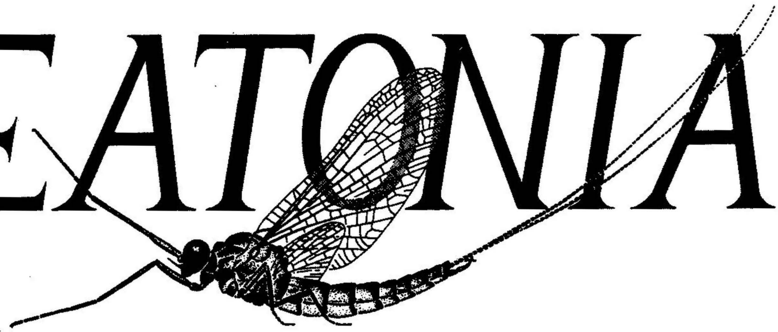
6-21-1976

Eatonia No. 21-22, Jun. 21, 1976

William L. Peters

Janice Peters

EATONIA



Nos. 21-22 Florida A & M University, Tallahassee June 21, 1976

This issue follows the meeting of mayfly workers at the Second International Conference on Ephemeroptera and, as was the case after the 1970 Conference, it is a double issue. The editors were happy to attend the Second Conference in Cracow, Poland, to personally meet many ephemeropterists, to hear the interesting presentations, to participate in discussions and a number of beautiful excursions, and to visit the Freshwater Biological Laboratory of the Polish Acadmy of Sciences and the Hydrobiology Laboratory of Jagiellonian University in Cracow and the laboratories of the Max-Planck-Institute for Limnology in Germany.

One of the discussion leaders from the First Conference, J. W. Leonard, passed away in 1975 and we have also learned of the recent death of V. K. Mayo. The biographical information on Dr. Leonard in this issue has graciously been prepared by H. H. Ross and an article on the life and work of Dr. Mayo should appear in the next issue.

Special thanks go to Dr. Jacob who prepared new drawings for some Eatonia subsections. In addition, we thank Dr. Ross, Dr. Tshernova, Mr. Lewis, Dr. Tuša, and the many persons who sent reprints for inclusion in Eatonia # 21-22. We are most grateful to individuals who have sent contributions for publication costs, and we hope your generosity will continue in the coming years.

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.

JUSTIN W. LEONARD

By Herbert H. Ross

On May 26, 1975, ephemeropterology lost one of its most ardent disciples, Dr. Justin W. (Doc) Leonard who was stricken with a heart attack while visiting relatives in Logan, Iowa. Among aquatic workers he is best known for the book "Mayflies of Michigan Trout Streams" (co-authored with his wife Fannie), and for pioneering on many clever ideas aimed at improving productivity of trout streams. But Doc was a man of many talents and is known to thousands of other colleagues, students, and naturalists as a rare philosopher of conservation and natural resources, as an inspiring teacher, and as a lecturer who combined humanistic, technological, and scientific values in the classroom and in his television and radio appearances. These attributes won him national and international standing.

Born on October 28, 1909, in Moulton, Iowa, Doc was graduated from Grinnell College in 1931, and received the masters and doctoral degrees from the University of Michigan in 1932 and 1937, respectively. In 1934, he began a productive career with the Michigan Department of Natural Resources (then the Department of Conservation), first in its Ann Arbor office, the Institute of Fisheries Research, then as director of the Hunt Creek Fisheries Experiment Station.

From 1943 to 1946, his Michigan activities were interrupted by World War II service as malaria control officer for the Southwest Pacific war theater with headquarters in Guadalcanal, retiring with the rank of major. He returned to Ann Arbor as assistant director of the Institute of Fisheries Research, then in 1951 he moved to Lansing as assistant deputy director in charge of research and development for the Michigan Department of Natural Resources.

Doc, however, felt that the greatest need in conservation lay in giving college students an understanding of the interplay of science and humanistic values so necessary to achieving progress in the area of natural resource management and conservation. This conviction undoubtedly was a major factor in his decision in 1964 to join the faculty of the School of Natural Resources, the University of Michigan. Since then he served as chairman of the fisheries and wildlife and resource planning and conservation departments, and as acting dean of the school.

