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Comments on the systematics and nomenclature of selected Austrian mayflies (Insecta: Ephemeroptera)

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Within recent years major changes in the understanding of mayfly systematics have taken place and controversial opinions on the taxonomic status of even common Central European taxa make access for the non-specialist extremely difficult. Nomenclatural decisions affecting the Austrian checklist are discussed to provide a guideline for the comparison of recent taxonomic proposals including full bibliographic references.

1 Introduction

Since July 2000 the EU Water Framework Directive is the legislative basis for the future water management and protection. The biota are now seen as the most important quality components for the evaluation of the ecological status. This input of ecological knowledge into water management decisions might help to win the struggle for ecologically healthy systems.

Although there is a consensus that national environmental policy must be based upon the best scientific level available, the design of biological monitoring programmes has to factor in the cost-benefit aspect. Most of the member countries will be confronted with the task to harmonise methods, assessment schemes and colour banding the water quality maps. To ensure a sound scientific quality of the future biomonitoring it has to be recommended to create, adapt or harmonise comprehensive standard works, such as species inventories, identification keys, textbooks about species traits and ecological information. Consistent use of scientific names, especially in species and genus group names, must be considered a basic requirement for the maintenance of equally high standards in the applied sciences as well as in faunistic research, nature conservation and biomonitoring. The application of the principles of phylogenetic systematics is readily recognized as a means of furthering progress in the understanding of biodiversity and relationships within and between taxonomic groups. On the other hand new findings and their interpretation necessarily create a phase of broad discussion until the combined results will be widely accepted as a base for advanced application and general use.

2 The European Water Framework Directive

The European water policy of the past 25 years was marked by a confusion of numerous individual directives which have become extremely involved. Since July 2000 a general concept for the European water management and protection has been installed. This new legislative construct - the EU Water Framework Directive - defines a methodological framework for assessing water-bodies in the future. However, the precise method for determining the ecological status is still to be defined.

The "Ecological status" is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters. The environmental objectives should ensure that "good status" of surface water and groundwater is achieved at Community level. This status comes quite near to the "high status" which is described by the natural reference conditions. The ecological status of rivers must be determined on the basis of near-natural reference conditions. Thus the assessment of possible changes in water quality from a water type-specific, natural reference condition is at the core of this directive.

The biota are the most important quality components for the evaluation of the ecological status. Only in cases when the biota indicate an impairment of the water body, the hydro-morphological and physico-chemical components are investigated in addition to the biological components.

The communities investigated comprise algae, macrophytes, benthic invertebrates, and fish. To describe the biological elements the following attributes have to be considered: taxonomic composition, abundance, diversity, and the ratio of disturbance sensitive taxa to insensitive taxa. It is obvious that a rapid (and sometimes reiterated) change in scientific names already long established and in prevailing use, will inevitably lead to an undesirable confusion affecting the general understanding and comparability of data especially for the non-specialist.

3 Current implications for Austria

For the implementation of the monitoring aspects in compliance with the EU Water Framework Directive the Austrian water management authorities want to keep a sound scientific level of field work, processing and analysis of samples, and assessment of the ecological status of streams and rivers in Austria.

To ensure a high level of quality the government, namely the Ministry for Agriculture, Forestry, Environment and Water Management, provides several technical supports including the development of scientific methods for applied uses. With respect to taxonomic work these measures include the providing of reliable keys for identification, the offering of courses for taxonomic training, and the compilation of check lists for a national species inventory of freshwater organisms (*Fauna Aquatica Austriaca*).

As a part of this philosophy of quality control aspects of nomenclature have to be carefully considered. In this respect the authors welcome any unbiased discussion of nomenclatural problems but suggest a cautious and rather conservative treatment of genus names (see also LANGE-BERTALOT 1998). Correct and meticulous quotation of relevant sources for the application of scientific names will greatly aid the mutual understanding as well as the comparability of different studies.

4 Systematics and nomenclature

Within recent years the taxonomic situation concerning mayflies (Ephemeroptera) and mayfly systematics has entered a phase of considerable innovations. For all parties concerned, taxonomists as well as limnologists, it is not always easy to clearly understand where the unavoidable necessity for immediate changes ends and the field of broad discussion begins. To render comparison of new and established taxonomic views more easily the authors would like to review the main topics and propose the guidelines followed for the updating of the national checklist.

Nomenclature for Ephemeroptera listed in the last inventory of Austrian species (BAUERNFEIND & al. 1995) in MOOG (1995) largely followed BAUERNFEIND (1994, 1995) with the addition of species reported for Austria since 1992. Information on synonymy as well as the reasoning behind nomenclatural decisions have been published briefly in BAUERNFEIND (1990) and BAUERNFEIND & WEICHELBAUMER (1991, 1994). A variety of new propositions have been made since then. These are mostly linked with nomenclatural changes, necessitating a treatment of the issues in question for an updated national checklist.

