 11 mm ; females, 12,5 mm.

Head (Fig. 5) brown with a wide pale band behind the eyes. Antennae brown, slightly darker at base and paler behind.

Pronotum (Fig. 5) paler than head with a distinct dark pattern. Legs brown with darker distal end of femora. Gills (Fig. 6) simple without constriction. Abdomen pale, soft, except well sclerotized terminal segments.



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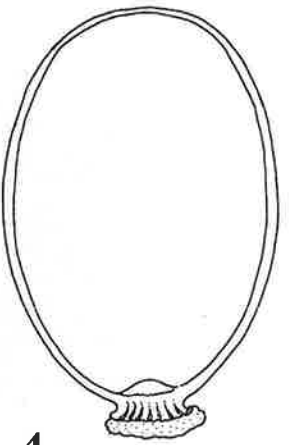

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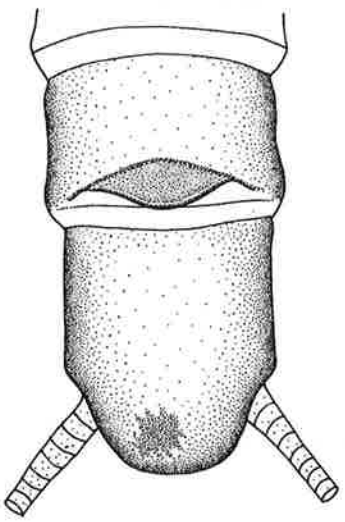

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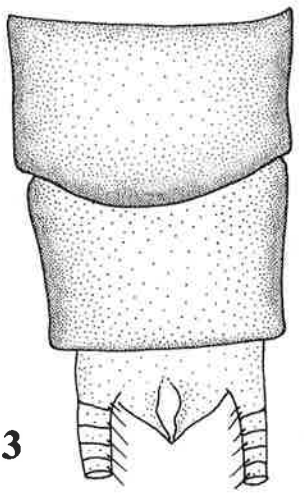

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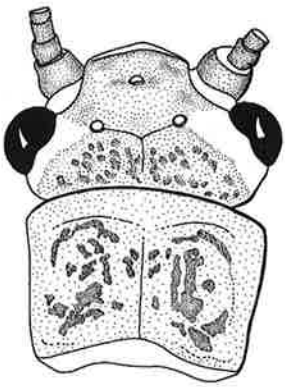
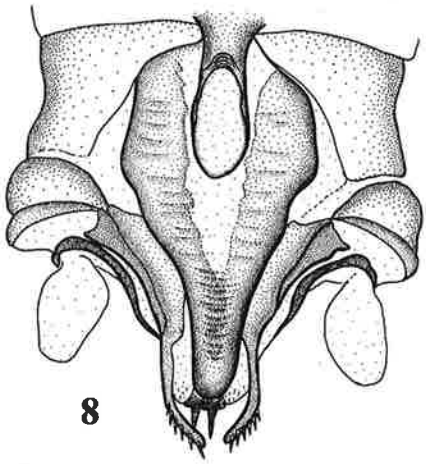
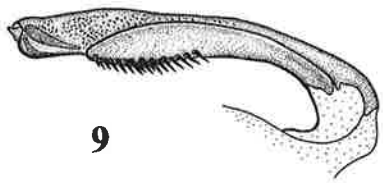
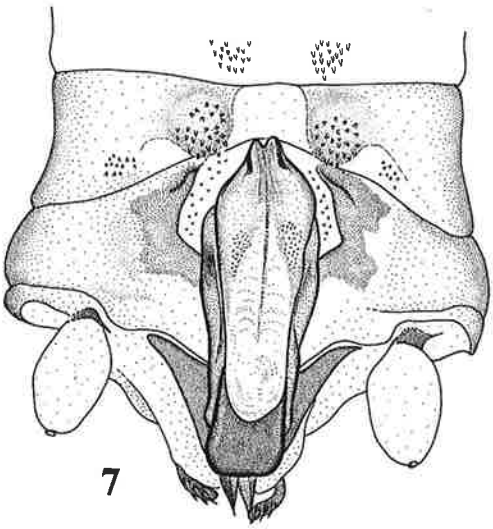
Figs 1-4. *Isoperla berthelemyi* sp. n. : 1, head and pronotum of male adult ; 2, tip of male abdomen in ventral view ; 3, tip of female abdomen in ventral view ; 4, egg.

