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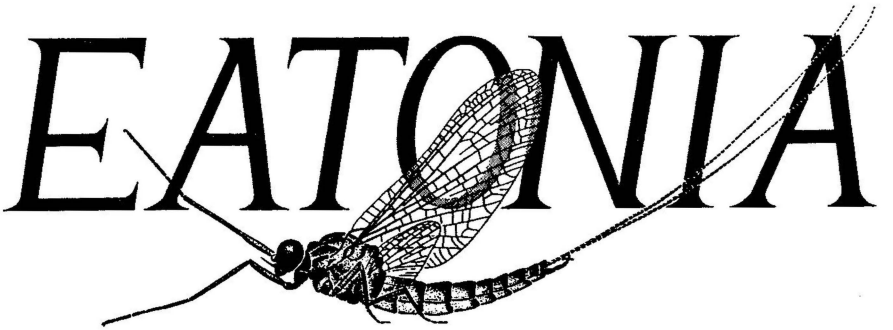
# Eatonia No. 17, Sep. 10, 1973

William L. Peters

Janice Peters




No. 17 Florida A & M University, Tallahassee September 10, 1973

Three special features appear in this issue of Eatonia. We thank I. Müller-Liebenau and V. Puthz for their work in preparing the Second International Conference on Ephemeroptera. We further thank J. J. H. Szent-Ivany and E. I. V. Ujházy for the article on mayflies in folklore, and we are most grateful to U. Jacob for the illustrations appearing before News and Notes and Recent Ephemeroptera Literature.

In addition, we thank all Ephemeroptera workers who have sent reprints, and continue to request your help in compiling future issues.

Individuals who wish to request Eatonia should write the editor, University P. O. Box 111, Florida A & M University. University and institutional library requests should be addressed to Dr. N. E. Gaymon, Director of Libraries, University P. O. Box 78, Florida A & M University, Tallahassee, Florida 32307.

## EPHEMEROPTERA IN THE REGIMEN OF SOME NEW GUINEA PEOPLE AND IN HUNGARIAN FOLKSONGS

By Joseph J. H. Szent-Ivany and Elisabeth I. V. Ujházy

Many insect species of various orders and large spiders of the genus Selenocosmia (Mygalomorpha, Theraphosidae) are used by the people of Papua New Guinea to supplement their diet. Amongst the insects, the following species were recorded as food: the large cricket Brachytrypes achatinus Saussure; adults and instars of the large, spiny, black or brown coloured stick insects ("walking sticks") of the genus Eurycantha; adults of several species of tussock moths (Lymantriidae); adults and nymphs of the shield bug, Agapophyta boschmai Blöte (Pentatomidae), found in dense populations on pigeon pea (Cajanus cajan); larvae of the palm weevil, Rhynchophorus bilineatus (Montrouzier); the coconut rhinoceros beetle, Scapanes australis (Boisduval);

the giant Papuan rhinoceros beetle Oryctes centaurus Sternberg, common in sago palms, sometimes also in coconut plantations; and adults of the melolonthid pasture grub Lepidiota vogeli Brenske, at times a serious pest of pastures, garden lawns, golf courses, and air strips in the Central Highlands [Szent-Ivany 1956(1958); Catley 1963]. The pasture beetle, Lepidiota vogeli, is considered by the people of the Asaro Valley a delicacy. The adult beetles swarm in very large numbers for a short while after sunset or sometimes during the day in very cloudy weather. The beetles are collected in large beer bottles and cooked on open fire. Mr. R. S. Carne, Regional Agricultural Officer in the Central Highlands (in 1954; now Principal Agronomist at Highlands Agricultural Experiment Station, Aiyura) tasted the cooked chafers and he found them quite palatable [Szent-Ivany 1956(1958)]. Many other insect species were found as supplementary food amongst the people of the mountainous Simbai area of the Madang District of New Guinea by Dr. R. Rappaport and Professor A. Vajda of Columbia University (New York). These are included in a comprehensive paper on the economic insects of Papua New Guinea (Szent-Ivany; paper in preparation).

During the senior author's agricultural insect surveys in the Eastern Highlands in the 1950s, Mr. Jim Taylor, coffee planter at Goroka and one of the leading pioneers of the Central Highlands of New Guinea, mentioned that at the time when he served as a patrol officer with the Administration of the former Mandated Territory of New Guinea in the 1930s, he observed the swarming of a mayfly in very dense populations above the Sepik River in northeastern New Guinea. The mayflies were cooked and eaten by the people living in the area. Mr. Taylor himself prepared a meal from this mayfly species and offered it to one of his Australian guests.

When the senior author had the pleasure of meeting Dr. William L. Peters during the XIV International Congress of Entomology in Canberra, he mentioned to him Mr. Taylor's noteworthy observations. He also told Dr. Peters that in Hungary there is a well-known folksong in which the swarming of another mayfly is poetically described and the insect is symbolically mentioned in connection with short-lived loves. Later Dr. Peters asked Szent-Ivany to write a short article on these two subjects for Eatonia and this request was gladly fulfilled. Whilst discussing the folksong with Mrs. Elisabeth I. V. Ujházy, one of the best "connoisseurs" of folksongs in the Hungarian community of South Australia, she told Szent-Ivany that her uncle, Dr. Dezsö Mihalik, a well-known songwriter and composer in Northern Hungary (later Czechoslovakia) wrote the text of a very melodious folksong in which the short life of the adult of the large European mayfly, Palingenia longicauda (Olivier), is mentioned as a symbol of man's love. The late Dr. D. Mihalik (who died a few years ago at the age of 90) composed a beautiful gypsy type melody to the sentimental poem. Because of Elisabeth Ujházy's vast knowlege of Hungarian folksongs and because of her meticulous job of translating the text of her uncle's song, Szent-Ivany asked her to be co-author of this paper.

## New Guinea

To obtain some more information on Mr. Taylor's observations and on the exact location where the observations were made, Szent-Ivany wrote a letter to Mr. Taylor who in his reply of the 17th March 1973 gave a fine description of his experience on the mayfly meal and on the swarming of the insect in dense populations. We cite the relevant part of his letter in the following paragraphs:

# EATONIA

A NEWSLETTER FOR EPHEMEROPTERISTS

Prepared by the S. H. Coleman Library, Florida A & M University

in cooperation with

School of Agriculture and Home Economics, Florida A & M University

Department of Biology, University of Utah

Janice G. Peters - - - - - - - - - - - - - - - - - - - - - - - Editor
William L. Peters and George F. Edmunds, Jr. - Editorial Committee

This public document was promulgated at an annual cost of $620.00 or $0.33 per copy for the purposes of (1) acquainting all workers with the current research of others, (2) promoting increased knowledge of the literature, especially among workers recently entering the field, and (3) promoting more precise methods and techniques of studying Ephemeroptera. It appears twice each year.


"I remember the appearance of the May-flies en masse... Observing from a hillock at Ambunti about 100 ft above sea level, I could see the river flowing for about 2000 metres towards the village of Malu. Several hectares of the river were covered by countless numbers of May-fly.

"They were pale gold in colour, reddening a little where the concentration of the swarm was greatest. They were mostly above the water but apparently some on the water. On land they would have resembled a field of ripening corn.

"They could be collected and were so in containers, dishes, wooden or metal, buckets or canisters by drawing the vessel (container) along the surface of the water or through denser parts of the swarms.

"At the time of which I am speaking, about September or October 1931, I had an auditor from headquarters of Rabaul as my guest.

"I knew that the river folk consumed the May-fly as food and I treated it as if it were white bait-fish fry — and cooked them in batter and served the dish in place of a fish course.

"The auditor expressed his pleasure at the dish but did not forget it. I met him in Canberra 14 years later and he repeated his encomium but he may have had other thoughts concealed.

