

New version of the database “Ephemeroptera of the World” as the first experience of a permanent and objective web catalogue in biology

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Two databases, “Ephemeroptera of the World” and “Phylogeny of Ephemeroptera”, are now available from the website <http://www.insecta.bio.pu.ru>. They are linked by a common front-page, common alphabetic index, common list of references and numerous links, however, both are basically different and each database can be used separately. While the web database “Phylogeny of Ephemeroptera” represents a usual scientific work, the web database “Ephemeroptera of the World” is unusual in a way that it can objectively reflect all scientific literature on the Ephemeroptera. This is the first attempt to build such a database in all biology. Cataloguing of biological information of a group of animals as a web database is necessary, but existing sites do not fulfill the requirements needed in such catalogues. In existing web catalogues, objective information is mixed with subjective opinions by the compilers in such a manner that further development of these databases for scientific needs is impossible. Principles elaborated for the database “Ephemeroptera of the World” can be used to create such comprehensive global databases, which could be used and filled up for an unlimitedly long time without reconstruction. The most important principles include correct selection of objective nomenclatural information from subjective scientific information, using primary binomina as universal markers for nomenclatural species, uniting typified supra-species nomenclatural taxa according to their type genera, and using the universal form of typified names.

Keywords: database; taxonomic catalogue; Ephemeroptera

Which kind of information can and which cannot be a subject of database

Attempts have been made to create databases of species and/or higher taxa, including the “Tree of Life”, “Biology Catalog”, “AlgaeBase”, “Species Fungorum”, “AnimalBase”, “Fauna Europaea”, “World Porifera Database”, “Hexacorallians of the World”, “The World Spider Catalog”, “TicksBase”, “ChiloBase”, “Odonata Database”, “Orthoptera Species File Online”, “Blattodea Species File Online”, “On-line Systematic Catalog of Plant Bugs”, “ScaleNet”, “World Scarabaeidae Database”, “ScarabNet”, “Cerambycidae Database”, “W Taxa-Electronic Catalogue of Weevil names (Curculionoidea)”, “Universal Chalcidoidea Database”, “AntBase”, “Bumblebees of the World”, “Trichoptera World Checklist”, “LepIndex”, “Global Taxonomic Database of Tineidae (Lepidoptera)”,

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“Global Taxonomic Database of Gracillariidae”, “Catalogue of Craneflies of the World”, “World Turtle Database”, “AviBase” and others.

Actually, neither species nor any other natural object can be entered into computers which are not boxes or cabinets for stored natural history objects, therefore only logical objects can be stored in electronic formats. Each logical object is a concept created by a human, and if so, a question needs to be asked: who is the author of these databases? Two possibilities exist: (1) the information is created by a certain author or a limited group of authors who prepared the database; (2) the information is taken from existing literature, and all literature sources are reflected in the appropriate database as equal. These two approaches are basically different and should be clearly distinguished.

In the first case, when the database consists of statements regarded by its author(s) to be correct, this database is considered a scientific body of work, and as any scientific work it must have a clear authorship; it cannot be anonymous or attributed to some organisation with an unlimited number of contributors. Such a database should never be regarded as a single source of any field of knowledge, but it should be assumed that there is the possibility of other databases being available on the same subject, compiled by different author(s). Somebody considers that a statement that “a species *a-us* belongs to the genus *B-us* and inhabits C-landia” can be absolutely correct and that it does not require reference of the original source. Actually, the placement of the species *a-us* to the genus *B-us* reflects an author’s personal opinion that this species is phylogenetically closer to other species placed in the genus rather than to other species. This also depends on if the author accepts the principles of phylogenetic systematic or other opinions of current classification. The statement that the species *a-us* inhabits C-landia proceeds from the author’s opinion that determination of individuals from C-landia as members of the species *a-us* is correct. This is a reflection of the author’s personal species concept. Statements such as these cannot be divided into those that are correct or that are in error, which then would require correction. They are components of certain scientific concepts, those correct in one context and in error in another context at the same time; they are components of scientific knowledge, about which nobody may give final conclusion if it is correct or not. If such statements are presented as correct, it is insufficient to give references to their original source, but should additionally clearly indicate the author of the database, who selected these sources and believes that this information is correct.

