

FIRST RECORDS OF THE ALPINE STONEFLY SPECIES *PROTONEMURA JULIA* NICOLAI, 1983 (INSECTA, PLECOPTERA) IN CROATIA

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The known geographical distribution of the stonefly species *Protonemura julia* Nicolai, 1983 (Nemouridae, Amphinemurinae) has been considerably extended with new records from Croatia. For the first time, this so-called endemic species of the Italian Julian Alps was found in the mountainous region Gorski kotar (north-western Croatia), at Čabranka River spring area in summer 2006. The first record of the species was reconfirmed on the next field trip in autumn 2006, and it was additionally found at Gerovčica Stream spring area. The new records reported here are the southernmost findings of *P. julia*, confirming indications that some springs in the Gorski kotar area serve as microrefugia for cold stenothermic species.

Key words: *Protonemura julia* Nicolai, Plecoptera, alpine endemic species, Croatia, Gorski kotar

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Poznata geografska rasprostranjenost obalčara *Protonemura julia* Nicolai, 1983 (Nemouridae, Amphinemurinae) značajno je proširena novim nalazima u Hrvatskoj. Ova endemska vrsta talijanskih Julijskih Alpa pronađena je u ljeto 2006. u Gorskom kotaru (sjeverozapadna Hrvatska), na izvorišnom području rijeke Čabranke. Njena prisutnost potvrđena je terenskim istraživanjem vodenih kukaca istog područja i u jesen iste godine, kada je dodatno pronađena i na izvorišnom području Gerovčice. Novi nalazi, opisani u ovom radu, predstavljaju najjužnije poznate nalaze ove vrste obalčara te potvrđuju naše pretpostavke da neki izvori u Gorskom kotaru predstavljaju mikrorefugije za neke stenotermne vrste hladnih voda.

Ključne riječi: *Protonemura julia* Nicolai, Plecoptera, obalčari, alpski endem, Hrvatska, Gorski kotar

INTRODUCTION

The stonefly fauna of Croatia is poorly known with only 28 species so far officially recorded (SIVEC, 1980; 1985), based on reliable determination of adult insects and eggs. Most likely, this number represents just a small part of the species present in Croatia, because about 100 stonefly species are known for the neighbouring Slovenia, (SIVEC, 2001), making Slovenia one of the areas with the richest and most diverse stonefly fauna in Europe.

Because Croatia borders several limno-geographical regions of Europe (ILLIES, 1978), many additional stonefly species should be found in future, including some species new to science.

One of the most zoogeographically interesting regions of Croatia should be the poorly inhabited mountainous region Gorski kotar, where the north-western border of Croatia and Slovenia is situated. It seems there are some microrefugia for cold stenothermic species, as at the Čabranka River spring area (HORVAT, 1995; MALICKY *et al.*, 2007; PREVIŠIĆ *et al.*, 2009).

In the European Alps, only four endemic *Protonemura* species are recently known: *P. nimborella* (Mosely, 1930), *P. bipartita* Consiglio, 1962, *P. algovia* Mendl, 1968 and *P. julia* Nicolai, 1983 (VINÇON & RAVIZZA, 2005).

P. julia was described from the Italian Julian Alps (NICOLAI, 1983), close to the Italian-Slovenian border, and in Italy it is known only from the type locality (FOCHETTI *et al.*, 1998; FOCHETTI & DE FIGUEROA, 2006). Therefore, it is generally considered as an endemic species of the Alps (VINÇON & RAVIZZA, 2005), Italy (FOCHETTI, 2007), northern Italy (STOCH, 2003), and Italian Julian Alps (FOCHETTI *et al.*, 1998; FOCHETTI & DE FIGUEROA, 2006).

Nevertheless, it was lately also confirmed from Karawanken in southern Austria (Graf & Hutter, 2002), close to the Austrian-Slovenian border, and from several localities in Slovenia (Sivec, unpublished data).

In addition, it was recently found at two karst spring areas in the north-western part of Croatia, the Gorski kotar region.

MATERIAL AND METHODS

Adult specimens of *P. julia* were observed on June 18, 2006 and October 15, 2006 in northern Gorski kotar (Fig. 1). The specimens were collected manually and with an entomological net. All samples were fixed in 80% ethyl alcohol. In the laboratory they were analyzed under a stereomicroscope and stored in 80% ethyl alcohol. Identification of the species based on morphological characteristics of the male and female genitalia was done through comparison with the original description from NICOLAI (1983). Nomenclature and systematics are according to ZWICK (1973) and DEWALT *et al.* (2009). Specimens here reported (ten males and thirty females) are kept in the Popijač stonefly collection at the Department of Zoology, Division of Biology, Faculty of Science, University of Zagreb.



Fig. 1. Locations of the *Protonemura julia* Nicolai, 1983 records (1 and 2) in Croatia.