Doc is the author of over 70 articles and books on aquatic insects, fisheries, and conservation. Several of the first category were co-authored with his wife Fannie, who survives him. He was active in many scientific societies and was past president of the National Wildlife Society and the Michigan Academy of Science, Arts, and Letters, past vice president of the American Society of Limnology and Oceanography, and former editor of the American Fisheries Society. He lectured across the nation on ecology and conservation, and appeared on many radio and television programs.

Music was also dear to Doc's heart. An accomplished violinist, he thoroughly enjoyed his participation with local chamber music groups. He also played a stirring guitar and at home regaled many a visiting scientist with ballad and song.

With his gracious personality, his ability to dig down to sensible perspectives, his flair for incisive and stimulating discussion, and above all his willingness to listen intelligently to the problems of old and young, Doc brightened every life he touched. These qualities and his uncanny ability to translate scientific information into language understandable by all endeared him to his students and he soon became one of the most popular professors on the University of Michigan campus.

Above all, Doc was a blythe spirit of a breed all too rare in this world. He will be sorely missed. His long time science-writer friend Larry Bush summed up the situation succinctly and simply: "Doc Leonard liked people and people liked Doc Leonard."

News and Notes

From August 23-28, 1975, more than 50 ephemeropterists and members of their families assembled at the Freshwater Biology Laboratory in Cracow, Poland, for the Second International Conference on Ephemeroptera. Following welcoming ceremonies and an introductory lecture on running water ecology by J. Illies, papers were presented. It was most exciting to hear the excellent work being done currently on Ephemeroptera — research on biosystematics, phylogeny, faunal surveys, biogeography, morphology, parasitology, biology, ecology, and environmental quality. These papers will be published in a separate volume of Proceedings of the Second International Conference on Ephemeroptera, now being edited by R. Sowa.

E A T O N I A

A NEWSLETTER FOR EPHEMEROPTERISTS

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

in cooperation with

School of Science and Technology, 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.

Sessions were held on Saturday, Monday and Tuesday. The other days were devoted to informal discussions and excursions. The trip down the Dunaječ River Gorge in rafter boats was one highlight of the Conference. Participants were also treated to a tour of the Wieliczka Salt Mine, the oldest rock-salt mine in Europe. Collecting trips to Carpathian mountain streams, a tour of the Old City in Cracow, and shorter visits to interesting points in the vicinity of Cracow were all part of the schedule. The Organizing Committee also handled arrangements for special tours for individuals.

We are certain that all participants join us in thanking Prof. Dr. Wróbel of the Freshwater Biology Laboratory, Polish Academy of Sciences in Cracow, Miss Skolimowska, Technician Secretary, Polish Academy of Sciences in Cracow, other members of the Organizing Committee, and the many other persons who gave of their time and energy to make the Second International Conference on Ephemeroptera a success.

From August 29 to September 3, following the meetings in Cracow, some 20 persons went to Germany for a post-conference excursion to the laboratories of the Max-Planck-Institute for Limnology in Plön and Schlitz and a collecting trip through the Harz Mountains. This bus tour, conducted by I. Müller-Liebenau and E. J. Fittkau, provided a happy and pleasant ending to the 1975 Conference. To the two leaders, to Prof. Dr. Illies (Schlitz), to Prof. Dr. Sioli (Plön), and to the many others who contributed to the success of the excursion, we offer our sincere gratitude. Special recognition must be given to Dr. Müller-Liebenau who was responsible for the overall planning of this most profitable and enjoyable Second International Conference on Ephemeroptera.

* * * * *

In 1975, Entomological Reprint Specialists (P.O. Box 77224, Dockweiler Station, Los Angeles, California 90007) published a reprint edition of the following book: B. D. Burks, 1953, The Mayflies, or Ephemeroptera, of Illinois (originally published as Article 1, Bulletin 26, of the Illinois Natural History Survey). The reprint edition has a preface by G. F. Edmunds, Jr. listing the changes in higher classification made since 1953 and is available from the publisher for $15.00.

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Since Ephemeroptera are recognized prey of many invertebrates and vertebrates, we have never attempted to list papers on mayfly predators in Eatonia; however, two interesting papers have recently come to our attention. These are a first report of mayflies and stoneflies as prey of *Polycelis nigra* and *P. tenuis* (Turbellaria, Tricladia) by T. B. Reynoldson and P. Bellamy (1975, Freshwat. Biol. 5:305-312) and a report on the feeding method and prey selection of *Atherix ibis* (Diptera, Athericidae) by A. G. B. Thomas (1975, Ann. Limnol. 11:169-188).