In the second case, when information is taken from the literature, the database as a whole can be anonymous or can be compiled by an unlimited number of contributors. In such a database, instead of statement that the species *a-us* belongs to the genus *B-us*, it is stated that in the publication N the species *a-us* was placed in the genus *B-us*, and in the publication M the species *a-us* was placed in the genus *C-us*. Instead of the statement that the species *a-us* inhabits C-landia, it is stated that in the publication N the species *a-us* was reported from C-landia and in the publication M there was expressed doubt about the correctness of the species determination made in the publication N. Such a database can be absolutely objective and correct in the sense that it objectively reflects all literature, correctly informing the reader about which statements exist in which publications. Unlike the database which reflects opinion of its compiler and exists until this opinion will be changed, a database which objectively reflects literature can exist for an unlimitedly long time, never becoming out of date. My search of the internet has indicated that this type of

database is currently not available. To catalogue the scientific literature on the Ephemeroptera, I prepared a database “Ephemeroptera of the World”, which has been online since 28.II.2008. In this database, several novel principles are introduced, which allows input of information taken objectively from the existing literature. These principles are explained below.

The problem of species catalogues and its resolution

In the objective literature database references about species should be distributed, not among species, but among species names because a particular species concept can be a subject of disagreement: names can also be a subject of disagreement, but unlike species concepts, names can be formalised equivocally.

The main problem of catalogues of species names is the instability of binary nomenclature. Initially, a stable nomenclature was originated by Linnaeus (1752, 1753, 1758). In his classification, if a species was initially determined as belonging to a specific genus, it was given a non-homonymous binary name, which could not be changed in the future. But since Latreille (1802) introduced families and other family-group categories to the Linnaean categories of genus and order, it became easy to add new hierarchical levels above the genus category. However, a similarly easy way to add new hierarchical levels below genus level has not been suggested. According to the most recent version of the International Code of Zoological Nomenclature (Code), it is only possible to insert one level, the subgenus, between genus and species categories. Usually the subgenus category is avoided by zoologists because its spelling is inconvenient. As a result, when classification becomes more and more composite thanks to discoveries of new species and/or new characters, which help to unite taxa into natural groups, the new categories which are necessary to reflect these changes are added only above the genus category, but not below it. Due to this, an **inflation of genera** takes place: generic rank is shifted lower and lower, passing from the group for which it was initially attributed, at first to subordinate taxa, then to taxa subordinated to them, and so on.

For example, originally the generic rank was given to a holophyletic taxon which united all mayflies, and this taxon received the generic name *Ephemera*. Within this genus Linnaeus (1758) distinguished informal infrageneric groups “*Ephemera cauda trisetata*” and “*Ephemera cauda bisetata*”. Later, with an increasing number of known species the generic rank and the generic name *Ephemera* were shifted from mayflies as a whole to the group “*Ephemera cauda trisetata*”, while the former taxon *Ephemera* was assigned a rank of tribe and a family-group name Ephemerides (Leach 1815). In accordance with this, mayflies formerly placed in the group “*Ephemera cauda bisetata*” were placed in new genera *Baetis* and *Cloeon* and their binary names were changed. Later, the generic rank and the name *Ephemera* was shifted to a more particular taxon of mayflies, and in accordance with this, in the binary names of other mayflies, the generic name *Ephemera* was changed to new generic names. The last restriction of the taxon *Ephemera* was suggested by Kluge (2004), when a plesiomorphon *Sinephemera* was established, and the taxon *Ephemera* s.str. (*Ephemera*/fg11 in the hierarchical nomenclature) was restricted to a holophyletic group uniting only those species, whose male genitalia have peculiar rolled titillators. Here, as well as in many other cases, changing of the generic name in species binomina was connected not with wrong initial determination of these species, but only with subsequent resolution of classification.