"To me they (the May-fly cakes) were delicious. I was younger then." (Taylor 1973, pers. commun.)

Mr. Taylor was unable to give me the specific name of the mayfly but Dr. Peters has kindly suggested that it could have been a species "of the genus Plethogenesia in the family Palingeniidae" [suborder Plectoptera, superfamily Ephemeroidea in Tshernova's system (1970) (cf. Eatonia 13-14, January 1972)].

## Hungary

Animals of various phyla appear in folksongs of European nations. As in other countries, also in Hungary, mainly vertebrates (especially birds) are subjects of the text of popular tunes, in both original Hungarian folksongs and "gypsy songs." Such are the nightingale (Luscinia m. megarhynchos Brehm), the blackbird (Turdus m. merula L.), the golden oriole [Oriolus o. oriolus (L.)], the reed warbler (Acrocephalus ae. aerundinaceus L.), the swallow (Hirundo r. rustica L.), the skylark (Alauda a. arvensis L.), the great titmouse (Parus m. major L.), the turtle-dove [Streptopelia t. turtur (L.)], the stock-dove (Columba oe. oenas L.), the wood-pigeon (Columba p. palumbus), the heron (Ardea c. cinerea L.), the crane [Grus g. grus (L.)], and the white stork [Ciconia c. ciconia (L.)] (for the nomenclature of these birds see Keve, 1960). Amongst the mammals mainly domestic animals are mentioned, but the fox and the house mouse also occur in some, the latter in a well-known, fast "csárdás"-song (csárdás is one of the national folkdances in Hungary). Amongst other vertebrates we know only of two: the frog Rana esculenta L. and the viper Vipera berus L. which occur in at least one song each. The text of both of these is rather humoristic and the one on the viper is a fiery csárdás which used to be played in our county by the gypsy-band as the first csárdás at the dance around the open fire upon conclusion of the vintage. More than half of the songs on birds which we know have sentimental, sad melodies and texts. Only a few invertebrates are mentioned in Hungarian folksongs. Such are the ladybird beetle, Coccinella septempunctata L., the common cockchafer, Melolontha melolontha L., and the large mayfly Palingenia longicauda. Of the two songs in which Palingenia is mentioned, the first one (cited below) is well-known throughout Hungary and the world where Hungarians live scattered in smaller or larger communities. It is often sung during celebrations, parties, etc. by both country and city people. We were unable to trace its composer and songwriter. It is probably a rather old folksong of the gypsy type melody. In its text a poetical description is given of the hundreds of thousands of Palingenia swarming above the River Tisza, the second largest river of Hungary, and turning its surface to a "cemetery" when they drop onto the river after a very short life, as short as the love of the songwriter with his sweetheart.

It is the large size and the appearance in very dense populations during the swarming of the adults which must have drawn the attention of non-entomologists and simple country people to Palingenia longicauda. The adult insect is 25-38 mm long and its cerci measure 7-8 centimeters which gives a full length of close to 12 cm to some individuals (Dudich & Loksa 1969, p. 395). The species was described by Olivier in 1791 and it has been placed into the genus Palingenia by Burmeister in 1839. It occurs in various parts of Hungary but it appears to be most abundant in the River Tisza. Besides Hungary it occurs in some other European countries, such as Germany and France (Walker 1853) and Czechoslovakia (Obenberger 1959).* The saprophytic larvae live in holes in the mudbank of rivers. The swarming of Palingenia longicauda above

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* There is an excellent photograph of this phenomenon in the River Danube, Bulgaria, by Russev (1973) [84], Ed.

the River Tisza usually occurs in late spring — early summer, mostly between the 10th and 20th of June (Ujhelyi in Móczár 1969). The exitus of the adults as in some other species is sudden and spectacular. Hundreds of thousands of adults cover the surface of the Tisza in thick layers. The river folks call them the "Flowers of the Tisza." The Hungarian vernacular is "tiszavirág" which means in verbal translation to English: "Tisza-flower." However, the collective vernacular "kérész" of the whole order of Ephemeroptera is also referred sometimes to P. longicauda as we see in the first song. We cite here both songs, first with their original Hungarian text and then we give a free English translation (that of the first by Szent-Ivany and of the second by Ujházy).

First Song — original Hungarian text (songwriter and composer unknown)

Amikor tavasszal a Tisza virágzik,
Futó habja felett ezer kérész játszik.
Egy sem él odáig míg olvasok százig:
Temetö a Tisza mikor kivirágzik.

A mi szerelmünk is ilyen kérész-élet,
Alighogy kivirult mindjárt semmivé lett.
De az én két szemem hulló könnytöl ázik:
Úgy vágyom a Tiszát mikor kivirágzik!

Free English translation:

When in the spring the Tisza blossoms,
Thousands of mayflies play above its running ripples.
None of them lives until I count hundred:
The Tisza turns to a grave-yard when it blossoms.

Our love was like the life of a mayfly.
It ended before it really began to blossom.
But with tears in my eyes I am longing
For the Tisza when it blossoms!

Second Song — original Hungarian text by Dr. D. Mihalik

Sötét körisfa alatt néztem a szemébe;
Véletlenül ott maradt kezem a kezébe.
Mindig mondta hogy szeret, hogy sírig hün szeret —
Tavaszi szél hozta el hozzám a levelet.

Lekaszálva már a rét, tarlón jár a posta.
Az utolsó levelet az öszi szél hozta;
Még azt irja, hogy szeret, de érzem már vége:
Tiszavirág, délibáb a férfi hüsége.

English translation by Elisabeth Ujházy:

Our eyes met under a shady ash-tree;
My hands slipped in his accidentally.
He swore his love and faithfullness —
The breeze of spring brought his letters.

The meadows are mowed, the land is bare.
His last letters came by the autumn air;
He still writes of love, but I know its over:
Man's love is like mirage and Tisza-flower.

Although the text of the second song was written by a man (the late Dr. D. Mihalik), the contents indicate that the composer and songwriter interpreted the words of a girl who feels that her sweetheart does not love her anymore. Although he still writes, apparently from the wording of his letters she knows that soon it will be all over and in her despair she generalizes, saying that all men are the same: their love lasts only for a short time, as short as the life of the mayfly or the presence of the fata morgana above the horizon which is so often seen during the summer on the great Hungarian Plain.

Hungarians are very musical people. They have innumerable songs with original old Hungarian melodies (collected in country areas by such famous composers as Béla Bartók and Zoltán Kodály) and with the typical gypsy melodies, both types being equally favoured by the authors of this paper. Both of us are interested in the collecting of folksongs and one of us (Szent-Ivany) besides his professional interests (various aspects of entomology and zoogeography) has two more hobbies: the collecting of animal stamps and that of folksongs in which animals are mentioned. It would not be surprizing if in the future we would come across some more songs about mayflies.

We are grateful to Mr. Jim Taylor for the lively description of his observations and experiences in New Guinea and to Mr. H. T. Condon, Curator of Birds at the South Australian Museum (Adelaide), for the checking of the English vernaculars of birds mentioned in this paper.

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# News and Notes

Vorläufige Mitteilung betreffend das 2. Internationale Ephemeropteren-Symposium 1974 in Polen

Wie bekannt, wurde bei unserer 1. Internationalen "Conference on Ephemeroptera" in Tallahassee, 17.-20. August 1970, beschlossen, die nächste Tagung im Jahre 1974 in Europa abzuhalten. — Dr. Ingrid Müller-Liebenau und Dr. Volker Puthz, die die Vorbereitung und Organisation übernommen hatten, haben nach Rücksprache mit den Herren Doc. Dr. R. Sowa und Doc. Dr. S. Wróbel (Kraków, Polen) sich darum bemüht, diese Konferenz in Kraków abzuhalten.