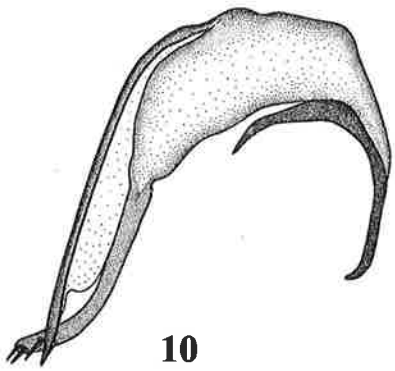
Figs 1-4. *Isoperla berthelemyi* sp. n. : 1, tête et pronotum de l'adulte mâle ; 2, extrémité de l'abdomen du mâle en vue ventrale ; 3, extrémité de l'abdomen de la femelle en vue ventrale ; 4, œuf.











Figs 5-10. *Protonemura phoenicia* sp. n. : 5, head and pronotum, and 6, cervical gills of male adult ; 7, tip of male abdomen in dorsal view ; 8, tip of male abdomen in ventral view ; 9, epiproct in lateral view ; 10, left paraproct.

Figs 5-10. *Protonemura phoenicia* sp. n. : 5, tête et pronotum, et 6, branchies cervicales de l'adulte mâle ; 7, extrémité de l'abdomen du mâle en vue dorsale ; 8, extrémité de l'abdomen du mâle en vue ventrale ; 9, épiprocte en vue latérale ; 10, paraprocte gauche.

MALE (Figs 5 to 10)

Tergite VIII (Fig. 7) with two separate groups of stronger spines medially on the posterior margin. Tergite IX with a median bilobed expansion covered with strong spines. Sternite IX (Fig. 8) normal, distally extended into a long and narrow subgenital plate, basally with ovally extended shape well developed vesicle. Tergite X with a few scattered spines medially around tip of the epiproct. Epiproct (Fig. 9) simple, long and thin in lateral view with an indistinct terminal filament. Lateral sclerites thin, thread like, gently curved upwards near the epiproct tip. Ventral sclerite wide, ventral half of sclerite bearing strong short spines. Paraprocts (terminology of Baumann, 1975) (Fig. 10) : inner lobes hidden by the subgenital plate, pointed, strongly sclerotized, nearly as long as the tip of median lobe. Middle lobe of paraprocts narrow, strongly sclerotized, much longer than a small membranous apical lobe, extending into a long gently curved rode with a raw of strong spines on its apical part. Outer lobes mostly sclerotized, elongate and recurved dorsally alongside cerci. Cerci membranous, short and unmodified.

FEMALE (Fig. 11)

Sternite VII (Fig. 11) only with a weak and indistinct postero-median pregenital plate. Sternite VIII supporting a large bilobed horn like subgenital plate. By the shape it is close to *Protonemura cressa* Zwick from Crete, but it distinctly differs in the shape of horn like lobes.

NYMPH (Figs 12, 13)

General shape of nymphs and setation are very distinct, and similar to *P. pectinata* Berthélemy and Dia by the very long and pointed setae along the edges of pronotum (Fig. 12), and on the posterior margins of tergites (Fig. 13).

AFFINITIES

P. phoenicia belongs to the *corsicana* group as defined by AUBERT (1964), which has a circum mediterranean distribution. Female is most similar to *P. cressa* Zwick, 1978 from Crete, however the male of this species, described later (ZWICK 1996), is completely different from the new species by the shape of paraproct lobes, and epiproct. This distinctly separates *phoenicia* also from all other *Protonemura* species of the group.

Nymphs are characteristic by their very long setae on the pronotum and rear margins of tergites. They are very close to the nymphs of *P. pectinata* Berthélemy and Dia, and at the present we are not able to separate these two species.

ETYMOLOGY

This species is named in reference to a major historical name of Lebanon.

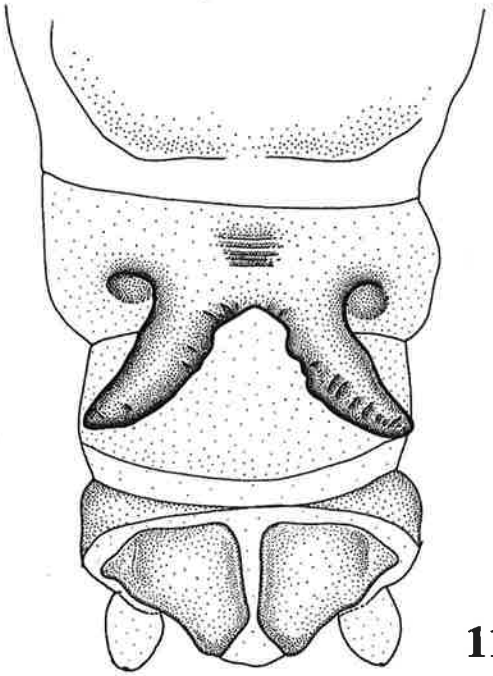
4. Ecology

4.1. *I. berthelemyi*

Larvae live preferently on stony bottoms rich in fine deposits (silt) with leaf detritus. In the Aouali tributary older larvae, never abundant, were sampled from March to June. Imagines were caught on riparian herbaceous vegetation from April onwards ; the males are particularly active and fast flying.