In other cases, changes of binary names are connected with changing opinions about status of these or that supraspecific taxa. For example, during a rather short period from 1980 to 2000, W.P. McCafferty suggested the following changes in binary names: *Pseudocloeon alachua* – to *Baetis alachua* – to *Plauditus alachua* – to *Acentrella alachua*; *Pseudocloeon cestum* – to *Barbaetis cestus* – to *Plauditus cestus*; *Baetis propinguus* – to *Labiobaetis propinguus* – to *Pseudocloeon propinguum* (for references see the database). Taking into account that the type species of *Pseudocloeon* has not been rediscovered, and the genera *Barbaetis* and *Plauditus* have no distinct diagnoses, these changes are not definitive. Opinions about generic placement of taxa expressed by different authors can change over time.

According to the rules still retained in the fourth edition of the International Code of Zoological Nomenclature, the ending of a species name is to be changed in accordance with the gender of the generic name. Since Latin grammar is rather complicated, and in most cases not applicable to zoological names created by authors who were not familiar with it, endings of many species names appear to be undetermined and are used differently by different authors.

As a result of the change of generic names, binomina which initially were not homonymous may become secondary homonyms; in this case, according to the Code, the younger of them should be renamed reversibly. Due to this there are some cases where different authors, who have different opinions about the status of certain generic names, use different species names for the same species. For example, the same species should be determined either as *Epeorus sinitshenkovae* Tshernova 1981, or *Epeorus ninae* Kluge 1995, if *Iron* (with the species *Iron sinitshenkovae* Braasch & Zimmermann 1979) is treated as a genus or a subgenus of the genus *Epeorus*.

As a result of instability in generic names, endings of species names and species names as a whole, there appear problems with their cataloguing, especially in electronic databases. These problems can be easily and equivocally resolved if **primary binomina** are used. According to the Code, if homonymous primary binomina appear, the later names are renamed irreversibly. This means that in the whole of zoological nomenclature, each available primary binomen is absolutely unique and can never coincide with any other available primary binomen. If we write primary binomina in a form different from secondary binomina, such primary binomina become absolutely reliable markers of species (Kluge 1999a,b, 2000, 2004). In taxonomic texts primary binomen should be written with generic names at the end in square brackets. For example: *diptera* [*Ephemer*a] or *diptera* Linnaeus 1761 [*Ephemer*a]. For file names and other markers in electronic databases, other spellings of the primary binomina can be used, but in all cases there must be a species name with an original ending and the generic name that was supplied with it in the original description. Square brackets are the most conveniently used punctuation marks, if primary binomina are mentioned in texts. In catalogues of type specimens, published by the Zoological Institute of Russian Academy of Sciences and in the web database “AnimalBase”, generic names of primary binomina are also indicated at the end, but separated by a comma; this seems to be less convenient than square brackets because in text a comma can be confused with commas indicating the structure of a sentence. In the list of type specimens of Ephemeroptera in the British Museum (Kimmins 1971), generic names of primary binomina are written at the end, but included in parentheses. This is also less convenient than square brackets because generic names in parentheses can be confused with subgeneric names.

In various electronic databases (such as “ZooBank”, “Fauna Europaea”, “The Paleobiology Database”, “AlgaeBase”, “Species Fungorum”, “World Porifera Database”, “A World Catalogue of Centipedes”, “Catalogue of the Odonata of the World”, “Orthoptera Species File Online”, “Blattodea Species File Online”, “Online Systematic Catalog of Plant Bugs”, “Cerambycidae database”, “LepIndex”, “Amphibian Species of the World”, “AviBase”) records for each species are identified by a unique number/identifier. Use of these numbers would be unnecessary if instead primary binomina were used. Unlike arbitrary numbers which vary in different databases, all primary binomina are universal and can be used to create a global biodiversity database.