Inzwischen hat Dr. Wróbel einen Plan für dieses Symposium der Polnischen Akademie der Wissenschaften vorgelegt und um Genehmgigung gebeten, dieses Symposium am Institut für Limnologie der Polnischen Akademie der Wissenschaften abhalten zu dürfen. Die Anwort auf diesen Antrag wird im Juli 1973 erwartet.

Am 17. Mai 1973 war Herr Dr. Wróbel persönlich in Plön, so dass nähere Einzelheiten bezüglich des Symposiums mit Dr. Müller-Liebenau besprochen werden konnten.

Als Zeitpunkt ist der 1.-5. Juni 1974 vorgesehen (Herbst 1974 ist nicht möglich wegen Internationaler Limnologentagung in Kanada und Plecopteren-Symposium in Washington).

31. Mai 1974: Anreise nach Kraków

1. und 2. Juni: Vorträge

3. Juni: ganztägige Exkursion an den Raba-Fluss mit Sammelmöglichkeit

4. Juni: weitere Vorträge

5. Juni: ganztägige Exkursion an den Dunajec-Fluss (voraussichtlich keine Sammelmöglichkeit)

6. Juni: Abreise von Kraków und Ankunft in Plön.

Im Anschluss an die Tagung in Kraków ist eine ca. 4 bis 5-tägige Exkursion nach Plön (Max-Planck-Institut für Limnologie) und nach Schlitz (Limnologische Flussstation des Max-Planck-Institut für Limnologie) vorgesehen.

Zurzeit wird noch die endgültige Zusage der Polnischen Akademie der Wissenschaften erwartet, dass die Tagung in Kraków stattfinden kann. Nähere Einzelheiten werden zusammen mit den Einladungen mitgeteilt. — Es ist vorgesehen, vor Beginn der Tagung die Abstrakte der zu haltenden Vorträge zu drucken, so dass jeder Teilnehmer diese Abstrakte schon zu Beginn der Tagung in Händen hat. Die vollständigen Vorträge können wahrscheinlich später in den Acta Hydrobiolo-

gica der Polnischen Akademie der Wissenschaften gedruckt werden.

- I. Müller-Liebenau
- V. Puthz
(1. Juli 1973)

* * * * *

Udo Jacob (Dresden) has completed his dissertation at the Fakultät für Mathematik und Naturwissenschaften des Wissenschaftlichen Rates der Karl-Marx-Universität Leipzig (1972). It is titled "Beitrag zur autochthonen Ephemeropterenfauna in der Deutschen Demokratischen Republik," and treats Ephemeroptera of the West Palearctic as well as those of the DDR. The thesis includes a good amount of taxonomic revision and species are classified ecologically, biologically, zoogeographically, and according to position in a water classification system. Sixty-seven species of Ephemeroptera are autochthonal in the DDR, and seventeen new species records are given for this region. In addition, the phylogenetic systematic method is used to diagram the classification and relationships of the West Palearctic Ephemeroptera.

* * * * *

The Proceedings of the First International Conference on Ephemeroptera have been published by E. J. Brill, Oude Rijn 33a, Leiden, Holland, and are available from the publisher for 160 guilders. Articles from the Proceedings are abstracted in this issue of Eatonia.

We have recently seen four other books on aquatic biology which are worth mention. The first, edited by Cairns and Dickson, is a collection of papers presented at the Symposium on Biological Methods for the Assessment of Water Quality in Los Angeles, 1972, and contains works by A. R. Gaufin; W. A. Brungs; J. Cairns, Jr., K. L. Dickson & G. Lanza; T. W. Beak, T. C. Griffing & A. G. Appleby; and others. The second, edited by Lamotte and Bourlière, is devoted to collecting methods in fresh and salt water. The chapter, "L'échantillonnage des peuplements d'invertébrés des eaux continentales courantes," by G. Tuffery, gives a good, well-illustrated, comparative account of collecting and sampling methods. The other two books are written at a general level for beginning students. Ecology of Fresh Water gives a clear account of different areas of study in aquatic ecology, while the book Environments in Profile is written almost as a laboratory manual. It gives detailed comparative methods of testing water and sampling habitats, as well as a simple key to types of organisms inhabiting fresh water.

1. Cairns, J., Jr. & K. L. Dickson, Eds. 1973. Biological Methods for the Assessment of Water Quality. ASTM STP 528, Am. Soc. Testing & Materials, Philadelphia. 256 p.
2. Lamotte, M. & F. Bourlière, Eds. 1971. Problèmes d'Écologie: l'Échantillonnage des Peuplements animaux des Milieux aquatiques. Masson & Co., Paris. 294 p.
3. Brown, A. L. 1971. Ecology of Fresh Water. Heinemann Educational Books, London. 129 p.
4. Kaill, W. M. & J. K. Frey. 1973. Environments in Profile: An Aquatic Perspective. Canfield Press, San Francisco. 206 p.

Addition to Eatonia Index (Eatonia #16):

p. 8. The species Euthyplocia punensis is described from female imagos. Twelve figures are included with the description.

* * * * *

Three new papers have been published on classificatory and phylogenetic systems in Ephemeroptera. We continue to summarize these important works.

I. Koss (1973) [47] gives a phylogenetic diagram and classification of Ephemeroptera based primarily on morphological characters of eggs. After each superfamily, families are listed in order of specialization.

Superfamily Heptageniodea
- Siphlonuridae
- Siphlaenigmatidae
- Baetidae
- Metretopodidae
- Oligoneuriidae
- Heptageniidae
- Ametropodidae

Superfamily Leptophlebioidea
- Leptophlebiidae

Superfamily Ephemeroidea
- Behningiidae
- Potamanthidae
- Euthyplociidae
- Ephemeridae
- Polymitarcidae

Ephemerelloidea
- Ephemerellidae
- Tricorythidae

Caenoidea
- Neoephemeridae
- Caenidae

Prosopistomatoidea
- Baetiscidae
- Prosopistomatidae

II. Landa (1973) [50] presents a phylogeny of Ephemeroptera at the family level based on nymphal internal anatomy (tracheal system, Malpighian tubes, and nerve bands).

A. First evolutionary line characterized by simple tracheal system

1. Siphlonuridae, Rallidentidae, Ameletopsidae, Baetidae

2. a) Oligoneuriidae, Isonychiidae, Coloburiscidae
   b) Heptageniidae, Arthropleidae

B. Second evolutionary line characterized by profound changes in tracheal system

1. a) Polymitarcidae, Euthyplociidae
   b) Palingeniidae, Ephemeridae, Potamanthidae

(Behningiidae placed between the ephemerid-branch and the leptophlebiid-branch)

2. a) Leptophlebiidae, primitive group
   b) Leptophlebiidae, specialized group

3. a) Leptohyphidae, Ephemerellidae
   b) Tricorythidae, Neoephemeridae, Baetiscidae, Caenidae, Prosopistomatidae

4. Oniscigastridae, Chiloporteridae

III. A classification and phylogeny of Ephemeroptera based primarily on nymphal gills, body form, development of hairs on cerci, and adult wing venation is given by Riek (1973) [83].

