

# Mayflies (Ephemeroptera) of the River Vjosa, Albania

Ernst BAUERNFEIND

Ephemeroptera material (larvae and winged stages) from the lower course of the River Vjosa (Vjosë), Albania, was collected during several collecting trips between 2014–2017 by different working groups. A total of 34 taxa, 23 of them new for the mayfly fauna of Albania, were identified. The presence of several rare and highly sensitive taxa (e.g., *Prosopistoma pennigerum*) as well as the high species diversity confirm the exceptional importance of the River Vjosa not only for Albania but also in a European context.

## **BAUERNFEIND E., 2018: Eintagsfliegen (Ephemeroptera) der Vjosa, Albanien.**

Während mehrerer Exkursionen am Unterlauf des Flusses Vjosa (Vjosë), Albanien, wurden zwischen 2014–2017 von verschiedenen Arbeitsgruppen Eintagsfliegen (Ephemeroptera) in allen Stadien (Larven, Subimagines, Imagines) gesammelt. Insgesamt konnten 34 Taxa identifiziert werden, von denen 23 neu für die Fauna Albanien sind. Das Auftreten mehrerer seltener und hoch empfindlicher Arten (z. B. *Prosopistoma pennigerum*), sowie die insgesamt hohe Diversität bestätigen eindrucksvoll die herausragende Bedeutung des Vjosa Flußsystems nicht nur für Albanien sondern ebenso in einem gesamteuropäischen Kontext.

**Keywords:** Ephemeroptera, mayflies, River Vjosa, Vjosë, Albania.

## Introduction

Mayflies (order Ephemeroptera) are pterygote hemimetabolous insects with aquatic larvae almost exclusively inhabiting freshwater habitats (rarely brackish waterbodies), where they occupy a wide variety of niches from the crenalic to the potamalic river sections. Larvae are mostly grazers-scrappers and collectors-gatherers, while some specialised taxa developed active and passive filter feeding and (rather exceptionally) predaceous habits. The presence of a subimaginal winged instar, characteristic for Ephemeroptera, is unique within recent pterygote insects.

Larval communities may reach high densities (up to 3,000–6,500 ind./m<sup>2</sup> river bottom; IDE 1940, WILLIAMS 1980) and exhibit considerable species richness in ecologically undisturbed rivers (BAUERNFEIND & MOOG 2000). They represent essential elements in most benthic communities, regarding nutrient cycling and trophic transfers (FERRO & SITES 2007). Together with Plecoptera and Trichoptera (EPT-taxa) they are considered to represent valuable indicators for various environmental parameters and, accordingly, are used for the assessment and long-term monitoring of biological water quality (BUFFAGNI et al. 2001, MOOG & HARTMANN 2017).

The mayfly fauna of Albania is still poorly known (SARTORI 2001, 49). Approximately 370 nominal species of Ephemeroptera are so far known for Europe (BAUERNFEIND & SOLDÁN 2012), about 130 taxa have been recorded from the Balkans (PUTHZ 1978, PUTHZ 1980, ZABRIĆ & SARTORI 1997, BAUERNFEIND 2003, KOVÁCS & MURÁNYI 2013, ČUK et al. 2015, PETROVIĆ et al. 2015, VILENICA et al. 2015), including 32–35 for Albania (PUTHZ 1980, KOVÁCS & MURÁNYI 2013). The compilation of Ephemeroptera species for Albania in HERSHKOVITZ et al. (2015, electronic version), listing 133 taxa, is not based on published country records or reference specimens and is therefore of rather limited value; its inferences to the supposed vulnerability of mayfly taxa to climate change have been drawn

from insufficient – and partly erroneous – data. No records of Ephemeroptera on species level have been published so far for the River Vjosa, but an overview on family and genus level has been provided by BEQIRAJ et al. (2008) and CHATZINIKOLAOU et al. (2008). The present investigation increases the number of Ephemeroptera taxa recorded in Albania to 56 (plus 3 unconfirmed records), 34 of them recorded at the river Vjosa.