* * * * *

Dr. O. A. Tshernova has written concerning a typographical error in the key to families and genera of the Heptageniidae in the Holarctic and Oriental regions (1974) [153]. Couplet 16(13) should begin "Передняя лапка ♂ 1 $^1/_6$ - 2 раза ..., [Fore tarsus of the male 1 $^1/_6$ - 2 times ...]," not $1^1/_6$ - 1 times .... Also, she does not wish to transfer *Heptagenia abnormis* Tshernova to the genus *Bleptus*, so that the last line of couplet 3(4) should be corrected to read "Эндемичный палеарктический род с одним видом в Японии [An endemic Palearctic genus with one species from Japan."

* * * * *

The following corrections to the key to the *Stenonema* [and *Stenacron*] mayfly nymphs by Lewis (1974) [99] are reprinted from the AQC Newsletter (Analytical Quality Control, USEPA, Cincinnati), April, 1976, #29, p. 9:

Pages 11 and 12, couplets 5-7

5. Crown of maxilla with 11-13 pectinate spines (Fig. 57) . . *S. pallidum*
   Crown of maxilla with 7-10 pectinate spines (Fig. 56). 6

7. Inner margin of outer canine of left mandible with 8 teeth (Fig. 82). . . . . *S. candidum*
   Inner margin of outer canine with 5-7 teeth (Fig. 85) 8

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Addition to Eatonia Index (Eatonia #20)

p. 32-33 I. Tuša [92] published on a new method he has used to store vials containing comparative, seasonal zoobenthos samples from different localities. We apologize for omitting this reference from the methods section of Eatonia #20.

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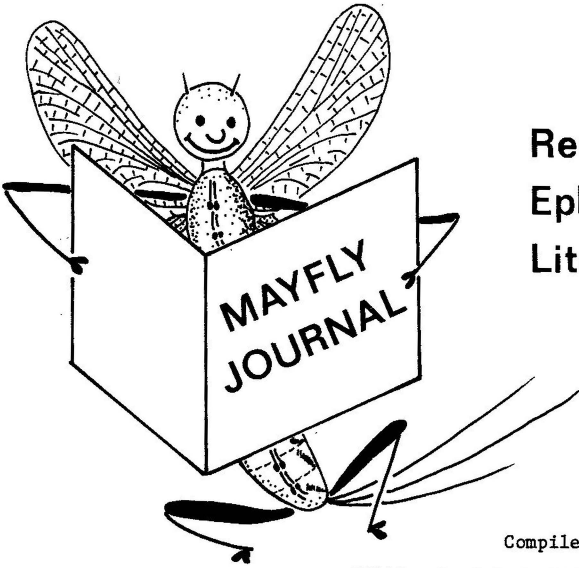

Recent Ephemeroptera Literature

Compiled by
William L. Peters and G. F. Edmunds, Jr.

Алимов, А. Ф. Alimov, A. F.

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Alimov, A. F., V. V. Boullion, N. P. Finogenova, M. B. Ivanova, N. K. Kuzmitskaya, V. N. Nikulina, N. G. Ozeretskovskaya & T. V. Zharova

[2] -1972. Biological productivity of Lakes Krivoe and Krugloe, p. 39-56, 3 figs., 14 tables, IN Kajak, Z. & A. Hillbricht-Ilkowska [eds.], Productivity Problems of Freshwaters (Proc. IBP-UNESCO Symp. Prod. Probl. Freshwaters, Poland, 1970). Warszawa-Kraków.

Allan, J. D.

[3] -1975. The distributional ecology and diversity of benthic insects in Cement Creek, Colorado. Ecology, 56:1040-1053, 9 figs., 8 tables.

Allen, R. K.

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Armitage, P. D., A. M. MacHale & D. C. Crisp

[5] -1975. A survey of the invertebrates of four streams in the Moor House National Reserve in Northern England. Freshwat. Biol., 5:479-495, 4 figs., 5 tables.

Babu, J. P. & J. E. Hall

[6] -1975. Histochemistry of hydrolytic enzymes of virgulate xiphidiocercariae. J. Parasitol., 61:877-881, 3 figs., 1 table.

Байкова, О. Я. Bajkova, O. Ya.