Superfamily Prosopistomatoidea
Baetiscidae
Prosopistomatidae

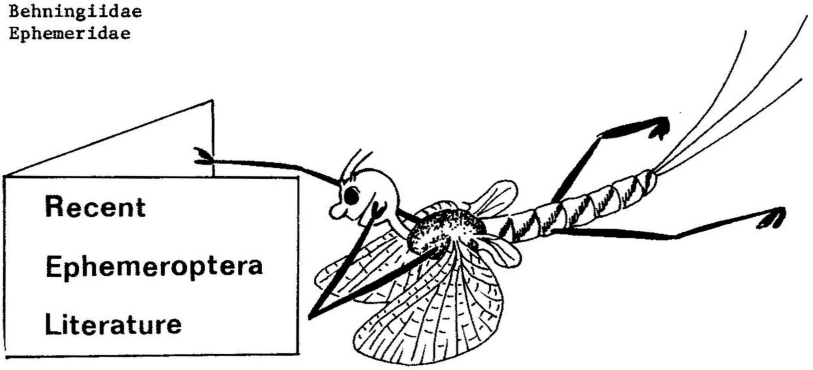
Superfamily Caenoidea
Neoephemeridae
Caenidae

Superfamily Baetoidea
Siphlonuridae (Oniscigastrinae, Rallidentinae, Nesameletinae, Siphlonurinae, Metretopodinae, Acanthametropodinae, Ametropodinae, Pseudironinae)
Baetidae (Callibaetinae, Baetinae, Siphlaenigmatinae)
Ameletopsidae (Ameletopsinae)
Oligoneuriidae (Oligoneuriinae, Chromarcyinae, Isonychiinae, Coloburiscinae)

Superfamily Heptagenioidea
Heptageniidae

Superfamily Leptophlebioidea
Leptophlebiidae
Ephemerellidae
Tricorythidae

Superfamily Ephemeroidea
Behningiidae
Ephemeridae




Compiled by

William L. Peters and George F. Edmunds, Jr.

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EATONIA INDEX

compiled by Janice G. Peters

The numbers in brackets refer to paper numbers listed in the Recent Ephemeroptera Literature. When a paper treats two or more topics, or when it easily could be treated in different ways, we give one abstract with short cross references at the end of other significant sections

TAXONOMY

BAETIDAE

Baetis aurantiaca Burmeister
SEE Heptageniidae, Ecdyonurus aurantiacus

Baetis beskidensis sp. n. (nymph; Poland) Sowa (1972) [88] p. 711.

Baetis bundyi sp. n. (nymph; Northwest Territories, Canada) Lehmkuhl (1973) [53] p. 343.

Baetis calcaratus sp. n. (male & female imagos, nymph, egg; Poland) Keffermüller (1972) [41] p. 24.

Genus Baetodes Needham & Murphy (redescription) Mayo (1972) [61] p. 226.

Baetodes andamagensis sp. n. (male nymph; Peru) Mayo (1972) [61] p. 231.

Baetodes bellus sp. n. (male nymph; Vera Cruz, Mexico) Mayo (1972) [61] p. 236.

Baetodes chilloni sp. n. (female nymph; Peru) Mayo (1972) [61] p. 228.

Baetodes fortinensis sp. n. (male nymph; Vera Cruz, Mexico) Mayo (1972) [61] p. 238.

Baetodes obesus sp. n. (female nymph; Vera Cruz, Mexico) Mayo (1972) [61] p. 233.

Baetodes sancticatarinae sp. n. (male & female nymphs; Santa Catarina, Brazil) Mayo (1972) [61] p. 240.

Baetodes solus sp. n. (female nymph; Peru) Mayo (1972) [61] p. 231.

Baetodes spinifer Traver (spelling emended) Mayo (1972) [61] p. 226.

Baetodes spiniferum Traver
SEE Baetodes spinifer

Baetodes traverae sp. n. (female nymph; Peru) Mayo (1972) [61] p. 230.

Baetodes veracrusensis sp. n. (male nymph; Vera Cruz, Mexico) Mayo (1972) [61] p. 239.

Cloeon agnewi *nomen novum* [new name for Cloeon exiguum (Crass, 1947) NEC Navas, 1918] Hubbard (1973) [37] p. 18.

Cloeon exiguum (Crass, 1947) NEC Navas, 1918
SEE Cloeon agnewi

Subfamily Callibaetinae subfamily n. Riek (1973) [83] p. 164.

Family CHILOPORTERIDAE family n. Landa (1973) [50] p. 158.

EPHEMERELLIDAE, Ephemerellinae

Ephemerella (Drunella) kabulensis sp. n. (nymph; Afghanistan) Allen (1973) [4] p. 163.

Ephemerella (Serratella) subsolana sp. n. (nymph; Afghanistan) Allen (1973) [4] p. 164.

Ephemerella (Acerella) uenoi Allen & Edmunds [= Ephemerella (Acerella) undatella Allen syn. n.; transferred from subgenus Drunella) Allen (1973) [3] p. 527.

Ephemerella (Drunella) uenoi Allen & Edmunds
SEE Ephemerella (Acerella) uenoi

Ephemerella (Acerella) undatella Allen
SEE Ephemerella (Acerella) uenoi

EPHEMERELLIDAE, Teloganodinae

Genus Manohyphella gen. n. Allen (1973) [4] p. 160.

Manohyphella keiseri sp. n. (female imago; Malagasy Republic) Allen (1973) [4] p. 163.

HEPTAGENIIDAE

Ecdyonurus aurantiacus (Burmeister) comb. n. [= Ecdyonurus pazsiczkyi (Pongrácz) syn. n.; transferred from genus Baetis; designation of lectotype] Puthz (1973) [80] p. 262.

Ecdyonurus pazsiczkyi (Pongrácz)
SEE Ecdyonurus aurantiacus

Heptagenia aurantiaca of Rostock, 1875 NEC Burmeister, 1839
SEE Rhithrogena diaphana

Rhithrogena aurantiaca of Eaton, 1885 and subsequent authors NEC Burmeister, 1839
SEE Rhithrogena diaphana

Rhithrogena baikovae sp. n. (male imago; Ussuri Basin, USSR) Sowa (1973) [89] p. 24.

Rhithrogena buresi sp. n. (male imago, female nymph; Bulgaria) Sowa (1973) [89] p. 21.

Rhithrogena diaphana Navas [= Rhithrogena aurantiaca of Eaton, 1885, Rostock, 1875 (Heptagenia), and subsequent authors NEC Burmeister, 1839] Puthz (1973) [80] p. 267.

Rhithrogena lepnevae Brodskij (= Rhithrogena unicolor Tshernova syn. n.; male imago redescribed) Sowa (1973) [89] p. 24.

Rhithrogena unicolor Tshernova
SEE Rhithrogena lepnevae

Stenonema integrum (McDunnough) (nymph) Lewis, P. A. (1973) [57] p. 68.

Stenonema scitulum Traver (nymph) Lewis, P. A. (1973) [57] p. 65.

Stenonema terminatum (Walsh) (nymph) Lewis, P. A. (1973) [57] p. 67.

LEPTOPHLEBIIDAE

Choroterpes inornata Eaton (nymph) Kilgore & Allen (1973) [43] p. 321.

Choroterpes oaxacaensis sp. n. (nymph; Oaxaca, Mexico) Brusca & Allen (1973) [16] p. 137.

Paraleptophlebia altana sp. n. (male & female imagos, nymph; California, USA) Kilgore & Allen (1973) [43] p. 321.

Paraleptophlebia memoralis (Eaton) (nymph) Kilgore & Allen (1973) [43] p. 325.

Thraulodes brunneus Koss (nymph) Kilgore & Allen (1973) [43] p. 325.

Thraulodes salinus sp. n. (male & female nymphs; Arizona, USA) Kilgore & Allen (1973) [43] p. 325.

Thraulus demoulini *nomen novum* [new name for Thraulus maculatus Peters & Tsui, 1972 NEC Needham & Murphy, 1924) Peters & Tsui (1972) [75] p. 565.

Thraulus maculatus Peters & Tsui, 1972 NEC Needham & Murphy, 1924
SEE Thraulus demoulini

Traverella castanea sp. n. (nymph; New Mexico - also Arizona, USA) Kilgore & Allen (1973) [43] p. 327.