The flight period is quite different according to the catchments and climate.

In the Aouali river system (humid et subhumid climate), the species flies in Spring (March-April). On the contrary, in the Oronte river system (arid climate), *I. berthelemyi* flies in Summer and Autumn (from late May to mid-November).



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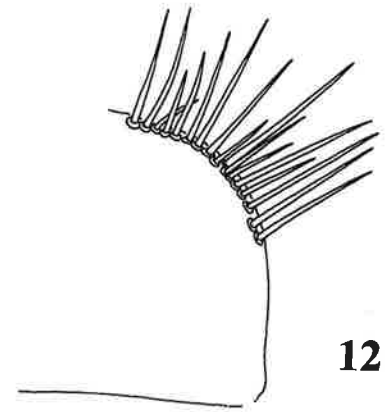

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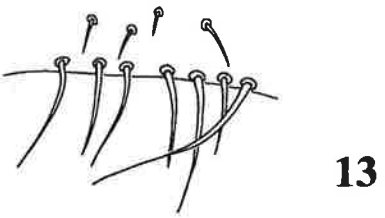

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Figs 11-13. *Protonemura phoenicia* sp. n. : 11, terminal segments of female in ventral view ; 12, part of lateral margin of nymphal pronotum ; 13, part of posterior margin of nymphal fifth tergite.

Figs 11-13. *Protonemura phoenicia* sp. n. : 11, segments terminaux de la femelle en vue ventrale ; 12, vue partielle du bord latéral du pronotum nymphal ; 13, vue partielle du bord postérieur du 5e tergite nymphal.

In fact, *I. berthelemyi* was discovered long ago but could not be named in the absence of males (= *Isoperla* sp., C. Berthélemy det. in DIA 1983). *I. berthelemy* is a cool-adapted species living from crenal to hyporhithral. It is semistenotherm (annual water temperature range : 13°-18°C, DIA 1983, 1993) and was found living together with *Protonemura zernyi* and *Leuctra kopetdaghi* in two stations (Abdel Hadi, Oronte catchment ; Ras-el-Aïn, Aouali catchment). A very interesting fauna colonizes the Oronte river and, for instance, in the same sites two new species of mayflies were discovered recently (see MARIE, DIA & THOMAS 1999 and 2000). *Isoperla berthelemyi* lives at moderate elevation (range : 570 to 850 m a.s.l. ; mean slope : 1 to 5 %), and anyway is less alticolous than *I. libanica* Aubert, found at 1400 m a.s.l. (J. Aubert leg., then A. Dia leg.). *I. berthelemyi* is rather rheophilic but shows a great tolerance regarding current velocity (range : 23-120 cm/s) : so in the Aouali catchment, by low waters, this species can survive in spite of low current speed.

4.2. *P. phoenicia*

The geographical distribution of *P. phoenicia* appears restricted to the Western Slope of Mount Lebanon (North and Central Lebanon). Vegetation belongs to the supramediterranean series *Quercus calliprinos, Q. infectoria, Q. cerris* and *Platanus orientalis* (1000/1100 to 1500/1600 m a.s.l.). Mean annual rainfall : 1200 mm.

P. phoenicia was found in the main rheocren springs of two adjacent catchments. These high discharge springs correspond to the resurgence of subterranean rivers belonging to a system of karstic caves (Cenomanian limestone).

The flight period is autumnal and short (five weeks). It corresponds to the end of the dry period, and the beginning of rainfall and rise of the water table.

Abiotic parameters

Nahr Ibrahim catchment :

Afqa Spring is the main spring of the Nahr Ibrahim stream. It is the main sampling site for this species. Elevation : 1150 m a.s.l. Slope : 14 %. Width at the sampling period (low water) : 2-3 m. Discharge : 0,9 m^3/s by low water (July-October) ; mean annual value : 2,8 m^3/s.

Nahr Qâdicha-Abou Ali catchment :

About 500 m downstream of the main spring of the Nahr Qâdicha [downstream the river is named Abou Aali]. Slope exceeding 25 %. Mean annual discharge range : 1,5 m^3/s. Width (low water) : 3-4 m.

The two sites exhibit a large diversity of substrates : rocks, boulders, cobbles, gravel, sand, silt, leaf detritus, very abundant aquatic mosses and filamentous encrusting algae. Boulders and cobbles are the main habitat of *P. phoenicia* larvae. This species is typically cold stenotherm (water temperature, year round : 8-10°C) and restricted to head waters : cold streambrooks near their source, with a high discharge, but it was found at moderate current speed. Altitudinal range : 1150-1500 m.

Acknowledgements

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