Fig. 2. Čabranka River spring area (549 m a.s.l.) – first locality of *Protonemura julia* Nicolai, 1983 in Croatia (Photo: A. Previšić).



Fig. 3. Gerovčica Stream spring area (467 m a.s.l.) – second locality of *Protonemura julia* Nicolai, 1983 in Croatia (Photo: A. Previšić).



Fig. 4. *Protonemura julia* Nicolai, 1983 – male imago (Photo: I. Sivec).

RESULTS AND DISCUSSION

The species *P. julia* (Fig. 4) was found close to the town of Čabar (northern Gorski kotar, north-western Croatia), at Čabranka River spring area (549 m a.s.l.) (Fig. 2), at the border with Slovenia, on June 18, 2006. The first record of the species was reconfirmed on the next field trip on October 15, 2006, when it was additionally found at Gerovčica Stream spring area (467 m a.s.l.), near Zamost village (Fig. 3), close to the border with Slovenia.

Both localities are karst spring areas with rocky stream and with many waterfalls in its course, probably similar to the described type locality in Italian Julian Alps (NICOLAI, 1983).

Our second findings of *P. julia* were much later (mid October) than assumed flight period (from end of spring to early summer) according to NICOLAI (1983), most probably because of the special thermal regime of water at big karst spring areas.

The following stonefly species were also observed with *P. julia* at Čabranka River spring area in June 2006: *Amphinemura sulcicollis* (Stephens, 1836), *Nemoura minima* Aubert, 1946, *Protonemura auberti* Illies, 1954, *Protonemura intricata* (Ris, 1902), *Isoperla rivulorum* (Pictet, 1841) and *Leuctra inermis* Kempny, 1899; and in October 2006: *Protonemura auberti* Illies, 1954, *Protonemura nitida* (Pictet, 1835), *Isoperla* cf. *lugens* (Klapálek, 1923), *Leuctra albida* Kempny, 1899 and *Leuctra mortoni* Kempny, 1899.

Stonefly species *Protonemura autumnalis* Raušer, 1956 and *Leuctra mortoni* Kempny, 1899 were also observed with *P. julia* at Gerovčica Stream spring area in October 2006.

The new records reported here are the southernmost findings of *P. julia*, confirming our assumptions of Gorski kotar as the area with microrefugia for some cold stenothermic species.

Former claims on narrow endemic status of *P. julia* (FOCHETTI *et al.*, 1998; STOCH, 2003; VINÇON & RAVIZZA, 2005; FOCHETTI & de FIGUEROA, 2006; FOCHETTI, 2007) proved to be wrong and today we can see that the geographical distribution of this species spreads from north-eastern Italy (NICOLAI, 1983) and southern Austria (GRAF & HUTTER, 2002) through the large part of Slovenia (Sivec, unpublished data) to the northern border of Croatia. Therefore, future studies of *P. julia* will be focused on determining the complete distribution, ecology, behavioural pattern and exact threat status of this species. Recently, this species was included with DD status (data deficient) on the preliminary Red list of stoneflies of Croatia (POPIJAČ, 2008).