The problem of taxonomic catalogues and its resolution

Most catalogues of biological names follow certain classification schemes. At the same time, biological classifications based on phylogeny reflect a scientific theory and are the subject of scientific discussions. This means that no single classification is universally accepted by all active systematists. Through investigations, as new apomorphies are discovered, new holophyletic taxa are established and old plesiomorphons are abandoned, the old classification becomes out of date. Therefore, catalogues based on outdated classifications become less useful. The catalogue “Ephemeroptera of the World” lacks this shortcoming. All information included in this catalogue is objective, i.e. it does not reflect the compiler’s personal opinions about phylogeny, classification and/or nomenclature of mayflies. Classifications suggested by authors in their publications are cited and all taxa names are given in original form. My own opinion on mayfly phylogeny is expressed in a separate database “Phylogeny of Ephemeroptera” which is connected to “Ephemeroptera of the World” by numerous links, but is not to be taken as an essential component.

In an objective literature database, references about supraspecific taxa, such as those about species (see above), should be distributed not among taxa but among taxa names. Supraspecific taxa names belong to two basically different groups – typified (which are used either as ranking, or as hierarchical) and non-typified (which are used either as circumscriptional, or irregularly) (Kluge 1999a,b, 2000, 2004).

Among typified nomenclatures, the hierarchical nomenclature is more powerful and rational than the ranking one, but the ranking nomenclature is traditional and remains widely used. The database “Ephemeroptera of the World”, being objective in relation to literature sources, reflects hierarchical and ranking names as equivalent ones. Typified names can be used to form both ranking and hierarchical names of taxa; besides this, typified names can be written in a **universal form**, which does not belong to a concrete taxon. The universal form of typified names should be understood and accepted by every zoologist without discussion, because it reflects the suggested rules of the International Code of Zoological Nomenclature and ICZN Opinions, but not individual opinions. Each name in the universal form represents a separate nomenclatural object in terms of the Code. For example, both the genus *Ephemera* and the subgenus *Ephemera* with any circumscriptions and diagnoses constitute a single nomenclatural object, whose usage is regulated by a set of nomenclatural rules for genus-group names, and has one authorship – Linnaeus 1758. In the universal form, this nomenclatural object can be shortly indicated as “*Ephemera/g*”. This means “*Ephemera* as an available genus-group name, independently of its taxonomic status”. The nomenclatural object which can be

defined as “Ephemeroidea, Ephemeridae, Ephemerinae, Ephemerini, Ephemerina and any other names derived from the generic name *Ephemera* and formed from the base Ephemer- and any suffix and ending”, in the universal form can be briefly indicated as “Ephemera/f”. This means “available family-group names derived from the generic name *Ephemera*”. According to the Code, it has the authorship Latreille 1810 and has priority upon later family-group names. Both these nomenclatural objects together can be abbreviated in the universal form as “Ephemera/fg”. Such spelling of the universal form is the most convenient for taxonomic texts, being well-distinguishable from names of concrete ranking taxa – genus *Ephemera* and others. For file-names and other markers in electronic databases other spellings of the universal form can be used, not obligatory with symbols indicating family-group and genus-groups, but in all cases with the generic name.

In systematics, genus-group and family-group names are not separated. A taxon of the same circumscription and diagnosis, in different classifications, can have different ranks either of the genus-group or of the family-group. In accordance with this, in the database “Ephemeroptera of the World” references to all taxa names derived from the same generic name are compiled on one page. The title of this page and all links to it are given in the universal form. This page contains several tables, each with references to one ranking or hierarchical name. At the head of this page are listed invariable attributes of the typified name – authorship of the genus-group name, its type species, source of its designation, and authorship of the family-group name (if present). All other attributes (such as spelling, rank, systematic position, etc.) are variable, so they are given only in certain lines of the tables, being connected with corresponding literature sources.

All typified nomenclatures (both ranking and hierarchical) are organised in such a manner that in different classifications the same name can belong to different taxa, and different names can belong to the same taxon. This fact makes creating catalogues difficult. If one uses a database where typified names are united under names in the universal form, this problem is partly dissolved: in this case one file still contains data about different taxa, but data about one taxon are not dispersed in different files.

Non-typified names are not regulated by the Code, and they can be only regulated by the rules of circumscriptional nomenclature; sometimes they are used not in accordance with the circumscriptional principle, but irregularly. In the database “Ephemeroptera of the World”, references to each non-typified name are united to one file which includes a single table. This file is linked with the database “Nomina Circumscribentia Insectorum”, which contains all nomenclatural parameters of non-typified names in arthropodology.