Identification of mayfly taxa in the Balkans is often problematic and we are still far from a thorough understanding of Ephemeroptera taxonomy in this area. Many taxa are only known from original descriptions that are inadequate for modern taxonomic standards, and in several cases only a single stage (larva or adult) has been described. The frequently used keys constructed for the identification of West European (ELLIOTT & HUMPESCH 1983, ELLIOTT & HUMPESCH 2010) and Central European mayflies (STUEDEMANN et al. 1992, BAUERNFEIND & HUMPESCH 2001, BAUERNFEIND & LECHTHALER 2014) do not include taxa endemic to the Balkans and unsophisticated use in this area may easily lead to misidentifications.

### Study area

The area under investigation was the Vjosa riverine floodplain in southwestern Albania. Collecting sites were situated around the villages Kashisht (40°35'N 19°32'E), Poçemi (40°30'N 19°43' E), Kuta (Kutë, 40°23'N 19°43'E) and in the tributary Drino River near its union with the Vjosa, 3 km southeast Tepelena (Tepelenë, ca. 40°16'N 20°03'E). Habitat types sampled for larvae included the main channel, side channels, erosion pools, and oxbows. Imagines were collected mainly from open gravel, pioneer vegetation, and riparian wetlands. Field trips were conducted on 14.6.2014, 8.10.2016, 24.4.-26.4.2017, 17.9.-23.9.2017 and 6.10.-8.10.2017.

### Material and Methods

Winged specimens (subimagines, imagines) were collected by sweep net and larvae were collected by live-sorting benthic samples taken with a 500µm net. Specimens were fixed and stored in 75% ethanol, permanent microscopical slides were prepared for most taxa (standard preparation after MÜLLER-LIEBENAU 1969, 11), mounting medium Liquid de Faure, modification after KÜHNELT (ADAM & CZIHAK 1964, 163). The material was deposited at the Natural History Museum Vienna, Austria (Naturhistorisches Museum Wien, NHM). Some voucher specimens were deposited at the University of Natural Resources and Life Sciences Vienna, Austria (Universität für Bodenkultur, BOKU). Nomenclature follows BAUERNFEIND & SOLDÁN (2012).

## Results

Tab. 1: Species list – taxa collected. Abbreviations: L – larva, N – nymph (= last instar larva), ♂ – male imago, ♀ – female imago, SI – subimago, + – endemic to the Balkans, X – new for Albania. See figures 1–4. – Tab. 1: Liste der gesammelten Arten. Abkürzungen: L – Larve, N – Nymphe (= schlüpfreifes letztes Larvenstadium), ♂ – Männchen Imago, ♀ – Weibchen Imago, SI – Subimago, + – Balkanendemit, X – neu für Albanien. Siehe Abbildungen 1–4.