OLIGONEURIIDAE

Oligoneuriopsis elisabethae sp. n. (nymph; South Africa) Agnew (1973) [1] p. 118.

Oligoneuriopsis jessicae sp. n. (nymph; South Africa) Agnew (1973) [1] p. 116.

SIPHLONURIDAE

Subfamily Nesameletinae subfamily n. Riek (1973) [83] p. 164.

TRICORYTHIDAE

Leptohyphes baumanni sp. n. (male & female nymphs; Arizona, USA) Kilgore & Allen (1973) [43] p. 327.

Leptohyphes brunneus sp. n. (nymph; Oaxaca - also Jalisco, Morelos, Chiapas, Mexico) Allen & Brusca (1973) [5] p. 85.

Leptohyphes consortis sp. n. (nymph; Vera Cruz, Mexico) Allen & Brusca (1973) [5] p. 87.

Leptohyphes dicinctus sp. n. (female nymph; Guerrero, Mexico) Allen & Brusca (1973) [5] p. 83.

Leptohyphes ferruginus sp. n. (nymph; Vera Cruz, Mexico) Allen & Brusca (1973) [5] p. 88.

Leptohyphes hispidus sp. n. (nymph; Vera Cruz, Mexico) Allen & Brusca (1973) [5] p. 88.

Leptohyphes lestes sp. n. (nymph; Guerrero, Mexico) Allen & Brusca (1973) [5] p. 89.

Leptohyphes lumas sp. n. (nymph; Chiapas - also Oaxaca, Vera Cruz, Tabasco, Mexico) Allen & Brusca (1973) [5] p. 91.

Leptohyphes melanobranchus sp. n. (female nymph; Guatemala) Allen & Brusca (1973) [5] p. 85.

Leptohyphes phalarobranchus sp. n. (male nymph; Arizona, USA) Kilgore & Allen (1973) [43] p. 328.

Leptohyphes pilosus sp. n. (nymph; Vera Cruz, Mexico) Allen & Brusca (1973) [5] p. 91.

Leptohyphes quercus sp. n. (female nymph; Arizona, USA) Kilgore & Allen (1973) [43] p. 328.

Leptohyphes spiculatus sp. n. (nymph; Morelos, Mexico) Allen & Brusca (1973) [5] p. 92.

Tricorythodes corpulentus sp. n. (nymph; New Mexico, USA) Kilgore & Allen (1973) [43] p. 330.

Tricorythodes dimorphus Allen (male imago) Kilgore & Allen (1973) [43] p. 330.

Tricorythodes minutus Traver (nymph) Kilgore & Allen (1973) [43] p. 330.

Tricorythodes notatus sp. n. (nymph; Morelos - also Oaxaca, Mexico) Allen & Brusca (1973) [5] p. 94.

Tricorythodes ulmeri sp. n. (nymph; Morelos, Mexico) Allen & Brusca (1973) [5] p. 95.

## OTHER TAXONOMY

Key to nymphs of European species of the fuscatus-group of Baetis. Sowa (1972) [88].

Notes on Ephemeroptera from Syria, Lebanon, and Israel. Puthz (1973) [78].

Variability and additional characters of Baetis pentaphlebodes, B. buceratus, and Ephemerella mucronata. Cloeon viride Schneider is probably a color variety of C. simile Eaton. Keffermüller (1972) [42].

Use of statistical techniques of dendrite method and Czekanowski's diagram to distinguish similar species (Baetis calcaratus sp. n. and B. tricolor Tshernova). Keffermüller (1972) [41].

Important morphological characters which can be used to distinguish male imagos and nymphs of species of Baetis. Müller-Liebenau (1973) [67].

Morphological characters in Ephemeroptera eggs. Koss (1973) [47].

Important morphological characters in the Ephemeroptera thorax. Such characters can be indicators of genera or phyletic lines. Tsui (1973) [96].

Preliminary remarks on revision of Eastern Hemisphere Leptophlebiidae. Peters & Edmunds (1972) [73].

## BIOLOGY — life histories

Eggs of Baetis rhodani required from 36 days (at 7.5° C) to 8 days (at 25° C) to begin hatching. Hatching continued for 5 days. Fertility exceeded 90% at temperatures below 17.5° C and rapidly declined to 0% above 25° C. Oxygenation of water seemed to increase the number of eggs hatching successfully. Benech (1972) [9].

Fecundity and reproductive potential of Baetis rhodani. Females of a spring generation contain more eggs (average 4,500) than those in later months (July average 200). There is a similar decrease in number of ovarioles and production of an ovariole, as well as a slight reduction in egg size. Calculations are given for the total potential number of eggs in last instar nymphs, the total number of eggs actually laid (assumed to equal total number of first instars), population estimates of young instars under 1 mm as a part of stream production, and a prediction of the number which will reach maturity (< 1%). Benech (1972) [10].

Growth and energy budget of Stenonema pulchellum under controlled expermental conditions. Fed only on a cultured diatom (Navicula minima), the mayfly ingested 0.176 to 0.432 calories in a 12 hr period. Nymphal molts resulted in a .28 mm increase in body length. Nymphs showed a high metabolic demand, losing 3 times as many calories through respiration as stored as growth. Trama (1972) [93].

Life cycle of mayfly species in Alberta, Canada. Siphlonurus alternatus, Paraleptophlebia debilis, Tricorythodes minutus, Ephemerella tibialis, and E. lapidula show an A2 pattern (nymphs hatch, grow, and emerge in summer) according to the Landa classification. Ephemerella coloradensis, E. inermis, E. doddsi, E. grandis ingens, Epeorus longimanus, Caenis simulans, Cinygmula ramaleyi, Leptophlebia cupida, Rhithrogena virilis, and Callibaetis coloradensis show an A3 pattern (nymphs present but no overwinter growth. Different populations of a Baetis tricaudatus "complex" show A2 and A3 patterns. Data on Canadian species is compared with surveys from Europe. Clifford, Robertson & Zelt (1973) [22].

Life cycle of Cloeon triangulifer in a pond in Quebec, Canada. The species overwintered as eggs and young nymphs and emerged from June until October. Gibbs (1973) [34].

Life cycles of Ephemeroptera in temporary pools and streams in Oregon, USA. Two types of life cycle are indicated: (1) species which colonize temporary waters from nearby permanent waters (Ameletus sp. and Baetis tricaudatus), (2) species which survive the dry period in the egg stage (Centroptilum elsa, Siphlonurus occidentalis, Leptophlebia pacifica). Lehmkuhl (1973) [54].

Life cycle, growth rate, and population dynamics of Hexagenia (H. limbata and H. bilineata) in a South Dakota reservoir, USA. A 2 year cycle (22 months) is predominant, although favorable conditions can produce a one year cycle (actually 13-14 months). Hudson & Swanson (1972) [38].

Life cycle of Baetisca rogersi in a Florida stream, USA. Nymphs were present from September to June and emerged from March to July. The 12 nymphal instars required 4 months to develop under laboratory conditions. Pescador (1973) [71].

Biology of Leptophlebia vespertina in Sweden, including life cycle, habitat preference, diel activity, general activity, temperature tolerance, food, growth, predators, subimaginal emergence, molt, imaginal flight activity, copulation, oviposition, egg number, total production, and energy content. Kjellberg (1972) [45].

Life cycles of Leptophlebia vespertina and L. marginata in a North Wales lake, UK. The growth rates, habitat, emergence, and hatching period of eggs of these 2 species are compared. Brittain (1972) [15].