What kind of information should be presented in a catalogue?

There is an opinion that a catalogue can contain information about nomenclatural actions only. According to this, some catalogues include the authorship of taxa names, binomen combinations and synonymy, but do not contain other references. Instead of this, we must clearly define which actions are nomenclatural. There are only three kinds of actions which should be regarded as nomenclatural: (1) publication of a new available taxon name; (2) subsequent designation of the type taxon for that name, where it was not designated in the original publication; and (3) suppression of a name by plenary power or by other means. All other actions, such as transferring a species from one genus to another, splitting a genus into several ones, establishing a new

synonymy, etc., are not nomenclatural, but are taxonomic information. According to the International Code of Zoological Nomenclature all zoologists must account for nomenclatural actions, independently if there is agreement or not. The name published following all criteria of availability has date priority, independently of quality of the publication; the earliest type designation is correct, independently of its results, and suppression of a name, made in accordance with the Code, makes this name unavailable. No one may ignore nomenclatural actions. Therefore, it is necessary to catalogue all nomenclatural actions to make this information available to all zoologists. Such a catalogue, which would include information about all nomenclatural actions in zoology (i.e. all available taxa names with their authorship and types), is extremely necessary, but, unfortunately, is not currently available. “Nomenclator Zoologicus” (Naevae 1939–1996) is the only comprehensive catalogue of genus-group names, but includes no information about type species.

Unlike true nomenclatural actions, other taxonomic actions, such as various changes of binomen combinations (marked as “**comb.n.**”), change of rank in limits of the same nomenclatural group (marked as “**stat.n.**”), establishment of new subjective synonymy (marked as “**syn.n.**”) and restoring a valid name from synonyms, are no more than opinions by certain taxonomists, and other taxonomists can choose to ignore them. Each scientist can decide if a certain species should be attributed to a specific genus, if a certain taxon should have a specific rank, or if these names belong to the same taxon (i.e. are synonyms) or to different ones. Since all zoologists use the same Code, when their opinions concerning taxonomy coincide, they use the identical names, whether independently taken from the literature or independently determined. Knowledge about taxonomic actions where a name was changed has the same (but not higher) importance as knowledge about any other scientific works – morphological descriptions, physiological experiments, ecological observations, faunistic reports, etc.

Thus, only two types of taxonomic databases are justified: (1) brief, which reflect only true nomenclatural actions – publications of available taxa names, designations of type taxa and suppressions of taxa names; (2) comprehensive, which include maximum information about published scientific data.

The database “Ephemeroptera of the World” belongs to the second type. It is rather difficult to determine the boundary between literature citations that should be required for the database or those that can be ignored. Besides taxonomic and morphological publications, which should be obligatorily included, there are many faunistic lists and ecological investigations. Some of these have been published by knowledgeable specialists, and include information which can be useful in the taxonomy of a specific taxon. Sometimes taxonomic literature cannot be understood without knowledge of certain faunistic or ecological publications, and such publications should be included in the database obligatorily. But there are also many faunistic lists which duplicate other lists and many synecological investigations, where mayfly species are merely mentioned among other aquatic organisms. It would be ideal to include these citations in the database, if possible, but not obligatory.

Structure of the database “Ephemeroptera of the World”

The database “Ephemeroptera of the World” consists of a large number of HTML files connected by numerous links. These files are: (1) front-page with table of contents; (2) introduction; (3) instructions to contributors; (4) list of arbitrary signs;

(5) 27 files with a list of references; (6) alphabetic index of supra-species taxa names (both typified and non-typified); (7) 26 files with a list of species names; (8) several thousands of species-name files; (9) several hundred typified-name files; (10) and several dozens of circumscription-name files. Each page has a banner with the title of the database and links to the front-page and to the alphabetic indices of supra-species and species names.

In the alphabetic list of supra-species taxa names, all typified names are given in the universal form. In the alphabetic list of species names, all names are given as primary binomina. For example, instead of “*Pseudocloeon alachua*”, “*Baetis alachua*”, “*Plauditus alachua*”, “*Acentrella alachua*”, here is given a single name *alachua* [*Pseudocloeon*] with a link to corresponding species-name page. This results in a more concise format.