<b>Siphonuridae Ulmer, 1920 (1888)</b> <i>Siphonurus (Siphonurus) lacustris</i> EATON, 1870	L, N		
<b>Baetidae Leach, 1815</b> <i>Baetis (Baetis)</i> sp. nov. (near <i>Baetis nexus</i> NAVÁS, 1918) <i>Baetis (Baetis) beskidensis</i> SOWA, 1972 <i>Baetis (Baetis) ? lutheri</i> MÜLLER-LIEBENAU, 1967 <i>Baetis (Baetis) meridionalis</i> IKONOMOV, 1954 <i>Baetis (Nigrobaetis) muticus</i> (LINNAEUS, 1758) <i>Baetis (Rhodobaetis) rhodani</i> (F.J. PICTET, 1843) <i>Centroptilum luteolum</i> (O. F. MÜLLER, 1776) <i>Cloeon (Cloeon) dipterum</i> (LINNAEUS, 1761) <i>Procloeon (Procloeon) bifidum</i> (BENGTSSON, 1912) <i>Procloeon (Pseudocentroptilum) ? romanicum</i> (BOGOESCU, 1951) <i>Procloeon (Pseudocentroptilum) pennulatum</i> (EATON, 1870)	L L, N, ♂ L, N, SI, ♀ L, N L L L L, ♂, ♀ L, N L L, N	+   +    +  +	X X X      X X X
<b>Oligoneuriidae Ulmer, 1914</b> <i>Oligoneuriella rhenana</i> (IMHOFF, 1852)	L		
<b>Heptageniidae Needham, 1901</b> <i>Ecdyonurus (Ecdyonurus) aurantiacus</i> (BURMEISTER, 1839) <i>Ecdyonurus (Ecdyonurus) puma</i> JACOB & BRAASCH, 1986 <i>Heptagenia (Heptagenia) longicauda</i> (STEPHENS, 1836) <i>Heptagenia (Heptagenia) sulphurea</i> (O.F. MÜLLER, 1776) <i>Rhithrogena neretvana</i> TANASJEVIĆ, 1985 <i>Rhithrogena bulgarica</i> BRAASCH, SOLDÁN & SOWA, 1985 <i>Rhithrogena zernyi</i> BAUERNEFIND, 1991	L, N, SI, ♂, ♀ L, N, SI, ♂, ♀ L, N L N, ♂ L, N ♂	+    + + +	X X   X X X
<b>Leptophlebiidae Banks, 1900</b> <i>Choroterpes (Choroterpes) picteti</i> (EATON, 1871) <i>Habrophlebia eldae</i> JACOB & SARTORI, 1984 <i>Pavaleptophlebia submarginata</i> (STEPHENS, 1836)	L L, N, ♂, ♀ L		X X X
<b>Ephemerellidae Klapálek, 1909</b> <i>Ephemerella ignita</i> (PODA, 1761) <i>Ephemerella maculocaudata</i> IKONOMOV, 1961 <i>Serratella ikononomovi</i> (PUTHZ, 1971) <i>Torleya major</i> (KLAPÁLEK, 1905)	L, SI, ♂, ♀ L, ♀ L L	+ +	X   X
<b>Caenidae Newman, 1853</b> <i>Brachycercus (?) harrisellus</i> CURTIS, 1834 <i>Caenis macrura</i> STEPHENS, 1836 <i>Caenis pseudorivulorum</i> KEFFERMÜLLER, 1960 <i>Caenis pusilla</i> NAVÁS, 1913 <i>Caenis rivulorum</i> EATON, 1884	L N, ♂ N, ♂ L, N L		X X X X X
<b>Neophemeridae Traver, 1935</b> <i>Neophemera maxima</i> (JOLY, 1870)	L		X
<b>Prosopistomatidae Laméere, 1917</b> <i>Prosopistoma pennigerum</i> (O.F. MÜLLER, 1785)	L		X



Fig. 1: *Ecdyonurus aurantiacus* ♂ Subimago (W. GRAF phot.).



Fig. 2: *Ecdyonurus aurantiacus* ♂ Imago (W. GRAF phot.).



Fig. 3: *Ephemerella maculocaudata* ♀ Imago (G. KUNZ phot.).



Fig. 4: *Ephemerella ignita* ♀ Imago with egg sac.  
– Abb. 4: *Ephemerella ignita* ♀ Imago mit Eiballen (G. KUNZ phot.).

## Discussion

**Remarks on identification:** *Baetis* (*Baetis*) sp. nov. (near *Baetis nexus* NAVÁS, 1918). The new taxon appears closely related to *Baetis nexus* NAVÁS (= *Baetis pentaplebodes* UJHELYI, 1966 sensu MÜLLER-LIEBENAU, 1969) in the larval stage, characterised i.a. by numerous strong conical bristles on abdominal sterna, but differs in some respects (e.g., setation of femora, details of mouthparts; the outer maxillary incisor group closely resembling the situation in *Baetis liebenauae* KEFFERMÜLLER, 1974). A formal description, however, should be based on more complete material including the winged stages.

*Baetis* (*Baetis*) *beskidensis* SOWA, 1972. Larvae closely resemble *B. fuscatus* (LINNAEUS, 1761) but differ in the structure of both mandibles (a small subapical tooth on outer margin of outer incisor group). In male imagines, turbinate eyes rather greenish-yellow (bright lemon yellow in *B. fuscatus*). The taxon was originally described from the eastern part

of the Polish Carpathians; subsequent records include Slovakia (DEVÁN 1991), Ukraine (GODUNKO & KOVÁCS 2008), and Romania (KOVÁCS & MURÁNYI 2013).

*Baetis* (*Baetis*) ? *lutheri* MÜLLER-LIEBENAU, 1967. The material from the Vjosa differs slightly from central European specimens, reminding in some respects of *Baetis* (*B.*) *mirkae* SOLDÁN & GODUNKO, 2008 (e.g., a tendency towards strong reduction of segments of the terminal filament). Differences, however, may still be considered to fall within the variation of nominal *Baetis lutheri* MÜLLER-LIEBENAU.