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[8] -1972. К познанию поденок (Ephemeroptera) бассейна Амура: II. Imagines (Rhithrogena, Heptagenia). [Contribution to knowledge of mayflies (Ephemeroptera) of the Amur Basin: II. Imagines (Rhithrogena, Heptagenia).] Изв. Тихоокеан. Научно-Исслед. Инст. Рыб. Хоз. Океаногр. (Izv. Tikhookean. Nauchno-Issled. Inst. Ryb. Khoz. Okeanogr.), 77:207-232, 54 figs., 1 table. [1]

[9] -1974. К познанию поденок (Ephemeroptera) бассейна Амура. On the study of may-flies (Ephemeroptera) from the basin of the Amur River. Энтомол. Обозр. (Entomol. Obozr.), 53:815-829, 69 figs.

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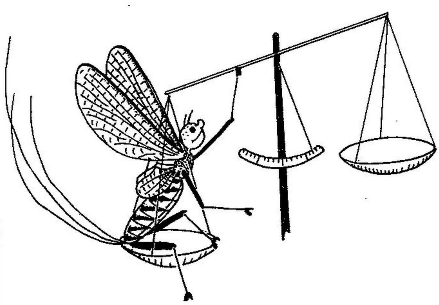

EATONIA INDEX

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 cross references at the end of other significant sections.

TAXONOMY

BAETIDAE

Baetopus tenellus (Albarda) (transferred from genus Centroptilum) Sowa (1975) [147] p. 259.

Centroptilum tenellum Albarda SEE Baetopus tenellus

Cloeon rabaudi (Verrier)
(transferred from genus Procloeon) Sowa (1975) [146] p. 113.

Genus Heterocloeon McDunnough (genus reinstated; = genus Rheobaetis Müller-Liebenau syn. n.) McCafferty & Provonsha (1975) [107] p. 124.

Heterocloeon berneri (Müller-Liebenau) (transferred from genus Rheobaetis) McCafferty & Provonsha (1975) [107] p. 124.

Heterocloeon curiosum (McDunnough) (= Rheobaetis traverae Müller-Liebenau syn. n.) McCafferty & Provonsha (1975) [107] p. 124.

Heterocloeon petersi (Müller-Liebenau) (transferred from genus Rheobaetis) McCafferty & Provonsha (1975) [107] p. 124.

Procloeon bifidum (Bengtsson)
a)- (designation of lectotype) Müller-Liebenau & Brinck IN Sowa (1975) [146] p. 107.
b)- (redescription of imagos, nymph, egg; = Procloeon pseudorufulum Kimmins syn. n.; = Procloeon lychnidense Ikonomov syn. n.) Sowa (1975) [146] p. 113.

Procloeon lychnidense Ikonomov
SEE Procloeon bifidum

Procloeon ornatum Tshernova (designation of lectotype; redescription of imagos, nymph, egg; = Procloeon pseudorufulum of Keffermüller 1960 NEC Kimmins, 1957) Sowa (1975) [146] p. 110, 113.

Procloeon pseudorufulum Kimmins
SEE Procloeon bifidum

Procloeon pseudorufulum of Keffermuller 1960 NEC Kimmins, 1957 SEE Procloeon ornatum

Procloeon rabaudi Verrier
SEE Cloeon rabaudi

Genus Rheobaetis Müller-Liebenau
SEE genus Heterocloeon

Rheobaetis berneri Müller-Liebenau
SEE Heterocloeon berneri

Rheobaetis petersi Müller-Liebenau
SEE Heterocloeon petersi

Rheobaetis traverae Müller-Liebenau
SEE Heterocloeon curiosum

EPHEMERELLIDAE

Genus Ephemerella subgenus Cincticostella Allen (additional description) Allen (1975) [4] p. 16.

Ephemerella aurivillii (Bengtsson) (= Ephemerella taeniata Tshernova syn. n.) Bajkova (1972) [7] p. 185.

Ephemerella basalis Imanishi (additional description of male imago; egg) Bajkova (1972) [7] p. 188.

Ephemerella (Cincticostella) boja sp. n. (nymph; Thailand; = Ephemerella TEA of Gose,1969) Allen (1975) [4] p. 18.

Ephemerella (Cincticostella) gosei sp. n. (nymph; Thailand; = Ephemerella TEB of Gose, 1969) Allen (1975) [4] p. 20.