Species-name pages

The file-name of each species-name page includes the primary binomen. The title of this page represents a primary binomen with full authorship. Then a table on species, subspecies and informal infra-species names is provided. This table contains all citations of this species-group name, each in a separate line. All citations are given in chronological order, independently of species binomina. Each citation, occupying one line, contains the following fields: (1) “**sources:**”— author, year and sometimes pages of the cited publication; (2) “**subjects:**”— by special symbols here are indicated stages of development which are described, figured and/or discussed in the cited publication, or geographical areas from which the species was reported, or other data contained in the cited publication (independently, if the compiler of the database regards it to be correct or not); (3) “**valid names:**”— that binomen, which the author of the cited publication regarded to be correct; besides genus and subgenus, here can be also indicated as informal taxon (for example, group of species); if the cited publication does not contain a certain unique binomen accepted by the author, the systematic position of this species or status of this species name is indicated, as was proposed in the cited publication; if the species is designated as the type of a generic name, this fact is also indicated here; if the name is regarded to be a junior synonym, in the field “valid name” there is given its older synonym with a link to the corresponding page; (4) “**invalid synonyms:**”— that species names which the author of the cited publication regarded to be junior or invalid synonyms, with links to the corresponding pages. For example the page “*peterseni* [*Ecdyonurus*]”:

peterseni Lestage 1930 [*Ecdyonurus*]

sources	subjects	valid names	invalid synonyms
Lestage 1930	...	<u><i>Ecdyonurus</i></u> <i>Peterseni</i> nom.n.	= <i>Ecdyonurus hyalinus</i> Esben-Petersen 1916 (non Ulmer 1912)
Tshernova 1941	...	<i>Ecdyonurus peterseni</i>	
Tshernova 1964	...	<i>Ecdyonurus peterseni</i>	
Demoulin 1973	...	<u><i>Afronurus</i></u> <i>peterseni</i> comb.n.	
Illies 1987	...	<u><i>Ecdyonurus</i></u> <i>peterseni</i>	

(continued)

sources	subjects	valid names	invalid synonyms
Tshernova 1980	...	<u>Cinygma peterseni</u> comb.n.	
Tshernova et al. 1986	...	<u>Cinygma peterseni</u>	= <i>Cinygma <u>abnorme</u></i> syn.n.
Flowers 1986	...	syn. <i>Cinygma <u>lyriformis</u></i> syn.n.	

Here underlined words are linked, corresponding to the pages “Ecdyonurus/fg”, “Afronurus/fg”, “Cinygma/fg”, “*hyalinus* [Ecdyonurus]”, “*abnormis* [Heptagenia]” and “*lyriformis* [Ecdyonurus]”.

Various opinions about synonymy and misidentifications are given as the following: if in the later publication a correction was given, author and year of this publication are written in the field “invalid synonyms”, with an exclamation mark in front. For example, in the page “*longicauda* [Baetis]”:

sources	subjects	valid names	invalid synonyms
...
Rolands 1856	...	<i>Baetis longicauda</i>	! Eaton 1871
Hagen 1863	...	<i>Baetis longicauda</i>	! Eaton 1871
Eaton 1871	...	<u>Heptagenia longicauda</u> comb.n.	= <i>Baetis <u>subfusca</u></i> syn.n. sensu Hagen 1863 = <i>Heptagenia <u>flavipennis</u></i> sensu Ronalds 1856 = <i>Heptagenia <u>venosa</u></i> ! Kimmins 1942
...
Kimmins 1942	...	<i>Heptagenia longicauda</i>	= <i>Heptagenia <u>flavipennis</u></i> syn.n. = <i>Baetis <u>cerea</u></i> syn.n. sensu Eaton 1871 = <i>Ecdyonurus <u>dispar</u></i>
...