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REFERENCES

- DEWALT, R. E., NEU-BECKER, U. & STEUBER, G., 2009: Plecoptera Species File Online. Version 1.1/3.5. <http://Plecoptera.SpeciesFile.org> (accessed March 15, 2009).
- FOCHETTI, R., 2007: Fauna Europaea: Plecoptera, Stoneflies. Fauna Europaea version 1.3. <http://www.faunaeur.org> (accessed March 15, 2009).
- FOCHETTI, R., DE BIASE, A., BELFIORE, C. & AUDISIO, P., 1998: Faunistica e Biogeografia regionale dei plecoteri Italiani (Plecoptera). *Memorie della Società Entomologica Italiana* **76**, 3–19.
- FOCHETTI, R. & DE FIGUEROA, J. M. T., 2006: Notes on diversity and conservation of the European fauna of Plecoptera (Insecta). *Journal of Natural History* **40** (41-43), 2361–2369.
- GRAF, W. & HUTTER, G., 2002: Neue Daten zur Steinfliegenfauna Österreichs (Insecta, Plecoptera). *Linzer Biologische Beiträge* **34** (2), 1085–1090.
- HORVAT, B., 1995: Checklist of the aquatic Empididae recorded from Slovenia, with the description of one new species (Diptera). *Acta entomologica slovenica* **3** (1), 25–35.
- ILLIES, J., 1978: *Limnofauna Europaea*. (Zweite, überarbeitete und ergänzte Auflage). Gustav Fischer Verlag, Stuttgart.
- MALICKY, H., PREVIŠIĆ, A. & KUČINIĆ, M., 2007: *Rhyacophila cabrankensis* nov. spec. from Croatia. *Braueria* **34**, 14–14.
- NICOLAI, P., 1983: A new species of *Protonemura* from the Italian Julian Alps (Plecoptera, Nemouridae). *Aquatic Insects* **5** (3), 173–176.
- POPIJAČ, A., 2008: Crveni popis obalčara (Plecoptera) Hrvatske. Državni zavod za zaštitu prirode, Zagreb. [Red list of stoneflies (Plecoptera) of Croatia. State Institute for Nature Protection, Zagreb.] http://www.dzpp.hr/eng_redlist.htm (accessed March 15, 2009).
- PREVIŠIĆ, A., WALTON, C., KUČINIĆ, M., MITRIKESKI, P. T. & KEROVEC, M., 2009: Pleistocene divergence of Dinaric *Drusus* endemics (Trichoptera, Limnephilidae) in multiple microrefugia within the Balkan Peninsula. *Molecular Ecology* **18** (4), 634–647.
- SIVEC, I., 1980: Plecoptera. *Catalogus Faunae Jugoslaviae* **III/6**, 1–30.
- SIVEC, I., 1985: Stoneflies (Plecoptera) from the Croatian National Zoological Museum in Zagreb. *Biološki vestnik* **33** (1), 57–60.
- SIVEC, I., 2001: Stoneflies (Plecoptera). In: HLAD, B. & SKOBERNE, P. (eds.), *Biological and Landscape Diversity in Slovenia: an overview*. Ministry of the Environment and Spatial Planning – Environmental Agency of the Republic of Slovenia, Ljubljana. p. 82–83.
- STOCH, F., 2003: Checklist of the Italian fauna. On-line version 2.0. Italian Ministry of Environment. <http://www.faunaitalia.it/checklist> (accessed March 15, 2009).

- VINÇON, G. & RAVIZZA, C., 2005: A review of the French *Protonemura* (Plecoptera, Nemouridae). *Annales de Limnologie – International Journal of Limnology* **41** (2), 99–126.
- ZWICK, P., 1973: *Insecta: Plecoptera. Phylogenetisches System und Katalog. Das Tierreich, Lieferung 94.* Walter de Gruyter, Berlin.

SAŽETAK

Prvi nalazi alpske vrste obalčara *Protonemura julia* Nicolai, 1983 (Insecta, Plecoptera) u Hrvatskoj

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Poznata geografska rasprostranjenost obalčara *Protonemura julia* Nicolai, 1983 (Nemouridae, Amphinemurinae) značajno je proširena novim nalazima u Hrvatskoj. Ova endemska vrsta talijanskih Julijskih Alpa pronađena je sredinom lipnja 2006. godine u Gorskom kotaru (sjeverozapadna Hrvatska), na izvorišnom području rijeke Čabranke (549 m n. m.). Njena prisutnost potvrđena je terenskim istraživanjem vodenih kukaca istog područja i sredinom listopada iste godine, kada je dodatno pronađena i na izvorišnom području Gerovčice (467 m n. m.), kratke pritoke Čabranke.

Novi nalazi, opisani u ovom radu, predstavljaju najjužnije poznate nalaze ove vrste obalčara te potvrđuju naše pretpostavke da neki izvori u Gorskom kotaru predstavljaju mikrorefugije za neke stenotermne vrste hladnih voda.

Kako je vrsta *P. julia* u Italiji poznata samo s tipskog lokaliteta, u znanstvenoj se literaturi smatra endemskom vrstom talijanskih Julijskih Alpa (FOCHETTI *et al.*, 1998; FOCHETTI & DE FIGUEROA, 2006), endemom sjeverne Italije (STOCH, 2003), endemom Italije (FOCHETTI, 2007) te endemom Alpa (VINÇON & RAVIZZA, 2005).

Sve navedene tvrdnje o endemičnosti ove vrste pobijene su ovim nalazima u Hrvatskoj, a koji su također nadovezani na nedavne nalaze ove vrste u Karavankama na jugu Austrije (GRAF & HUTTER, 2002) te brojne nalaze ove vrste u Sloveniji (SIVEC, neobjavljeni podaci). Time se pokazuje da bi stvarni areal ove vrste bio u Sloveniji, a da nalazi u Italiji, Austriji i Hrvatskoj, svuda uz granicu sa Slovenijom, zapravo predstavljaju samo rubne dijelove areala ove vrste. Zato bi i buduća istraživanja vrste *P. julia* trebala imati naglasak na utvrđivanju stvarne rasprostranjenosti i karakteristika staništa, te svih čimbenika koji utječu na rasprostranjenost i ugroženost ove vrste. Zbog nedostatka takvih detaljnijih podataka o ovoj vrsti, ona trenutno i ima DD (data deficient) status ugroženosti na nedavno izrađenom preliminarnom crvenom popisu obalčara u Hrvatskoj (POPIJAČ, 2008).