Ephemerella ignita (Poda) (= Ephemerella sibirica Tshernova syn. n.) Bajkova (1972) [7] p. 181.

Ephemerella orientalis Tshernova (male & female subimagos) Bajkova (1972) [7] p. 192.

Ephemerella rufa Imanishi (additional description of male imago) Bajkova (1972) [7] p.179.

Ephemerella sibirica Tshernova
a)- (male & female imagos) Bajkova (1972) [7] p. 181.
b)- SEE Ephemerella ignita

Ephemerella taeniata Tshernova
a)- (male & female imagos) Bajkova (1972) [7] p. 185.
b)- SEE Ephemerella aurivillii

Ephemerella thymalli Tshernova (male imago) Bajkova (1972) [7] p. 180.

Ephemerella triacantha Tshernova (male & female subimagos) Bajkova (1972) [7] p. 190.

Ephemerella TEA of Gose, 1969
SEE Ephemerella (Cincticostella) boja

Ephemerella TEB of Gose, 1969
SEE Ephemerella (Cincticostella) gosei

Cinygma adusta Imanishi
SEE Cinygmula adusta

Cinygma caucasica Tshernova
SEE Iron caucasicus

Cinygma cavum Ulmer
a)- (nymph) Bajkova (1974) [9] p. 827.
b)- SEE Cinygmula cava

Cinygma dorsalis Imanishi
SEE Cinygmula dorsalis

Cinygma frater (Tshernova) (transferred from genus Ecdyonurus) Tshernova (1974) [153] p. 812.

Cinygma hirasana Imanishi
SEE Cinygmula hirasana

Cinygma kurenzovi Bajkova
SEE Cinygmula kurenzovi

Cinygma malaisei Ulmer
SEE Cinygmula malaisei

Cinygma pellucida Brodsky (female imago, nymph; additional description of male) Bajkova (1974) [9] p. 823.

Cinygma tibiale Ulmer
SEE Cinygmula tibialis

Cinygma vernalis Imanishi
SEE Cinygmula vernalis

Cinygma zachvatkini (Tshernova) (transferred from genus Cinygmula) Tshernova (1974) [153] p. 812.

Cinygmula adusta (Imanishi) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula altaica Tshernova (male & female imagos) Bajkova (1974) [9] p. 818.

Cinygmula cava (Ulmer) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula dorsalis (Imanishi) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula grandifolia Tshernova (male & female subimagos) Bajkova (1974) [9] p. 816.

Cinygmula hirasana (Imanishi) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula kurenzovi (Bajkova) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula malaisei (Ulmer) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula tibialis (Ulmer) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula vernalis (Imanishi) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Cinygmula zachvatkini Tshernova
SEE Cinygma zachvatkini

Ecdyonurus austriacus Kimmins
SEE Ecdyonurus picteti

Ecdyonurus bellieri (Hagen) (= Ecdyonurus corsicus Esben-Petersen syn. n.) Puthz (1975) [132] p. 324.

Ecdyonurus corsicus Esben-Petersen
SEE Ecdyonurus bellieri

Ecdyonurus frater Tshernova
SEE Cinygma frater

Ecdyonurus nigrescens (Klapálek)
SEE Ecdyonurus picteti

Ecdyonurus picteti (Meyer-Dür) [species reinstated, removed from synonymy with Ecdyonurus venosus; = Ecdyonurus austriacus Kimmins syn. n.; = Ecdyonurus nigrescens (Klapálek) syn. n.; designation of lectotype] Puthz (1975) [132] p. 321.

Ecdyonurus ruffii Grandi (= Ecdyonurus wautieri Fontaine syn. n.) Puthz (1975) [132] p. 324.

Ecdyonurus tobiironis (Takahashi)
SEE Heptagenia tobiironis

Ecdyonurus venosus (Fabricius) [Ecdyonurus picteti (Meyer-Dür) removed from synonymy] Puthz (1975) [132] p. 321.

Ecdyonurus wautieri Fontaine
SEE Ecdyonurus ruffii

Ecdyonurus zhiltzovae Tshernova
SEE Notacanthurus zhiltzovae

Heptagenia arsenjevi Tshernova
a)- (male imago) Bajkova (1972) [8] p. 225.
b)- SEE Heptagenia flava

Heptagenia chinensis Ulmer (female imago) Bajkova (1972) [8] p. 217.