This means that Eaton (1871) regarded *Baetis subfusca* to be a junior subjective synonym of *Heptagenia longicauda*, the species identified by Hagen (1863) as *Baetis longicauda* he regarded to be *Heptagenia flavipennis* and the species identified by Rolands (1856) as *Baetis longicauda* was regarded to be what he called *Heptagenia venosa*. Kimmins (1942) regarded *Heptagenia flavipennis* and *Baetis cerea* to be junior subjective synonyms of *H. longicauda*; species identified by Eaton (1871) as *Heptagenia longicauda*, he regarded to be *Ecdyonurus dispar*. If we follow the link from the underlined word “*subfusca*” we will come to the page “*subfusca* [Baetis]”, where it is indicated that this name was regarded by Eaton (1871) to be a synonym of *Heptagenia longicauda* (with back link to the page “*longicauda* [Baetis]), and was regarded by Kimmins (1942) to be a synonym of *Ecdyonurus dispar* (with link to the page *dispar* [Baetis]):

sources	subjects	valid names	invalid synonyms
Stephens 1835	...	<u>Baetis subfusca</u> sp.n.	
...	

(continued)

sources	subjects	valid names	invalid synonyms
Eaton 1871	...	syn. <i>Heptagenia longicauda</i> syn.n.	
...	
Kimmins 1942	...	syn. <i>Ecdyonurus dispar</i> syn.n.	
...	

Besides the table on species names, the same page can give another table – on informal supra-species taxa, whose arbitrary names are formed from this species name (for example, “group *venosus*”). This table includes the same fields as in the species-table – “sources”, “subjects”, “actual name” (instead of “valid name”) and “synonyms”, but also includes fields “higher taxon”, “subordinated taxa” and “valid names”. The last one (“valid names”) is used for links to subsequently established valid generic names, not for data from the same source.

Typified-name pages

Each typified-name page unites all available data about genus-group and family-group taxa, whose names are formed from the same generic name. The file-name of each typified-name page includes this generic name. The title of this page represents a typified name in the universal form. Below it full authorship of the family-group and genus-group names is given with the type species and source of its designation. Then if available one or several tables follow, each with a separate typified name: table(s) with hierarchical name(s) (if present) – from the highest (accompanied with the smaller number) to the lowest (accompanied with the larger number); table(s) with family group name(s) – from the highest to the lowest; tables with genus-group name – genus and subgenus, if present. Then a list of **subordinated taxa** follows – this is an integral list of all supra-species taxa subordinated to any taxon of this page. This list is compact, because all taxa names are given in the universal form, being linked to corresponding pages. Then a list of **binomina** follows – this is an integral list including all species names, which at any time were combined with this generic or subgeneric name; these names are given as primary binomina and are linked with the corresponding pages. Then a table of undetermined species follows, which contains species reported in the literature as belonging to this genus without species names.

Each table for a typified name has the following fields: (1) “**sources:**” – author, year and sometimes pages of the cited publication; (2) “**subjects:**” – by special symbols here are indicated stages of development which are described, figured and/or discussed in the cited publication, or other data contained in the cited publication (independently, if the compiler of the database regards it to be correct or not); (3) “**valid names:**” – name in that spelling, which was used in the cited publication; if the name is regarded to be a junior synonym, in the field “valid name” there is given its older synonym, with a link to the corresponding page; (4) “**invalid synonyms:**” – that taxa names which the author of the cited publication regarded to be junior or invalid synonyms, including links to the corresponding pages; (5) “**higher taxon:**” – that taxon to which the author of publication attributed the taxon under consideration; (6) “**subordinated taxa:**” – that taxa which the author of publication regarded to be directly subordinated to the taxon under consideration. For example:

Acanthametropus/fg

f: Acanthametropodinae Edmunds (in Edmunds & Allen & Peters) 1963: 10

g: *Acanthametropus* Tshernova 1948: 1453, typus *A. nikolskyi* Tshernova 1948 (design. orig.)