Systematics and taxonomy are not rigid organizational frameworks. Today more than ever, they can be understood as science in progress. On the one hand they reflect scientific progress, on the other hand they reflect the (often differing) interpretations of characters, which in turn are based on the theoretical and methodological approaches of the respective authors. Recommendations on systematic arrangements must therefore be viewed primarily as a basis for discussion (cf. LANGE-BERTALOT 1998, BOCK 2000). At the same time, the systematic treatment of a group represents a form of organization that enables the necessary orientation for specialists and non-specialists alike, for example a rapid comparison of ecological or faunistic data. Stable nomenclature is therefore a key concern for species inventories and data-bases, which serve as a starting point for applied research.

Based on practical considerations, the "Fauna Aquatica Austriaca" takes a rather conservative approach designed to simplify use by a broad spectrum of readers. New scientific genus names, especially if originating from splitting or lumping traditional taxa as well as broader changes in the systematic arrange-

ments of higher categories (family/subfamily level) have a widespread impact on research at large. Since subgenera can highlight new taxonomic interpretations without endangering the continuity of scientific names in prevailing usage, preference was given to this approach rather than to more sweeping changes. This approach is advantageous particularly in those cases in which new classifications are clearly provisional and in which additional changes can be expected in the near future. In order to promote the necessary discussion – even on controversial modern interpretations – all new combinations are presented and commented upon here (along with the necessary bibliographic references). This approach should allow for a better understanding of publications lacking more detailed nomenclatural remarks as well as for comparability of the range of taxa used by different authors.

5 Selected Ephemeroptera-taxa currently in discussion

Ameletidae McCafferty 1991

Usually, the genus *Ameletus* has been placed in the family Siphonuridae. Its transfer to *Rallidentinae* PENNIKET (1966: 169) and elevation of rank to family level by TOMKA & ELPERS (1991: 117, sub Rallidentidae TOMKA & ELPERS, in error; cf. ICZN 1999 Art. 36.1.) is not accepted. More recent investigations (KLUGE & al. 1995) point to the usefulness of placing the genus in a separate family Ameletidae McCafferty (1991: 249). This interpretation will be followed in the updated Austrian species list.

Siphonuridae Ulmer 1920

Siphonurus alternatus was originally described in the genus *Siphurella* Bengtsson 1909: 11, which was subsequently generally considered to represent a junior synonym of *Siphonurus* Eaton 1868 a: 89. In order to underline the rather isolated position of the species within the group of related forms (Studemann & Landolt 1997), *Siphurella* could be treated as a subgenus of *Siphonurus* (cf. Hubbard 1990, Haybach 1998: 157). For the taxa recorded from Austria we propose therefore:

Siphonurus (*Siphurella*) *alternatus*

Siphonurus (*Siphonurus*) *aestivalis*, *S.* (*S.*) *armatus*, *S.* (*S.*) *croaticus*,
S. (*S.*) *lacustris*

Baetidae Leach 1815

Baetis sensu lato

The ubiquitous, very species-rich genus *Baetis* has recently undergone a range of often contrasting revisions and numerous new taxa have been erected. Diverging opinions exist about the status/systematic ranking of the new groupings

as genera (McCAFFERTY & WALTZ 1995, WALTZ & al. 1994) or subgenera (NOVIKOVA & KLUGE 1987, 1994). No consensus has been reached on the separation of the individual systematic entities and in many cases nomenclaturally undefined groups are employed ("*Baetis* complex" sensu WALTZ & McCAFFERTY 1997; "Volumetrical nomenclature" sensu KLUGE, in press). Relevant taxa for the list of Austrian species are *Nigrobaetis* NOVIKOVA & KLUGE (1987: 8), *Labiobaetis* NOVIKOVA & KLUGE (1987: 13), *Alainites* WALTZ & McCAFFERTY (in WALTZ & al.) 1994: 34, *Acentrella* BENGTSOON (1912: 110) and *Baetis* LEACH (1815: 137). The fundamentally divergent interpretations can be schematically represented as follows:

sensu NOVIKOVA & KLUGE (1987, 1994):

Baetis (*Nigrobaetis*) *niger*, *B. (N.) digitatus*, *B. (N.) muticus*

Baetis (*Labiobaetis*) *tricolor*

Baetis (*Acentrella*) *sinaica*

Baetis (*Baetis*) *fuscatus*, *Baetis* (*Baetis*) spp.

sensu WALTZ & McCAFFERTY (1994, 1997):

Baetis complex (synapomorphy: the femoral villopore)

Labiobaetis *tricolor*

Acentrella *sinaica*

Baetis *fuscatus*, *Baetis* spp.

non-*Baetis* complex (without femoral villopore)

Alainites *muticus*

Nigrobaetis *niger*, *N. digitatus*

At present it is hardly possible to decide which approach comes closer to the supposedly underlying phylogenetic lineages and no generally accepted concept exists for baetid genera. On a world wide scale new taxa are described in rapid succession and additional changes may be expected over the short term. The "Fauna Aquatica Austriaca" will take the practical approach and adhere to the historical interpretation of *Baetis* LEACH 1815, until more generally accepted evidence is forthcoming. Current nomenclatural treatment is still based on the most valuable revisionary work of MÜLLER-LIEBENAU (1969, 1981).