Heptagenia flava Rostock (= Heptagenia arsenjevi Tshernova syn. n.) Bajkova (1972) [8] p. 225.

Heptagenia iridina (Kolenati) SEE Rhithrogena iridina

Heptagenia soldatovi Tshernova (male & female imagos, subimagos) Bajkova (1972) [8] p. 221.

Heptagenia tobiironis (Takahashi) (transferred from genus Ecdyonurus; = Heptagenia sp. of Levanidova 1964, of Bajkova 1965) Bajkova (1972) [8] p. 216.

Heptagenia sp. of Levanidova 1964, of Bajkova 1965
SEE Heptagenia tobiironis

Iron caucasicus (Tshernova) (transferred from genus Cinygma) Tshernova (1974) [153] p. 812.

Genus Notacanthurus gen. n. Tshernova (1974) [153] p. 812.

Notacanthurus zhiltzovae (Tshernova) (transferred from genus Ecdyonurus) Tshernova (1974) [153] p. 812.

Rhithrogena alpestris Eaton (= Rhithrogena alpicola Navas syn. n.; = Rhithrogena brenneriana Klapálek syn. n.) Puthz (1975) [132] p. 327.

Rhithrogena alpicola Navas SEE Rhithrogena alpestris

Rhithrogena braaschi sp. n. (male & female imagos; Bulgaria) Jacob (1974) [80] p. 169.

Rhithrogena brenneriana Klápalek
a)- (designation of lectotype) Puthz (1975) [132] p. 327.
b)- SEE Rhithrogena alpestris

Rhithrogena imanica sp. n. (male imago; Ussuri Basin, USSR) Bajkova (1972) [8] p. 212.

Rhithrogena impersonata (McDunnough) (= Rhithrogena sanguinea Ide syn. n.) Flowers & Hilsenhoff (1975) [54] p. 211.

Rhithrogena iridina iridina (Kolenati) (transferred from genus Heptagenia; = Rhithrogena picteti carpathica Sowa syn. n.; designation of neotype) Puthz (1975) [132] p. 325.

Rhithrogena iridina picteti Sowa (status changed from species to subspecies) Puthz (1975) [132] p. 327.

Rhithrogena lepnevae Brodsky (female imago; = Rhithrogena unicolor Tshernova syn. n.) Bajkova (1972) [8] p. 207.

Rhithrogena picteti picteti Sowa SEE Rhithrogena iridina picteti

Rhithrogena picteti carpathica Sowa SEE Rhithrogena iridina iridina

Rhithrogena sanguinea Ide SEE Rhithrogena impersonata

Rhithrogena unicolor Tshernova SEE Rhithrogena lepnevae

Stenacron affine (Traver)
a)- (removed from synonymy with Stenacron heterotarsale
b)- SEE Stenacron interpunctatum interpunctatum

Stenacron areion (Burks) SEE Stenacron interpunctatum canadense

Stenacron canadense (Walker) SEE Stenacron interpunctatum canadense

Stenacron conjunctum (Traver)
a)- (removed from synonymy with Stenacron canadense)
b)- SEE Stenacron interpunctatum interpunctatum

Stenacron frontale (Banks) SEE Stenacron interpunctatum frontale

Stenacron heterotarsale (McDunnough) SEE Stenacron interpunctatum heterotarsale

Stenacron interpunctatum (Say) (validity of subspecies reaffirmed) Lewis (1974) [99] p. 26. [1]

Stenacron interpunctatum interpunctatum (Say) [= Stenacron conjunctum (Traver); = S. affine (Traver); S. pallidum (Traver) removed from synonymy] Lewis (1974) [99] p. 26. [1]

Stenacron interpunctatum canadense (Walker) [status changed from species to subspecies; = Stenacron areion (Burks) syn. n.; S. conjunctum (Traver)

[1]See footnote to next page

and S. proximum (Traver) removed from synonymy] Lewis (1974) [99] p. 26.[1]

Stenacron interpunctatum frontale (Banks) [status changed from species to subspecies; = Stenacron proximum (Traver)] Lewis (1974) [99] p. 26.[1]

Stenacron interpunctatum heterotarsale (McDunnough) [status changed from species to subspecies; Stenacron affine (Traver) removed from synonymy] Lewis (1974) [99] p.27.[1]

Stenacron pallidum (Traver) (species reinstated, removed from synonymy with Stenacron interpunctatum) Lewis (1974) [99] p. 30.[1]

Stenacron proximum (Traver)
a)- (removed from synonymy with Stenacron canadense)
b)- SEE Stenacron interpunctatum frontale

Stenonema alabamae Traver
SEE Stenonema exiguum

Stenonema exiguum Traver
[= Stenonema alabamae Traver syn. n.; = S. integrum of Leonard & Leonard 1962 NEC (McDunnough, 1924)] Lewis (1974) [99] p. 18, 22.