ALSO SEE: Zelt & Clifford [103] life cycle data on Ephemerella doddsi and Epeorus longimanus in Alberta, Canada; Waters & Crawford [97] life cycle and annual production of Ephemerella subvaria in Minnesota, USA; Cummins et al. [25] growth rates of Stenonema; Collins [23] notes on life histories of Caenis rivulorum, Baetis scambus, and Ephemerella ignita in the River Bela, England-UK; Sukop [90] notes on life cycles of Baetis alpinus, B. rhodani, and Rhithrogena semicolorata in the Křtiny River, Czechoslovakia.

BIOLOGY — adult activity

Discussion of ecological factors affecting mayfly distribution. Species migrate upstream to oviposit in areas of high oxygen, specific behavior varying with requirements of each species and type of river (high mountain, mid-course, and large plains). Bogoescu (1973) [14].

Documentation of a mass (120 specimens/$m^3$) upstream compensatory flight of Palingenia longicauda in the Danube River, Bulgaria. Egg drift is calculated, and methods by which adults compensate for wind direction are explained. Discussion of the compensatory flight for oviposition, with new records for Polymitarcys virgo and Oligoneuriella mikulskii. Russev (1973) [84].

Seasonal emergence patterns of Ephemeroptera in a South Carolina stream, USA. In the early season emergence pattern, most adults emerged in spring and the emergence curve tapered down slowly into the summer; in the late season pattern, emergence began slowly and peaked near the end of the season. Peak emergence appears to decrease as length of emergence increases. Carlson (1973) [21].

Responses of night-flying insects to near-ultraviolet (black) and yellow-green (filtered mercury vapor) light. Other lights were also used on occasion and electrophysical and behavioral responses in Lepidoptera and Trichoptera are compared. Ephemeroptera were more strongly attracted by yellow-green radiation than other insects, but specific differences occurred. Cloeon and Caenis nocturna showed yellow-green preference while C. horaria preferred black light and unfiltered mercury vapor light. Mikkola (1972) [62].

ALSO SEE: Kjellberg [45] adult activity and behavior of Leptophlebia vespertina in Sweden; Benech [10] fecundity and reproductive potential of Baetis rhodani; Petr [76] continuous emergence of Povilla adusta in Lake Volta, Ghana; Fremling [31] mass emergence records for Hexagenia limbata, H. bilineata, and Pentagenia vittigera in the Mississippi River, USA.

BIOLOGY — nymphal activity

Biology of Povilla adusta in an artificial lake, Lake Volta, Ghana. Vertical distribution in the lake is regulated by presence of plankton and periphytic algae, adequate oxygen, and suitable substratum (dead wood or papyrus). Petr (1973) [76].

ALSO SEE: Bogoescu [14] factors affecting nymphal distribution including gill-type, biological needs, and environmental factors; Wood [101] substrate selection of Hexagenia nymphs by particle size and homogeneity of sediments in Lake Erie, USA; Peters & Jones [74] habitats of Ephemeroptera in the Blackwater River, Florida, USA; Kjellberg [45] biology and nymphal behavior of Leptophlebia vespertina in Sweden; Disney [27] shift in habitat choice of Baetis and Afronurus nymphs in Cameroon according to size of nymphs; Schoonbee [85] habitat preferences of Ephemeroptera in Umgeni River, South Africa.

## CLASSIFICATION AND PHYLOGENY

Classification and phylogeny of Ephemeroptera based on nymphal gills, body form, and hairs on cerci and on adult wing venation. Riek (1973) [83].

Phylogeny of Ephemeroptera based on internal anatomy. Landa (1973) [50].

Phylogeny of Ephemeroptera based primarily on morphological characters of eggs. Koss (1973) [47].

Notes on phylogeny of Ephemeroptera with emphasis on Permian and Mesozoic fossils. Discussion of derivation of modern mayfly families from Permian ancestors. Tshernova (1972) [94].

Phylogeny of subfamilies of the Siphlonuridae and of families of Ephemeroidea. Comments are included on the Siphlaenigmatidae, Baetidae, Oligoneuriidae, Neoephemeridae, Caenidae, and Prosopistomatidae. Edmunds (1973) [29].

Phylogeny of the Heptageniidae and generic relationships within the Heptageniinae. Jensen & Edmunds (1973) [40].

Uncritical comments on and summary of symposium on "Phylogeny and classification of Ephemeroptera" at 1st Int. Conf. Ephemeroptera. Burks (1973) [17].

## ECOLOGY

Review and overview of trophic relations of aquatic insects. Components of their energy budget (ingestion-assimilation-production and egestion-respiration-excretion), food habit, and selective feeding are defined and discussed. A trophic classification system is proposed based on food categories (herbi-, detriti-, and carnivorous) and feeding mechanisms (shredders, collectors, scrapers, and predators). Aquatic insects are trophic generalists, ingesting anything available within certain particle sizes and texture limits in a general food compartment. Cummins (1973) [24].

Experimental determination of growth of 2 groups of detritus feeders: large particle shredders included 2 Tipulidae, 3 Limnephilidae, and one Pteronarcidae; fine particle feeders or collectors were Stenonema fuscum, S. tripunctatum, and S. canadense. Survival of Stenonema was highest at low density (growth rate 0.1% total body weight/day), but growth was higher at increased density (0.5%/day), and highest at high shredder density and low Stenonema density (up to 1.8%/day). Discussion of the conversion of detritus to food in stream ecosystem and estimation of standing crop of shredders necessary to process large particle input. Cummins, Petersen, Howard, Wuycheck & Holt (1973) [25].

Establishment of invertebrate communities on introduced log substrates over a 6-week period in the Kaskaskia River, Illinois, USA. Standing crop increased rapidly and relative composition of colonizing groups changed weekly. A group of logs placed in a riffle showed different community composition from that in quiet water. Logs placed at different depths in a pool showed the largest standing crop at intermediate depths (54 cm) although Stenonema was more abundant in deeper water. Over the 6 weeks, the average standing crop on introduced logs (1649 $mg/m^2$) remained smaller than that on logs already in the river (3417 $mg/m^2$). Discussion of wood as substrate. Nilsen & Larimore (1973) [69].

Vertical distribution of fauna in the substrate of the Sungai Gombak River, Malaysia. Many invertebrate groups occur at least 40 cm into the substrate. For Ephemeroptera, 29.8% were found in the first 10 cm, 30.8% from 10-20 cm, 3.4% from 20-30 cm, and 36% from 30-40 cm. Bishop (1973) [13].

Aquatic invertebrate communities of submerged bamboo and stony substrate in 3 Japanese rivers. The majority of insects showed no strong habitat preference. Those that did prefer bamboo with its associated dead leaves were Ephemerella rufa, E. nigra, and Baetis sp. 1. Baetiella sp. and Isonychia japonica were found more frequently in the stony areas. Tanaka (1971) [91].

Seasonal changes in aquatic insect communities of the Iga River system, Japan. Kitagawa (1972) [44].

ALSO SEE: Schoonbee [85] Ephemeroptera communities of the Umgeni River, South Africa.

FAUNAL STUDIES — geographical

Geographic origin and distributional patterns for 21 Mexican genera of Ephemeroptera. Seven categories are defined based on presumed point of origin (austral or boreal) and farthest latitudinal range (upper and lower south temperate, upper tropical, and upper, middle, and lower north temperate). Allen & Brusca (1973) [6].

New range extensions for species of Ephemerellidae, Tricorythidae, and Leptophlebiidae in the southwestern USA. Kilgore & Allen (1973) [43].

New German distribution records for Siphlonurus armatus, Rhithrogena ferruginea, and R. picteti picteti. Puthz (1973) [79].

New Polish distribution records for Baetis pentaphlebodes, B. buceratus, and Ephemerella mucronata. Keffermüller (1972) [42].