*Procloeon* (*Pseudocentropilum*) ? *romanicum* (BOGOESCU, 1951). Differences between *Procloeon* (*P.*) *nana* (BOGOESCU, 1951) and *P.* (*P.*) *romanicum* (BOGOESCU, 1951) are rather small, and the latter has frequently been considered to represent a junior subjective synonym of the former. No imaginal material was available and identification of the material from the Vjosa must be considered provisional. For a more detailed discussion see BAUERNFEIND & SOLDÁN (2012: 214 ff.).

*Ecdyonurus* (*Ecdyonurus*) *puma* JACOB & BRAASCH, 1986. The taxon was so far only known from the R. Morača, Montenegro. In all stages rather closely resembling *Ecdyonurus* (*E.*) *ruffii* GRANDI, 1953. Variation and several details of taxonomic characters are so far, however, only imperfectly known for both taxa.

*Rhithrogena neretvana* TANASIJEVIĆ, 1985. The taxon belongs to the *Rhithrogena alpestris* species-group and has so far only been known from the lower course of the River Neretva, Bosnia-Herzegovina. Larval characters have thus far not been described.

*Rhithrogena bulgarica* BRAASCH, SOLDÁN & SOWA, 1985. The taxon belongs to the *Rhithrogena diaphana* species-group and has so far only been known from Bulgaria and Greece. Larvae, however, closely resemble *Rhithrogena savoiensis* ALBA-TERCEDOR & SOWA, 1987 and may sometimes have been confused (see also discussion in Vilenica et al. 2015, 121). In male last instar larvae, the characteristic short, broad, and strongly curved titillator is usually already well discernible.

*Rhithrogena zernyi* BAUERNFEIND, 1991. The taxon belongs to the *Rhithrogena diaphana* species-group and has so far only been known from its type locality (Mostar) in Bosnia-Herzegovina. Larval characters have thus far not been described. Colouration pattern and shape as well as size of titillator are characteristic for male imagines.

*Brachycercus* (?) *harrisellus* CURTIS, 1834. Only a single young larva was collected, and characters separating *B. harrisellus* from *Brachycercus europaeus* were not yet sufficiently developed to allow for unambiguous identification.

**Aspects concerning distribution, ecology, and conservation:** From a distributional point of view, the Ephemeroptera taxa collected from the River Vjosa may easily be divided into three groups: (1) taxa endemic to the Balkans (see table 1), (2) potamallic taxa characteristic for large rivers and formerly widely distributed throughout Europe (*Choroterpes picteti*, *Brachycercus harrisellus*, [?] *Caenis pusilla*) or the Western Palearctic (*Heptagenia longicauda*, *Neoephemera maxima*, *Prosopistoma pennigerum*), and (3) comparatively common taxa occupying a rather wide range of habitats throughout the Western Palearctic (*Siphonurus lacustris*, *Baetis muticus*, *B. rhodani*, *Centropilum luteolum*, *Procloeon bifidum*, *Paraleptophlebia submarginata*, *Torleya major*), Palearctic (*Procloeon bifidum*, *Heptagenia sulphurea*, *Ephemerella ignita*, *Caenis macrura*, *C. pseudorivulorum*, *C. rivulorum*), or even Holarctic realm (*Procloeon pennulatum*, [?] *Cloeon dipterum*). Among the Ephemeroptera

taxa collected, the second group is obviously restricted to highly dynamic large rivers. The species united in this group have vanished from most localities of their former occurrence following river degradation caused by human activities, especially by changes in water discharge, flow regime, and sediment budget, which gravely influence the originally highly dynamic habitat turnover (including fast changes in habitat structure). These taxa must clearly be recognised as most vulnerable and therefore represent excellent indicators of ecological integrity (in the potamalic river section). Ephemeroptera species richness in the Vjosa appears exceptionally high compared with other rivers in Europe, again emphasising the outstanding importance of this river system in terms of nature conservation.