Stenonema femoratum (Say)
(subspecies removed) Lewis (1974) [99] p. 22.

Stenonema femoratum scitulum Traver
SEE Stenonema tripunctatum scitulum

Stenonema femoratum tripunctatum (Banks)
SEE Stenonema tripunctatum tripunctatum

Stenonema fuscum (Clemens) (subspecies established) Lewis (1974) [99] p. 24.

Stenonema fuscum rivulicolum (McDunnough) (transferred from synonym of Stenonema vicarium; status changed from synonym to subspecies) Lewis (1974) [99] p. 18,24.

Stenonema integrum (McDunnough) (subspecies established) Lewis (1974) [99] p. 25.

Stenonema integrum integrum (McDunnough) (= Stenonema metriotes Burks syn. n.) Lewis (1974) [99] p. 25.

Stenonema integrum wabasha Daggy (status changed from synonym of S. integrum to subspecies) Lewis (1974) [99] p. 25.

Stenonema integrum of Leonard & Leonard 1962 NEC (McDunnough, 1924)
SEE Stenonema exiguum

Stenonema mediopunctatum (McDunnough) (nymph) Lewis (1974) [99] p. 29.

Stenonema metriotes Burks
SEE Stenonema integrum integrum

Stenonema placitum (Banks) (species reinstated, removed from synonymy with Stenonema terminatum) Lewis (1974) [99] p. 31,35.

Stenonema rivulicolum (McDunnough)
a)- (removed from synonymy with Stenonema vicarium)
b)- SEE Stenonema fuscum rivulicolum

Stenonema rubrum (McDunnough) (= Stenonema varium Traver syn. n.) Lewis (1974) [99] p. 34.

Stenonema terminatum (Walsh) (Stenonema placitum removed from synonymy) Lewis (1974) [99] p. 31, 35.

Stenonema tripunctatum scitulum Traver (transferred from subspecies of Stenonema femoratum) Lewis (1974) [99] p. 35.

Stenonema tripunctatum tripunctatum (Banks) (status changed from subspecies of Stenonema femoratum to species; species reinstated) Lewis (1974) [99] p. 35.

Stenonema varium Traver
SEE Stenonema rubrum

Stenonema vicarium (Walker) [Stenonema rivulicolum (McDunnough) removed from synonymy] Lewis (1974) [99] p. 37.

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[1]Stenacron (= Stenonema interpunctatum-group) was established by Jensen while the paper by Lewis was in press. Lewis recognizes its validity in a footnote to page 9 [99].

LEPTOPHLEBIIDAE

Genus Calliarcys Eaton (nymph) Peters & Terra (1975)1974 [128] p. 61.

Calliarcys humilis Eaton (nymph) Peters & Terra (1975)1974 [128] p. 63.

Habrophlebia pusilla Traver SEE Habrophlebia vibrans

Habrophlebia vibrans Needham (female imago; redescription of male, nymph; = Habrophlebia pusilla Traver syn. n.) Berner (1975) [13] p. 139.

Habrophlebioides celeteria sp. n. (male imago, nymph; Tennessee, USA) Berner (1975) [13] p. 142.

Indialis rossi sp. n. (male imago; Kerala St., India) Peters (1975) [127] p. 160.

Leptophlebia bradleyi Needham (female imago, nymph; transferred from genus Paraleptophlebia) Berner (1975) [13] p. 146.

Leptophlebia intermedia (Traver) (female imago; additional description of male imago) Berner (1975) [13] p. 151.

Paraleptophlebia bradleyi (Needham) SEE Leptophlebia bradleyi

Paraleptophlebia volitans (McDunnough) (female imago) Berner (1975) [13] p. 153.

NEOEPHEMERIDAE

Neoephemera maxima (Joly) (redescription of nymph and imagos) Jażdżewska (1975) [82] p. 229.