New Ephemeroptera records from Turkey. Puthz (1972) [77].

New records of Ephemeroptera from Syria, Lebanon, and Israel. Puthz (1973) [78].

Aquatic fauna, including species of Ephemeroptera, of Table Mountain, Cape Province, South Africa. This list includes unpublished records of the late K. H. Barnard. Harrison & Barnard (1972) [36].

FAUNAL STUDIES — limnological

Fauna of the Blackwater River, Florida, USA, with aquatic insect species and discussion of their habitats. Peters & Jones (1973) [74].

Zooplankton and zoobenthos of a wet slack (freshwater-filled hollow between coastal sand dunes), England-UK. One Ephemeroptera species was recorded from a drainage ditch. Bevercombe, Cox, Thomas & Young (1973) [12].

Ephemeroptera species and their distribution in the River Bela, England-UK, are compared with records from similar English streams. Collins (1971) [23].

Continuing study of the bottom macrofauna (1965-1969) of the Goczałkowice dam reservoir, Poland, shows Chironomidae and Oligochaeta predominant with Caenis sp. and C. moesta present. Krzyżanek (1973) [49].

Aquatic fauna in the Nabari River, Japan. Makishita (1972) [59].

Aquatic fauna of the Katsura River system, Japan. Shima & Yamada (1972) [87].

Aquatic fauna of the Akuta River, Japan. Morishita (1972) [65].

Aquatic fauna of the Tawara and Uji Rivers, Japan. Yamada & Shima (1972) [100].

Aquatic fauna of the Uji and Yodo Rivers, Japan. Tsuda & Tani (1972) [95].

Aquatic fauna at the confluence of the Shidara and Seta Rivers, Japan. Yamada & Matsui (1972) [99].

Aquatic fauna of the Kamo River system, Japan. Matsui, Abe & Makishita (1972) [60].

Aquatic fauna of the Watsuka and Kizu Rivers, Japan. Shima (1972) [86].

ALSO SEE: Minshall & Andrews [63] benthic invertebrates of the Portneuf River, Idaho, USA; Learner et al. [52] macroinvertebrate species of the River Cynon, Wales-UK; Sukop [90] Ephemeroptera species of the Křtiny River, Czechoslovakia; Tanaka [91] aquatic invertebrates of the Yoro, Obitsu, and Isumi Rivers, Japan; Kitagawa [44] aquatic insects of the Iga River system, Japan; Schoonbee [85] Ephemeroptera species of the Umgeni River, South Africa.

## GENERAL

Report on and schedule of activities of 1st International Conference on Ephemeroptera. Peters (1973) [72].

Current trends and important areas of research in Ephemeroptera. Edmunds (1973) [28].

General article on Ephemeroptera. Berner (1971) [11].

## HYDROBIOLOGY

Longitudinal survey of chemical and physical effects on benthic animals of Portneuf River, Idaho, USA. Wastewater, thermal springs, phosphate processing operations, sewage treatment, and a removal of irrigation water have altered water quality and faunal distribution. Ephemerella inermis and Baetis tricaudatus were widely distributed. Paraleptophlebia heteronea, Epeorus longimanus, and Ephemerella grandis were present in upper reaches, while Callibaetis nigritus was the dominant mayfly at the highest station, directly below a dam. Minshall & Andrews (1973) [63].

Sudden fluctuations of water level below a dam on the Snake River, Wyoming, USA, have serious effects on aquatic life. A sudden drawdown destroyed up to 3 billion specimens in a 3 km section downstream from the dam, as calculated from quantitative samples. Kroger (1973) [48].

Description of Mississippi River, USA, and longitudinal distribution of burrowing mayflies (Hexagenia bilineata, H. limbata, and Pentagenia vittigera). Discussion of effects of temperature, impoundment, channelization, erosion, and pollution on the river and its mayflies. Fremling (1973) [31].

Comparison of methods for estimating annual production of Ephemerella subvaria in a Minnesota stream, USA. The removal-summation, instantaneous growth, and Allen curve methods gave similar results (26.4-28.9 $g/m^2$) while the Hynes method gave an estimation of 33.3 $g/m^2$. Turnover ratios are figured when possible and results are discussed. Waters & Crawford (1973) [97].

History and causes of the decline of Hexagenia in western Lake Erie, USA. Wood (1973) [101].

Effects of sand deposition from a rechanneled tributary on invertebrate fauna of the River Camel, England-UK. Diversity of species decreased significantly at the point of confluence and increased

downstream in relation to distance from the tributary. Among Ephemeroptera, Baetis pumilus and Ephemera danica were eliminated, Caenis rivulorum unaffected, and Baetis rhodani and Rhithrogena semicolorata increased in numbers with sand deposition. Nuttall (1972) [70].

Effects of chemical methods of gauging stream discharge (fluorescin and dichromate) on invertebrates of a French Pyrenees stream. There was an increase in total numbers of invertebrates in drift after injection of chemicals; drift returned to normal immediately after injection ceased. The increase in drift was not significant for any taxon. Décamps & Elliott (1972) [26].

Seasónal abundance and biomass of Ephemeroptera in the Křtiny River, Czechoslovakia. Sukop (1973) [90].

A comparison of importance of aquatic insects in diet of trout and competing fish, with suggestions of fish to avoid in stocking trout streams. Zelinka (1971) [102].

Representatives of benthic fauna isolated in pools along the Yodo River after high water include Ecdyonurus yoshidae, Polymitarcys ohigae, Epeorus latifolium, and Baetis thermicus. Morishita (1972) [66].

Altitudinal zonation of invertebrates in streams on Mt. Elgon, Kenya. Among Ephemeroptera, Dicercomyzon, Ephemerythus, Tricorythus, and Centroptiloides were found only below 1830 m. Acentrella species showed different altitudinal restrictions, while other genera were widespread at all altitudinal zones. Williams & Hynes (1971) [98].

Longitudinal zonation of the Umgeni River, South Africa, as determined from stony bottom Ephemeroptera fauna. Four communities are defined along the river course: Afronurus oliffi, A. barnardi, A. scotti, and A. peringueyi associations. The physical zonation is not always similar to the biological zonation. Schoonbee (1973) [85].

Limnology of floodplain, sand dune, and former estuary freshwater lakes on the East Gippsland coast, Australia. Atalophlebia sp. (australis group) was among benthic animals inhabiting the lakes. Timms (1973) [92].

ALSO SEE: Hudson & Swanson [38] 5 year field study of production, standing crop, and turnover of Hexagenia in a South Dakota reservoir, USA; Collins [23] effects of channelization on longitudinal distribution of Ephemeroptera in the River Bela, England-UK; Albrecht & Wünsche [2] amino acid composition of invertebrates in trout brook and carp pond are sufficient to meet food requirements of salmonid fish; Petr [76] biomass of Povilla adusta in Lake Volta, Ghana, and importance of this mayfly in fisheries and management of artificial African lakes.

## METHODS

Comparison of life cycle data, percentage composition, and biomass of aquatic insects obtained from coarse (720 µm) and fine (320 µm) dip nets. General inferences were similar although significant differences occurred due to age, size, and shape of insects. In such studies it is important to give empirically determined pore size rather than thread count. Zelt & Clifford (1972) [103].

Comparison of efficiency of floatation solution for sorting aquatic benthos (excluding Trichoptera with cases and molluscs). Sucrose solutions are relatively efficient and non-toxic. Live invertebrates floated longer than preserved, and those preserved in 10% formalin floated longer than those in 70% alcohol. Floatation time varied by species; Heptagenia sp. floated longer than Baetis sp. Flannagan (1973) [30].

Artificial substrate suitable for bioassay studies of Hexagenia. Fremling & Schoening (1973) [32].