Additional changes on the subgenus and species level have been proposed most recently: For *Baetis melanonyx* (PICTET 1843-1845: 258) and related South European taxa the new subgenus *Patites* THOMAS & DIA 2000: 105 has been erected. *Baetis gemellus* EATON 1885: 163, sensu MÜLLER-LIEBENAU (1969: 99-104) is currently considered to represent a new species *Baetis gadeai* THOMAS 1999: 25, most probably endemic to the Pyrenées. *Baetis gemellus* EATON quoted also for Austria previously (but not accepted, cf. BAUERNFEIND 1990: 76) must be considered a *species inquirenda*.

Centropitulum sensu lato

Species traditionally placed near *Centropitulum pennulatum* EATON (1870: 2) have received very divergent systematic interpretations (compare HAYBACH 1998: 144-145, 206), whereby the name *Cloeopitulum* KAZLAUSKAS (1972: 338) is unfortunately not available nomenclaturally (HUBBARD 1979: 3). An attempt to re-interpret the group was undertaken by KEFFERMÜLLER & SOWA (1984) taking into consideration the genus *Pseudocentropitulum* BOGOESCU 1947: 602. This solution, however, was not accepted by MCCAFFERTY & WALTZ (1990), who in turn transferred *Centropitulum pennulatum* and related forms to the genus *Procloeon* BENGTSSON (1915: 34). Subsequently, JACOB (1991) recommended separating these taxa in the subgenus *Pseudocentropitulum* within *Procloeon*. Clearly more information is necessary accounting for the interrelationships both within the group (BELFIORE & D'ANTONIO 1990) and with respect to *Cloeon* (q. v.). A pragmatical solution would be to provisionally unite these taxa within *Centropitulum* EATON 1869: 132 in the subgenus *Pseudocentropitulum*. The relevant taxa for Austria are:

Centropitulum (Pseudocentropitulum) pennulatum, *C. (P.) pulchrum*, *C. (P.) stenopteryx*

Centropitulum (Centropitulum) luteolum

The status of *C. stenopteryx* EATON 1871: 110, pl. V, remains unclear and the species is considered to represent a *species inquirenda*. For a more detailed description of the holotype see KEFFERMÜLLER & SOWA (1984).

Cloeon LEACH 1815

In their entirely new concept for the genus, KLUGE & NOVIKOVA (1992) distinguished a total of seven subgenera (*Centropitulum*, *Cloeon*, *Similicloeon*, *Intercloeon*, *Pseudocentropitulum*, *Procloeon*, *Pseudocentropitiloides*). This interpretation has attracted only few followers and the traditional delimitation of *Cloeon* is retained here as well, although the arguments of KLUGE & NOVIKOVA (1992) do contain interesting aspects. HAYBACH (1998: 197-204) discussed in detail the synonymy of *Cloeon dipterum* and *C. simile* after the revision by SOWA (1975, 1980). Based on pragmatic considerations, his views are followed here only in part, due to the indistinct morphological delimitation within the highly variable group. For the Austrian checklist *C. cognatum* STEPHENS 1835: 69 and *C. inscriptum* BENGTSSON 1914: 215 are therefore considered to represent junior synonyms of *Cloeon dipterum* (LINNAEUS 1761: 377) or *species inquirendae*. This aims to avoid provoking difficult-to-confirm reports in the faunistic literature (compare PUTHZ 1978: 259, footnote).

Baetopus KEFFERMÜLLER 1960

Baetopus tenellus (ALBARDA 1878: 128) has been reported from Germany (River Danube) in the immediate vicinity of the Austrian border (WEINZIERL & SEITZ 1993) and the species is expected to occur in Austria as well. The taxon was placed in the genus *Raptobaetopus* MÜLLER-LIEBENAU 1978: 470 (s.a. HAYBACH 1998: 194), which may perhaps be better treated as a subgenus limited zoogeographically within the Oriental region (HUBBARD 1990, KLUGE & NOVIKOVA 1992).

Heptageniidae NEEDHAM 1901*Heptagenia* sensu lato

The genus *Heptagenia* can also arguably be subdivided into subgroups. Kluge erected the subgenus *Dacnogenia* KLUGE 1987: 303, and JACOB & al. (1996) suggested transferring *H. fuscogrisea* to the genus *Kageronia* MATSUMURA 1931: 1479. The interpretation of KLUGE (1987), who proposed subgeneric status for the various subgroups, is accepted here. The relevant taxa for Austria are:

Heptagenia (Kageronia) fuscogrisea

Heptagenia (Dacnogenia) coerulans

Heptagenia (Heptagenia) sulphurea, *H. (H.) longicauda*, *H. (H.) flava*

Electrogena ZURWERRA & TOMKA 1985

KLUGE (1988: 298) regards this genus, whose features warrant a position between *Ecdyonurus* and *Heptagenia*, as a junior synonym of *Ecdyonurus* EATON 1868b: 142. Although a future revision of Palearctic and Oriental taxa may well necessitate a new interpretation of *Electrogena* and related genera, *Electrogena* is currently treated as a valid taxon by most authors.