## Acknowledgments

I am greatly indebted to S. BEQIRAJ, W. GRAF, J. GUNCZY, U. HECKES, M. HESS, G. KUNZ, E. LANDAIS and S. VITECEK for kindly donating the material collected by them. The author's sincere gratitude to Wolfram GRAF and his working group for their true friendship and long cooperation is most cordially expressed.

## Literature

- ADAM H. & CZIHAK G., 1964: Arbeitsmethoden der makroskopischen und mikroskopischen Anatomie. Verl. Fischer, Stuttgart, 583 pp.
- BAUERNFEIND E., 2003: The mayflies of Greece (Insecta: Ephemeroptera) – A provisional check-list. In: GAINO E. (Ed). Research update on Ephemeroptera & Plecoptera. Università di Perugia. Perugia, Italy, 99–107.
- BAUERNFEIND E. & HUMPESCH U.H., 2001: Die Eintagsfliegen Zentraleuropas (Insecta: Ephemeroptera): Bestimmung und Ökologie. Verl. Naturhistor. Mus. Wien, 1–239.
- BAUERNFEIND E. & LECHTHALER W., 2014: Ephemeroptera – Key to Larvae from Central Europe. DVD-Edition, Eutaxa Publ., Vienna; ISBN 3-9501839-6-5
- BAUERNFEIND E. & MOOG O., 2000: Mayflies (Insecta: Ephemeroptera) and the assessment of ecological integrity: a methodological approach. Hydrobiologia (Den Haag) 422/423, 71–83.
- BAUERNFEIND E. & SOLDÁN T., 2012: The Mayflies of Europe (Ephemeroptera). Apollo Books, Ollerup, Denmark, 1–781.
- BEQIRAJ S., LIÇAJ P., LUOTONEN H., ADHAMI E., HELLSTEN S. & PRITZL G., 2008: Situation of benthic macroinvertebrates in Vjosa River, Albania, and their relationships with water quality and environmental state. Conference Proceedings 'Balwois 2008', Ohrid, FYROM, 27–31 May 2008, 416–428.
- BUFFAGNI A., KEMP J.L., ERBA S., BELFIORE C., HERING D. & MOOG O., 2001: A Europe-wide system for assessing the quality of rivers using macroinvertebrates: the AQEM Project and its importance for southern Europe (with special emphasis on Italy). In: RAVERA O. (ed.), Scientific and legal aspects of biological monitoring in freshwater. Journal of Limnology 60, Suppl. 1, 39–48.
- CHATZINIKOLAOU Y., DAKOS V. & LAZARIDOU M., 2008: Assessing the ecological integrity of a Major Transboundary Mediterranean River Based on Environmental Habitat Variables and Benthic Macroinvertebrates (Aos-Vjose River, Greece-Albania). International Review of Hydrobiology 93, 73–87.
- ČUK R., ČMRLEC K. & BELFIORE C., 2015: The first record of *Ametropus fragilis* Albarda, 1878 (Insecta: Ephemeroptera) from Croatia. Natura Croatica 24 (1), 151–157.
- DEVÁN P., 1991: Nové a vzácné druhy podeniek (Ephemeroptera) fauny Slovenska. Biologia 46, 509–511.