An improved design for an Ekman-type grab with top lids which stay closed during retrieval, preventing escape of smaller benthic animals, most significantly Chironomidae and Oligochaeta. Numbers of Ephemeroptera collected remained about the same. Burton & Flannagan (1973) [18].

Design and use of an air lift for collecting sediment benthos. The air lift collects a greater variety of sediments than a corer, is easier to use, and does not disturb the benthos while being put in position. Mackey (1972) [58].

Report of Ephemeroptera among insects collected with Malaise trap, Missouri, USA. Cancelado & Yonke (1969) [20].

ALSO SEE: Mikkola [62] attraction of insects to different types of light; Bishop [13] new design for vertical substrate sampler.

## MORPHOLOGY AND PHYSIOLOGY

Types, nomenclature, and evolutionary development of perisympathetic organs (organs on sympathetic nerves near ventral nerve cord) in insects. Ephemeroptera adults have perisympathetic organs of a primitive median type. Grillot, Provansal, Baudry & Raabe (1971) [35].

Comparison of types of perisympathetic organs in 14 orders of insects. These organs are always present in the abdomen and sometimes in the thorax, and all show a characteristic structure of neurosecretory fibers filled with material from the ganglions. Raabe, Baudry, Grillot & Provansal (1971) [81].

Location and structure of perisympathetic organs in the nervous system of Ephemeroptera and Odonata. Abundance of neurosecretory cellules apparently changes during the reproductive cycle. Raabe & Provansal (1972) [82].

Essential amino acid content in proteins of aquatic invertebrates including Chitonophora kreighoffi, Baetis sp., Rhithrogena semicolorata, and Epeorus sp. Percentage crude protein (air dried) ranged from 52% to 59.9% in the Ephemeroptera. The amino acid composition of invertebrates in a trout brook and a carp pond is compared with requirements of salmonid fish. Albrecht & Wünsche (1972) [2].

ALSO SEE: Keffermüller [41] structure of penes of selected species of Baetis; Camatini & Saita [19] ultrastructure of arthropod muscles.

## PARASITES AND SYMBIOTIC ASSOCIATES

Distribution of Spirinella adipophila, protozoan parasite, in streams of the Eyzies region, France, and variations in numbers of Ephemera vulgata nymphs infested. Arvy & Delage (1973) [7].

Development of the nematode fish parasite, Rhabdochona (Filochona) ergensi. Larvae develop from eggs to third stage in Habroleptoides modesta. H. modesta, used as experimental intermediate host, also appears to be the natural host. Moravec (1972) [64].

Studies on attachment of Simuliidae to species of Afronurus and Baetis in Cameroon. Simulium lumbwanum settled on all sizes of Afronurus nymphs, while S. afronuri showed a choice for large nymphs. A preference for Baetis sp. D was evidenced by S. baetiphilum. Dispersion on nymphs is discussed, as is the neglected state of West African Ephemeroptera taxonomy. Disney (1973) [27].

New records of Simulium berneri from Elassoneuria and S. lumbwanum from Afronurus in Liberia. Garms (1972) [33].

Simuliidae of Pakistan. Two new phoretic species are described: Simulium (s.s.) jani from Rhithrogena sp. and S. (s.s.) rashidi from a 2-spined ally of Iron sp. S. (s.s.) ephemerophilum was found on Iron sp. and other mayflies, and an undescribed species is recorded from Katrain, India. Discussion of phoresis in Himalayan species of simuliids. Lewis, D. J. (1973) [56].

ALSO SEE: Arvy & Peters [8] review of parasites and associates of Ephemeroptera; Williams & Hynes [98] comments on distribution and habitat selection of Simulium copleyi and S. lumbwanum on Mt. Elgon, Kenya.

## PESTICIDES AND POLLUTION

Replicate pond study, California, USA, of the effects of Dursban on population dynamics of zooplankton, phytoplankton, and insects. Ephemeroptera were practically eliminated by the first Dursban treatment. Relationships of crustaceans and rotifers are considered in detail. Hurlbert, Mulla & Willson (1972) [39].

Zonation effects of acid-mine drainage recovery on a Pennsylvania stream, USA. In area of highest acidity a few species (Chironomidae) lived in abundance. Downstream, in the zone of active neutralization (where iron hydroxide precipitates) the biomass was at its lowest but species diversity increased slightly. Recovery continued below this point with mayflies and stoneflies appearing at average pH 3.8. Organic pollution is also discussed. Koryak, Shapiro & Sykora (1972) [46].

Effects of acid-mine drainage on a Tennessee river, USA. Mayflies (Stenonema and Ephemerella) and other aquatic insects were abundant above the source of pollution. Below, fauna was severely reduced with slight recovery evident 40 miles downstream. The acid stream is neutralized by an alkaline stream at a reservoir. Nichols & Bulow (1973) [68].

Survey, before construction of waste treatment facilities, of fish and invertebrate distribution and community structure of the River Cynon, South Wales-UK. Most mayfly species occurred above areas of coal washery discharge, sewage outlets, and industrial effluents. Learner, Williams, Harcup & Hughes (1971) [52].

Effects of and recovery from different concentrations of sugar factory wastes in 4 Polish ponds. After an oxygenless period, favorable conditions occur for development of macrobenthos, particularly Chironomidae, with Caenis sp. and Cloeon dipterum encountered rarely. Suggestions are given for pond management. Zięba (1973) [104].

ALSO SEE: Langford [51] comparative review of thermal effects on British and North American rivers; Minshall & Andrews [63] factors affecting water quality of the Portneuf River, Idaho, USA;

Fremling [31] mass emergences of burrowing mayflies as indicators of water quality of Mississippi River, USA; Tanaka [91] biological determination of water quality classes in the Yoro, Obitsu, and Isumi Rivers, Japan; Morishita [65] longitudinal study of water quality of the Akuta River, Japan; Shima & Yamada [87] longitudinal study of water quality of the Katsura River system, Japan; Matsui, Abe & Makishita [60] longitudinal study of water quality of the Komo River system, Japan; Kitagawa [44] longitudinal and seasonal study of water quality of the Iga River system, Japan; Tsuda & Tani [95] biotic indices of the Uji and Yodo Rivers, Japan; Yamada & Matsui [99] biotic indices of the Shidara and Seta Rivers at confluence, Japan; Yamada & Shima [100] biotic indices of the Tawara and Uji Rivers, Japan; Makishita [59] biotic index of the Nabari River, Japan; Shima [86] biotic indices of the Watsuka and Kizu Rivers, Japan.

## REVIEWS

Literature review of comparative effects of thermal pollution on British and North American rivers. Langford (1972) [51].

Review of current discoveries in the ultrastructure of arthropod muscle tissue. Gill muscles of Ephemeroptera have a structure similar to that of flight muscles. Camatini & Saita (1972) [19].

Review of fungi and invertebrates living in association with Ephemeroptera. Mayflies serve as passive vectors, support objects, phoretic associates, intermediate hosts, and victims of parasitic and predatory animals for more than 120 recorded species. Arvy & Peters (1973) [8].

ALSO SEE: Cummins [24] trophic relations of aquatic insects.

## ZOOGEOGRAPHY

Zoogeographic relationships of mayflies, stoneflies, and caddisflies of Northeast Asia, USSR. The nucleus of the fauna is Angarian (species which evolved in this region in the Tertiary). Holarctic, Palaearctic, and Oriental-Palaearctic elements are represented. Levanidova (1972) [55].

ALSO SEE: Allen & Brusca [6] origin and distribution patterns of 21 Ephemeroptera genera from Mexico; Harrison & Barnard [36] zoogeographic notes on the paleo-endemic fauna of the Cape Peninsula, South Africa.

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## ADDRESSES

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