Electrogena rivuscellana SARTORI & LANDOLT (in LANDOLT & al.) 1991: 460 was found to represent a junior synonym of *E. ujhelyii* (SOWA 1981: 375) by BELFIORE & DESIO (1995). This proposal has been widely accepted and is also followed in the Austrian checklist.

The status of *Electrogena fasciiculata* (SOWA 1974: 316) already doubted previously (HAYBACH 1998), has recently been reinvestigated by BELFIORE & al. (1999) and considered untenable, representing in fact a junior synonym of *E. affinis* (EATON 1883: Plate 46 e). Although not all problems are completely solved (e.g. variation in egg chorionic structure) the synonymy has been accepted and the Austrian records hitherto published sub *Electrogena fasciiculata* should actually refer to *E. affinis* (EATON 1883).

Epeorus sensu lato

Depending on the criteria used (larval or imaginal characters), a range of highly divergent interpretations of the generic/subgeneric arrangement within this extensive genus exists (compare HUBBARD 1990: 46). The proposition of TOMKA & ZURWERRA (1985; s.a. HAYBACH 1998: 267), which places the taxon *Epeorus alpicola* (EATON 1871: 148) in the subgenus *Ironopsis* TRAVER 1935: 36, is currently not generally accepted, although it represents an interesting approach (compare KLUGE 1988, 1997; ZURWERRA & al. 1986). Previously BRAASCH (1980) had already suggested a transfer to the genus *Iron* EATON 1883: Plate 23-24. Until more detailed results on the complex *Epeorus/Iron* become available based on Nearctic material (considering East Palearctic and Oriental forms as well), any subgeneric classification for *Epeorus alpicola* remains rather arbitrary.

Recently THOMAS & al. (2000) reinstated *Epeorus assimilis* (EATON 1871: 147) as a valid taxon, considering *Epeorus sylvicola* (PICTET 1865: 24) a slightly different species with restricted geographical range south of the Pyrenées. This opinion is followed for the Austrian list.

In the same paper THOMAS & al. (2000) proposed a mandatory change of ending (masculine gender) for both, *E. sylvicola* and *E. alpicola*. An interpretation of "sylvicola" and "alpicola" as compound latinized nouns in apposition seems more desirable (ICZN 1999, Art. 31.2.1.), rendering any change unnecessary. Therefore we retain the use of *Epeorus alpicola* (EATON) for the Fauna Aquatica Austriaca.

Leptophlebiidae BANKS 1900*Paraleptophlebia* LESTAGE 1917

Based on the potential polyphyly of the taxon *Paraleptophlebia* LESTAGE 1917: 340, KLUGE (1997) suggested subgeneric rank for the latter as a subgenus of *Leptophlebia* WESTWOOD 1840: 31. Considering the interpretations of taxonomic differences that are usually drawn in this family at the larval and imaginal level, a generic separation appears to be justified at present. *Paraleptophlebia* LESTAGE therefore is listed as a valid genus in the Austrian checklist, until a more detailed analysis of phylogenetic relationships becomes available.

Ephemerellidae Klapálek 1909

Our incomplete knowledge of East Palearctic and Oriental forms additionally complicates the interpretation of the more closely related groups within the family. This renders the systematic position of the few European species, also with respect to the numerous Nearctic taxa, a matter of debate. ALLEN (1980) elevated most of the subgenera to genus rank. This prompted JACOB (1993) to regroup the European species as well. The taxa that are relevant for the Austrian

species list are *Serratella* EDMUNDS (1959: 544), *Torleya* LESTAGE (1917: 366) and *Ephemerella* WALSH (1863: 377). The present study follows the arguments of KLUGE (1997), who pleads for maintaining subgeneric rank. The relevant taxa for Austria are:

- Ephemerella* (*Serratella*) *ignita*, E. (S.) *mesoleuca*
- Ephemerella* (*Torleya*) *major*
- Ephemerella* (*Ephemerella*) *mucronata*, E. (E.) *notata*

Caenidae NEWMAN 1853

MALZACHER (1976) reported *Caenis pusilla* NAVAS 1913: 63 from the Bodensee region sub *Caenis rhenicola* MALZACHER 1976: 130, and the species is expected to occur in Austria as well. The synonymy was established by ALBA-TERCEDOR & MALZACHER (1986) and is generally accepted presently.