Acanthametropus/fg1

sources:	subjects:	valid name(s):	syn.:	higher taxon:	subord. taxa:
Kluge 2004 ...		Acanthametropus/ fg1		<u>TRIDENTISETA</u> = <u>Baetis/fg1</u>	<i>Analetris</i> Acanthametropus/ fg2

Acanthametropus/fg2

sources:	subjects:	valid name(s):	syn.:	higher taxon:	subord. taxa:
Kluge 2004 ...		Acanthametropus/fg2		Acanthametropus/fg1	

familia Acanthametropodidae

sources:	subjects:	valid name(s):	syn.:	higher taxon:	subord. taxa:
McCafferty 1991	...	Acanthametropodidae stat.n.		<u>ARENATA</u>	<i>Acanthametropus</i>
Tomka & Elpers 1991	...	Acanthametropodidae		<u>EPHEMEROPTERA</u>	<i>Acanthametropus</i> <i>Analetris</i> <i>Siphuriscus</i>
...			

subfamilia Acanthametropodinae

sources:	subjects:	valid name(s):	syn.:	higher taxon:	subord. taxa:
Edmunds et al. 1963	...	Acanthametropodinae subfam.n.		<u>Siphonuridae</u>	<i>Acanthametropus</i>
Edmunds & Koss 1972	...	Acanthametropodinae		Siphonuridae	<i>Acanthametropus</i> <i>Analetris</i> <i>Siphuriscus</i> <i>Stackelbergisca</i>
...

genus Acanthametropus

sources:	subjects:	valid name(s):	syn.:	higher taxon:	subord. taxa:
Tshernova 1948 ...		<i>Acanthametropus</i> gen.n.		<u>Ametropodidae</u>	
Demoulin 1955 ...		<i>Acanthametropus</i>		Ametropodinae	
Edmunds & Allen 1957	...	<i>Acanthametropus</i>	= <u>Metreturus</u> syn.n.	<u>Siphonurinae</u>	
...			

taxa subordinated to *Acantametropus/fg1*, *Acanthametropodidae*, *Acanthametropodinae*, *Acanthametropus*:

Analetris/fg

Metreturus/g

Siphuriscus/fg

Stackelbergisca/g

binomina with *Acanthametropus*:

nikolskyi Tshernova 1948 [*Acanthametropus*]

pecatonica Burks 1953 [*Metreturus*]

Acanthametropus spp.:

sources	subjects	actual arbitrary names	synonymous arbitrary names	valid names
Berner 1977	...	<i>Acanthametropus</i> sp.		
...		

Here underlined words are linked, correspondingly, to the pages “*Tridentiseta*”, “*Baetis/fg*”, “*Arenata*”, “*Ephemeroptera*”, “*Siphonurus/fg*”, “*Ametropus*”, “*Metreturus/g*”, “*Analetris/fg*”, “*Siphuriscus*”, “*Stackelbergisca/g*”, “*nikolskyi [Acanthametropus]*” and “*pecatonica [Metreturus]*”.

Circumscriptional-name pages

The form of these pages is similar to that of typified-name pages. Below the title, instead of authorships of family-group and genus-group names, there is authorship of circumscription name, data about original circumscription, the oldest typified name (with link to corresponding page) and link to the database “*Nomina Circumscribentia Insectorum*”. All data is given in a single table with the same fields as the typified-name tables.

Present condition of the database “Ephemeroptera of the World”

At the present time (July 2009), the database contains more than 5000 taxa names, and among them are 61 non-typified taxa names, 779 genus-group names and 4489 primary species binomina. The genus-group and species-group names are in the most part available, but a few are unavailable. The total number of all typified names, including all names of superfamilies, families, subfamilies, tribes, subtribes names etc. is much higher than 779. The number of primary species binomina (4489) is much higher than the number of described species because all objective and subjective synonyms are included. Total number of all species binomina, if all combinations of species and generic names are counted is also much higher. These are all or nearly all the taxa names currently available, and in the future these numbers will increase with publication of new taxa.

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Internet databases

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- Amphibian Species of the World: an Online Reference. <http://research.amnh.org/herpetology/amphibia/index.php>
- AntBase. <http://antbase.org>
- AviBase – the world bird database. <http://avibase.bsc-eoc.org/avibase.jsp?pg=home&lang=EN>
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