- ELLIOTT J.M. & HUMPESCH U.H., 1983: A key to the Adults of the British Ephemeroptera with notes on their ecology. Freshwater Biological Association. Scientific Publications, Ambleside 47, 1–101.
- ELLIOTT J.M. & HUMPESCH U.H., 2010: Mayfly Larvae (Ephemeroptera) of Britain and Ireland: Keys and a Review of their Ecology. Freshwater Biological Association. Scientific Publications, Ambleside 66, 1–152.
- FERRO M. & SITES R., 2007: The Ephemeroptera, Plecoptera, and Trichoptera of Missouri State Parks with Notes on Biomonitoring, Mesohabitat Associations, and Distribution. *Journal Kansas Entomol. Soc.* 80, 105–129.
- GODUNKO R.J. & KOVÁCS T., 2008: Lichinki odnodenok (Insecta: Ephemeroptera) ukrainskoy chastini baseynu r. Tisi, zbirani protyagom 2006 roku. *Naukoviy visnik Uzhgorodskogo universitetu, Seriya Biologiya* 23, 164–166.
- HERSHKOVITZ Y., DAHM V., LORENZ A.W. & HERING D., 2015: A multi-trait approach for the identification and protection of European freshwater species that are potentially vulnerable to the impacts of climate change. *Ecological Indicators* 50, 150–160. [www.climate-and-freshwater.info/climate\\_score](http://www.climate-and-freshwater.info/climate_score) (download 16.12.2017)
- IDE F.P., 1940: Quantitative determination of the insect fauna of rapid water. University of Toronto Studies, Biological Series 47, 1–20, pl. 1–4.
- KOVÁCS T. & MURÁNYI D., 2013: New country data of some mayflies (Ephemeroptera) from Europe. *Folia Historiconaturalia Musei Matraensis* 37, 15–19.
- MOOG O. & HARTMANN A. (Eds.), 2017: *Fauna Aquatica Austriaca*, 3<sup>rd</sup> Edition 2017. Federal Ministry of Agriculture, Forestry, Environment and Water Management, Wien.
- MÜLLER-LIEBENAU I., 1969: Revision der europäischen Arten der Gattung *Baetis* Leach, 1815 (Insecta, Ephemeroptera). *Gewässer und Abwässer* 48/49, 1–214.
- PETROVIĆ A., MILOŠEVIĆ D., PAUNOVIĆ M., SIMIĆ S., DORĐEVIĆ N., STOJKOVIĆ M. & SIMIĆ V., 2015: New data on the distribution and ecology of the mayfly larvae (Insecta: Ephemeroptera) of Serbia (central part of the Balkan Peninsula). *Turkish Journal of Zoology* 39 (2), 195–209.
- PUTHZ V., 1978: Ephemeroptera. In: ILLIES J. (Ed.) *Limnofauna Europaea*. 2<sup>nd</sup> Edition, Gustav Fischer Verlag, Stuttgart, 256–263.
- PUTHZ V., 1980: Ergebnisse der Albanien-Expedition 1961 des Deutschen Entomologischen Instituts. 94. Beitrag: Ephemeroptera. *Beiträge zur Entomologie* 30(2), 343–355.
- SARTORI M., 2001: Current knowledge of mayfly research in Europe (Ephemeroptera). In: DOMINGUEZ E. (Ed.), *Trends in Research in Ephemeroptera and Plecoptera*. Kluwer Academic/Plenum Publishers, 47–52. (Proceedings of the IX International Conference on Ephemeroptera and the XIII International Symposium on Plecoptera held August 16–21, 1998, and August 20–23, 1998 respectively in Taft de Valle, Tucumán, Argentina).
- STUDEMANN D., LANDOLT P., SARTORI M., HEFTI D. & TOMKA I., 1992: Ephemeroptera. *Insecta Helvetica* Vol. 9., Mauron, Tinguely & Lachat SA, Moncor, Fribourg / Switzerland, 1–174.
- VILENICA M., GATTOLLIAT J.-L., MIHALJEVIĆ Z. & SARTORI M., 2015: Croatian mayflies (Insecta, Ephemeroptera): species diversity and distribution patterns. *ZooKeys* 523, 99–127.
- WILLIAMS D.D., 1980: Applied aspects of mayfly biology. In: FLANNAGAN J.F. & K.E. MARSHALL (Eds.), *Advances in Ephemeroptera Biology*, 1–17. Proceedings 3rd International Conference on Ephemeroptera, Winnipeg, Manitoba, 1979. Plenum Press, New York and London.
- ZABRIĆ D. & SARTORI M., 1997: First contribution to the mayfly fauna from Slovenia (Ephemeroptera). In: LANDOLT P. & M. SARTORI (Eds.), *Ephemeroptera & Plecoptera. Biology-Ecology-Systematics*, 147–151. Proceedings of the eight International Conference on Ephemeroptera and the twelfth International Symposium on Plecoptera August 1995 in Lausanne. MTL – Mauron + Tinguely & Lachat SA, Fribourg, Switzerland.

**Received:** 2018 05 25

**Address:**

Dr. Ernst BAUERNFEIND, Natural History Museum Vienna/Naturhistorisches Museum  
Wien, 2. Zoologische Abteilung, Burgring 7, A-1010 Wien, Austria.

E-mail: ernst.bauernfeind@nhm-wien.ac.at