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References

- ALBARDA, H. (1878): Descriptions of three new European Ephemeridae.- Entomologist's monthly magazin 15: 128-130, London
- ALBA-TERCEDOR, J. & P. MALZACHER (1986): A new synonym in the genus *Caenis* Stephens 1835 (Ephemeroptera: Caenidae).- Aquatic Insects 8 (1): 55-58, Lisse
- ALLEN, R. (1980): Geographic distribution and reclassification of the subfamily Ephemerellidae (Ephemeroptera: Ephemerellidae).- In: FLANNAGAN J. F. & K. E. MARSHAL (eds.): Advances in Ephemeroptera biology.- Proceedings of the 3rd International Conference on Ephemeroptera, 1979 Winnipeg: 71-91. Plenum Publ., New York
- BANKS, N. (1900): New genera and species of Nearctic Neuropteroid Insects.- Transactions of the American entomological society 26: 239-259, Philadelphia
- BAUERNFEIND, E. (1990): Der derzeitige Stand der Eintagsfliegen-Faunistik in Österreich (Insecta: Ephemeroptera).- Transactions of the American entomological society 26: 239-259, Philadelphia
- BAUERNFEIND, E. (1994): Bestimmungsschlüssel für die österreichischen Eintagsfliegen (Insecta: Ephemeroptera), 1. Teil.- Wasser und Abwasser Supplement 4/94: 1-92, Bundesanstalt für Wassergüte, Wien
- BAUERNFEIND, E. (1995): Bestimmungsschlüssel für die österreichischen Eintagsfliegen (Insecta: Ephemeroptera), 2. Teil.- Wasser und Abwasser Supplement 4/94 (1995): 1-96. Österreichisches Nationalkomitee der Internationalen Arbeitsgemeinschaft Donauforschung, Wien
- BAUERNFEIND, E. & P. WEICHSELBAUMER (1991): Eintagsfliegen-Nachweise aus Österreich (Insecta: Ephemeroptera).- Verhandlungen der zoologisch-botanischen Gesellschaft in Österreich 128: 46-66, Wien
- BAUERNFEIND, E. & P. WEICHSELBAUMER (1994): Neue Eintagsfliegen-Nachweise aus Österreich (Insecta: Ephemeroptera).- Linzer Biologische Beiträge 26/1: 366-367, Linz
- BAUERNFEIND, E., P. WEICHSELBAUMER & O. MOOG (1995): Ephemeroptera (Eintagsfliegen).- In: MOOG, O. (ed.): Fauna Aquatica Austriaca, Teil 3, Lieferung 1/Mai 1995, 17 pp. Wasserwirtschaftskataster, Bundesministerium für Land- und Forstwirtschaft, Wien

- BELFIORE, C. & C. D'ANTONIO (1990): *Pseudocentropilum calabrum* n. sp. (Ephemeroptera, Baetidae), a new species of mayfly from Southern Italy.- *Acta Entomologica Bohemoslovaca* 87: 117-121, Praha
- BELFIORE, C. & F. DESIO (1995): Taxonomy and distribution of *Electrogena ujhelyii* (Sowa, 1991) (Insecta: Ephemeroptera: Heptageniidae).- *Annalen des naturhistorischen Museums in Wien Serie B Zoologie und Botanik* 97: 151-154, Wien
- Belfiore, C., A. HAYBACH & M. KLONOWSKA-OLEJNIK (1999): Taxonomy and phenetic relationships of *Electrogena affinis* (Eaton, 1883) (Ephemeroptera: Heptageniidae).- *Annales de Limnologie* 35: 245-256, Toulouse
- BENGTTSSON, S. (1909): Beiträge zur Kenntnis der paläarktischen Ephemeriden.- *Lunds universitets arsbok N.F. Afd. 2, 5 No. 4*: 1-19, Lund
- BENGTTSSON, S. (1912): Neue Ephemeriden aus Schweden.- *Entomologisk tidskrift* 33: 107-117, Stockholm
- BENGTTSSON, S. (1914): Bemerkungen über die nordischen Arten der Gattung *Cloeon* Leach.- *Entomologisk tidskrift* 35: 210-220, Stockholm
- BENGTTSSON, S. (1915): Eine Namensänderung.- *Entomologisk tidskrift* 36: 34, Stockholm
- BOCK, W. J. (2000): Heuristics in systematics.- *The Ostrich* 71: 41-44, Cape Town
- BOGOESCU, C. D. (1947): Un genre nouveau d'Ephéméroptère trouvé en Roumanie.- *Academie Roumaine. Bulletin de la section scientifique* 29: 602-606, Bucuresti
- BRAASCH, D. (1980): *Iron yougoslavicus* Samal neu für Italien und Bulgarien (Insecta, Ephemeroptera, Heptageniidae).- *Faunistische Abhandlungen Staatliches Museum für Tierkunde in Dresden* 8: 81, Dresden
- EATON, A. E. (1868 a): An outline of a re-arrangement of the genera of the Ephemeridae.- *Entomologist's monthly magazin* 5: 82-91, London
- EATON, A. E. (1868 b): Remarks upon the homologies of the ovipositor.- *Transactions of the royal entomological society of London* 1868: 141-144, London
- EATON, A. E. (1869): On *Centropilum*, a new genus of the Ephemeridae.- *Entomologist's monthly magazin* 6: 131-132, London
- EATON, A. E. (1870): On some new British species of Ephemeridae.- *Transactions of the royal entomological society of London* 1870: 1-8, London
- EATON, A. E. (1871): A Monograph on the Ephemeridae.- *Transactions of the royal entomological society of London* 1871: 1-164, pl. 1-6, London
- EATON, A. E. (1883): A revisional monograph of recent Ephemeridae or Mayflies. Part I.- *The transactions of the Linnean society of London, Zoology* (2) 3: 1-77, pl. 1-24, London
- EATON, A. E. (1885): A revisional monograph of recent Ephemeridae or Mayflies. Part III.- *The transactions of the Linnean society of London, Zoology* (2) 3: 153-230, pl. 46-113, London
- EDMUNDS, G. F. jr. (1959): Subgeneric groups within the mayfly genus *Ephemerella* (Ephemeroptera: Ephemerellidae).- *Annals of the entomological society of America* 52: 543-547, Lanham
- HAYBACH, A. (1998): Eintagsfliegen (Insecta: Ephemeroptera) von Rheinland -Pfalz.- *Dissertation Johannes-Gutenberg-Universität Mainz*: 1-417, XIII + 129 pp. Anhang
- HUBBARD, M. D. (1979): Genera and Subgenera of Recent Ephemeroptera.- *Eatonia Suppl.* 2: 1-8, Tallahassee
- HUBBARD, M. D. (1990): *Mayflies of the World. A Catalog of the Family and Genus Group Taxa* (Insecta: Ephemeroptera).- *Sandhill Crane Press, Gainesville, Florida*, 1-119 [= *Fauna Flora Handbook No.8, Backhuys, Oegstgeest*]
- International Code of Zoological Nomenclature [ICZN] (1999).- 4th ed., XXIX, 1-306. International Trust for Zoological Nomenclature, London
- JACOB, U. (1991): Ephemeroptera: Zur Systematik der europäischen Baetidae auf Gattungsebene.- *Verhandlungen Westdeutscher Entomologentag* 1990: 271-290, Düsseldorf
- JACOB, U. (1993): Zur Systematik und Verbreitung der europäischen Ephemerellidae (Ephemeroptera).- *Verhandlungen Westdeutscher Entomologentag* 1992: 101-110, Düsseldorf

- JACOB, U., A. DORN A. & HAYBACH (1996): Systematik und Verbreitung der Gattung *Heptagenia* und nahestehender Taxa in Europa.- Verhandlungen Westdeutscher Entomologentag 1995: 83-105, Düsseldorf
- KAZLAUSKAS, R. S. (1972): Neues über das System der Eintagsfliegen der Familie Baetidae (Ephemeroptera).- XIII Meschdunarodnyi entomologitscheskij Kongress Moskwa, 2-9 awgusta 1968 , Trudy 3: 337-338 (abstract), Leningrad [= Proceedings of the 13th international congress on entomology 1968 Moscow]
- KEFFERMÜLLER, M. (1960): Badania nad fauna jetek (Ephemeroptera) Wielopolski.- Poznanski towarzystwo przyjaciol nauk, Prace Komisji matematyczno-przyrodnicze seria B nauki biologiczne 19(8): 411-467, pl. 1-11, Poznan
- KEFFERMÜLLER, M. & R. SOWA (1984): Survey of Central European species of the genera *Centroptilum* Eaton and *Pseudocentroptilum* Bogoescu (Ephemeroptera, Baetidae).- Polskie pismo entomologiczne 54: 309-340. Wroclaw
- KLAPÁLEK, F. (1909): Ephemerida, Eintagsfliegen.- In: BRAUER F. (ed.): Süßwasserfauna Deutschlands 8 (1): 1-32, (G. Fischer) Jena
- KLUGE, N. J. (1987): Mayflies of the genus *Heptagenia* Walsh (Ephemeroptera, Heptageniidae) of the USSR.- Entomologiceskoe Obcozranie 66 (2): 302-320, Moskwa (in Russian)
- KLUGE, N. J. (1988): Revision of genera of the family Heptageniidae (Ephemeroptera). I, Diagnoses of tribes, genera and subgenera of the subfamily Heptageniinae.- Entomologiceskoe Obcozranie 67 (2): 291-313, Moskwa (in Russian)
- KLUGE, N. J. (1997): New Subgenera of Holarctic mayflies (Ephemeroptera: Heptageniidae, Leptophlebiidae, Ephemerellidae).- Zoosystematica Rossica 5: 233-235, St. Petersburg
- KLUGE, N. J. (in press) in Proceedings of the IXth international conference on Ephemeroptera 1998, (in press)
- KLUGE, N. J. & E. A. NOVIKOVA (1992): Revision of the Palearctic genera and subgenera of mayflies in the subfamily Cloeoninae (Ephemeroptera, Baetidae) with descriptions of new species from the USSR.- Entomologiceskoe Obcozranie 71 (1): 60-83, Moskwa (in Russian)
- KLUGE, N. J., D. STUDEMAN, P. LANDOLT & T. GONSER (1995): A reclassification of Siphonuroidea (Ephemeroptera).- Mitteilungen der schweizerischen entomologischen Gesellschaft 68: 103-132, Lausanne
- LANDOLT, P., M. DETHIER, P. MALZACHER & M. SARTORI (1991): A new *Electrogena* species from Switzerland (Ephemeroptera, Heptageniidae).- Bulletin de la société vaudoise des sciences Naturelles 80: 459-470, Lausanne
- LANGE-BERTALOT, H. (1998): As a Practical Limnologist, How does one deal with the flood of new Diatom names?- Limnologia 28: 153-156, Berlin
- LEACH, W. (1815): Entomology.- Brewster's Edinburgh Encyclopedia 9: 57-172, Edinburgh
- LESTAGE, J. A. (1917): Contribution à l'étude des larves des Ephémères paléarctiques.- Annales de biologie lacustre 8 (1916): 213-458, Bruxelles
- LINNAEUS, C. (1761): Caroli Linnaei Fauna Suecica, sistens Animalia Sueciae Regni: descriptionibus Insectorum.- Editio altera, 1-578, XLVII + 2 pls. L. Salvii, Stockholmiae
- MALZACHER, P. (1976): Nachtrag zur Eintagsfliegenfauna des Bodenseegebietes. Beschreibung einer neuen Art der Gattung *Caenis* (Insecta, Ephemeroptera).- Beiträge zur naturkundlichen Forschung in Südwestdeutschland 35: 129-136, Karlsruhe
- MATSUMURA, S. (1931): Ephemerida. 6000 Illustrated Insects of the Japanese Empire: 1465-1480.- Tokyo (in Japanese)
- MCCAFFERTY, W. P. (1991): Towards a phylogenetic classification of the Ephemeroptera (Insecta): A commentary on systematics.- Annals of the entomological society of America 84: 343-360, Lanham
- MCCAFFERTY, W. P. & R. D. WALTZ (1990): Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America.- Transactions of the American entomological society 116, No. 4: 769-799, Philadelphia

- MCCAFFERTY, W. P. & R. D. WALTZ (1995): Labiobaetis (Ephemeroptera: Baetidae): new Status, new North American species, and related new genus.- *Entomological News* 106: 19-28, Philadelphia
- MOOG, O. (ed.) (1995): Fauna Aquatica Austriaca. Katalog zur autökologischen Einstufung aquatischer Organismen Österreichs.- Lieferung Mai 1995 (ohne durchgehende Paginierung).- Wasserwirtschaftskataster, Bundesministerium für Land- und Forstwirtschaft, Wien
- MÜLLER-LIEBENAU, I. (1969): Revision der europäischen Arten der Gattung Baetis Leach, 1815 (Insecta, Ephemeroptera).- *Gewässer und Abwässer* 48/49: 1-214, Max Planck Dokumentationsstelle, Göttingen
- MÜLLER-LIEBENAU, I. (1978): Raptobaetopus, eine neue carnivore Ephemeropteren-Gattung aus Malaysia (Insecta, Ephemeroptera: Baetidae).- *Archiv für Hydrobiologie* 82: 465-481, Stuttgart
- MÜLLER-LIEBENAU, I. (1981): Review of the original material of the baetid genera Baetis and Pseudocloeon from the Sunda Islands and the Philippines described by G. Ulmer, with some general remarks (Insecta: Ephemeroptera).- *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut* 78: 197-208, Hamburg
- NAVÁS, L. (1913): Notas entomológicas 4. Excursiones per los alrededores de Zaragoza. (1).- *Boletín de la sociedad Aragonera de ciencias naturales* 12: 61-69, Zaragoza
- NEWMAN, E. (1853): Proposed division of Neuroptera into two classes.- *Zoologist* 11 [appendix]: 181-204, London
- NEEDHAM, J. G. (1901): Ephemeridae.- In: NEEDHAM J. G. & C. BETTEN (eds.): *Aquatic Insects in the Adirondacks*.- *Bulletin of the New York State Museum* 47: 418-429, pls. 15-16, New York
- NOVIKOVA, E. A. & N. J. KLUGE (1987): Systematics of the genus Baetis (Ephemeroptera, Baetidae) with description of a new species from Middle Asia.- *Vestnik zoologii* 1978 (4): 8-19, Kiew (in Russian)
- NOVIKOVA, E. A. & N. J. KLUGE (1994): Mayflies of the subgenus Nigrobaetis (Ephemeroptera, Baetidae, Baetis Leach, 1815).- *Entomologiceskoe Obcozranie* 73(3): 623-644, Moskwa (in Russian)
- PENNIKET, J. G. (1966): Notes on New Zealand Ephemeroptera. IV. A new Siphonurid subfamily: Rallidentinae.- *Records of the Canterbury museum* 8: 163-175, Christchurch, New Zealand
- PICET, F. J. (1843-1845): *Histoire Naturelle générale et particulière des Insects Névroptères. Famille des Ephémères*.- 1-300, XIX + 47 pls., (Kessmann & Cherbuliz) Geneva
- PICET, F. J. (1865): *Synopsis des Névroptères d'Espagne*.- 1-123, (H. George) Geneve
- PUTHZ, V. (1978): Ephemeroptera.- In: ILLIES J. (ed.): *Limnofauna Europaea* 2. Auflage: 256-263, (G. Fischer) Stuttgart
- SOWA, R. (1974): Ecdyonurus fasciocolatus sp.n., espèce voisine d'E.affinis Eaton du midi de la Pologne (Ephemeroptera, Heptageniidae).- *Bulletin de l'academie polonaise des sciences serie sciences biologiques Classe II*, 22, No. 5: 315-323, Warszawa
- SOWA, R. (1975): What is Cloeon dipterum (Linnaeus 1761).- *Entomologica Scandinavica* 6(3-4): 215-223, Copenhagen
- SOWA, R. (1980): Taxonomy and ecology of European species of the Cloeon simile Eaton group (Ephemeroptera; Baetidae).- *Entomologica Scandinavica* 11(3): 249-258, Stockholm
- SOWA, R. (1981): Taxonomy and ecology of Ecdyonurus uhelyii sp.n. (Ephemeroptera, Heptageniidae) from the tributaries of Lake Balaton.- *Acta Hydrobiologica* 23: 375-380, Krakow
- STEPHENS, J. F. (1835): *Illustrations of British Entomology*.- Mandibulata 6: 54-70, pl. 29. London
- STUEDEMANN, D. & P. LANDOLT (1997): A phylogenetic system for the European species of Siphonurus (Ephemeroptera, Siphonuridae).- In: LANDOLT P. & M. SARTORI (eds.): *Ephemeroptera and Plecoptera. Biology, ecology, systematics (=Proceedings of the VIIIth international conference on Ephemeroptera Lausanne 1995): 554-560, MTL, Fribourg*
- THOMAS, A. (1999): Corrections à la Faune des Ephémères d'Europe occidentale: 1. Baetis gemellus Eaton, 1885, sensu Müller-Liebenau, 1969 = B. gadeai n. sp. (Ephemeroptera, Baetidae).- *Ephemera* 1(1) 1999: 23-30, Le Chesnay

- THOMAS, A., V. MARI & M. BRULIN (2000): Corrections à la Faune des Ephémères d'Europe occidentale: 2. *Epeorus assimilis* Eaton, 1885 est une espèce valide, distincte d'*E. sylvicolus* (Pictet, 1865) (Ephemeroptera, Heptageniidae).- *Ephemera* 1 (2) 1999 (erschienen 2000): 85-91, Le Chesnay
- THOMAS, A. & A. DIA (2000): Compléments et corrections à la faune des Ephéméroptères du Proche Orient. 4. Description de l'imago male de *Baetis baroukianus* Thomas & Dia, 1984 et érection de *Patites* n. subgen. (Ephemeroptera, Baetidae).- *Ephemera* 1 (2) 1999 (erschienen 2000): 105-109, Le Chesnay
- TOMKA, I. & C. ELPERS (1991): Problems in the phylogeny of the Ephemeroptera.- In: ALBA-TERCEDOR, J. & A. SANCHEZ-ORTEGA (eds.): Overview and strategies of Ephemeroptera and Plecoptera (= Proceedings of the VIth international conference on Ephemeroptera, 1989 Grenada): 115-134, Gainesville, Fla.
- TOMKA, I. & A. ZURWERRA (1985): Key to the genera of the Heptageniidae (Ephemeroptera) of the holarctic, oriental and ethiopian region.- *Entomologische Berichte Luzern* 14: 113-126, Luzern
- TRAVER, J. R. (1935): Two new genera of North-American Heptageniidae (Ephemeroptera).- *The Canadian Entomologist* 67: 31-38, Ottawa
- ULMER, G. (1920): Übersicht über die Gattungen der Ephemeropteren, nebst Bemerkungen über einzelne Arten.- *Stettiner Entomologische Zeitung* 81: 97-144, Stettin
- WALSH, B. D. (1863): Observations on certain N. A. Neuroptera, by H. Hagen, M. D., of Königsberg, Prussia; translated with notes and descriptions of about twenty new N. A. species of Pseudoneuroptera.- *Proceedings of the entomological society of Philadelphia* 2: 167-272, Philadelphia
- WALTZ, M. D. & W. P. MCCAFFERTY (1997): New generic synonymies in Baetidae (Ephemeroptera).- *Entomological News* 108: 134-140, Philadelphia
- WALTZ, M. D., MCCAFFERTY W. P. & A. THOMAS (1994): Systematics of *Alainites* n. gen., *Diphotor*, *Indobaetis*, *Nigrobaetis* n. stat., and *Takobia* n. stat. (Ephemeroptera, Baetidae).- *Bulletin de la société d'histoire naturelle de Toulouse* 130: 33-36, Toulouse
- WEINZIERL, A. & G. SEITZ (1993): *Raptobaetopus tenellus* (Albarda 1878) (Ephemeroptera, Baetidae) im bayerischen Donaugebiet.- *Lauterbornia* 13: 21-24, Dinkelscherben
- WESTWOOD, J. O. (1840): Ephemeridae.- *An introduction to the modern classification of Insects* Vol. 2: 24-34, (Longmans) London
- ZURWERRA, A. & I. TOMKA (1985): *Electrogena* gen. nova [sic], eine neue Gattung der Heptageniidae (Ephemeroptera).- *Entomologische Berichte Luzern* 13: 99-104, Luzern
- ZURWERRA, A., I. TOMKA & G. LAMPEL (1986): Morphological and enzyme electrophoretic studies on the relationships of the European *Epeorus* species (Ephemeroptera, Heptageniidae).- *Systematic entomology* 11(2): 255-266, Oxford

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