OLIGONEURIIDAE

Oligoneuria anomala Pictet (redescription of female imago) Puthz (1973) [131] p. 91.

POLYMITARCYIDAE

Asthenopodes albicans of (Pictet 1843) NEC (Percheron, 1838) SEE Asthenopodes picteti

Asthenopodes picteti *nomen novum* [new name for Asthenopodes albicans of (Pictet 1843) NEC (Percheron, 1838)] Hubbard (1975) [74] p. 111.

Campsurus decoloratus (Hagen) (nymph) McCafferty (1975) [106] p. 488.

Campsurus mahunkai sp. n. (male & female imagos; Bolivia) Puthz (1973) [131] p. 94.

POTAMANTHIDAE

Potamanthus bettini Morgan SEE Potamanthus verticis

Potamanthus myops (Walsh) (nymph) McCafferty (1975) [106] p. 455.

Potamanthus verticis (Say) (= Potamanthus bettini Morgan syn. n.) McCafferty (1975) [105] p. 224.

FOSSIL EPHEMEROPTERA

HEXAGENITIDAE

Ephemeropsis trisetalis Eichwald (additional description of fore wing) Tshernova & Sinitshenkova (1974) [154] p. 131.

Genus Hexameropsis gen. n. Tshernova & Sinitshenkova (1974) [154] p. 132.

Hexameropsis selini sp. n. (wings; early Cretaceous; Ukrainian SSR, USSR) Tshernova & Sinitshenkova (1974) [154] p. 133.

OTHER TAXONOMY

Descriptions of eggs of over 180 species representing all families except Palingeniidae. Keys are included, when possible, to subfamilies, genera, and species. Koss & Edmunds (1974) [93].

Determination table (key) to imagos of the subfamilies and genera of Heptageniidae occurring in the Holoarctic and Oriental Regions, with discussion of the genera. Also, Iron znojkoi Tshernova, dubiously assigned to Iron in 1938, was placed correctly. Tshernova (1974) [153].

Key to genera of the fossil family Hexagenitidae. Tshernova & Sinitshenkova (1974) [154].

Keys to imagos of families and genera of Ephemeroptera occurring in Germany. Illies (1974) [78].

Nymphal keys to genera of Ephemeroptera in Wisconsin, USA. Hilsenhoff (1975) [72].

Keys to nymphs of European genera of Leptophlebiidae. Gaino & Spanò (1975) [60].

Keys to nymphs of genera of one phyletic group of Leptophlebiidae occurring in the Eastern Hemisphere. Peters & Terra [(1975) 1974] [128].

Keys to male imagos and nymphs of species of Heptageniidae in Wisconsin, USA. Flowers & Hilsenhoff (1975) [54].

Comparative descriptions of nymphs of Stenonema and Stenacron with keys to nymphs and male imagos. Lewis (1974) [99].

Determination tables (keys) to imagos of species of Rhithrogena and Heptagenia from eastern USSR. Bajkova (1972) [8].

Keys to nymphs of genera and species of Ephemeroidea occurring in USA and Canada, with discussion of the species. McCafferty (1975) [106].

Key to nymphs of species of Ephemerella subgenus Cincticostella. Two new species groups are established in the subgenus, the insolta-group and the nigra-group. Allen (1975) [4].

Description and establishment of 6 species groups in European Rhithrogena: alpestris-group, dorieri-group, insularis-group, semicolorata-group, germanica-group, and sowai-group. Jacob (1974) [80].

Cinygma and Cinygmula from the Amur Basin, USSR, with descriptions of some unnamed species. A tentative rearrangement of species in Cinygma and Cinygmula is discussed. Bajkova (1974) [9].

Descriptions of unnamed Ephemerella imagos, and discussion of variation in the hind wing color of Ephemerella basalis. Bajkova (1972) [7].

Differentiation of Baetis bundyae from Baetis macani. Brittain (1975) [19].

Procloeon in Europe, with the tentative assignment of many records of Cloeon rufulum to Procloeon ornatum. Sowa (1975) [146].

Ephemeroptera of the Carpathian Mountain region of Poland with notes on distinguishing similar species, potential synonyms, dubious species, and a reevaluation of species formerly reported from the region with corrections or taxonomic revision when necessary. Sowa (1975) [147].

Notes on species of Heptageniidae in the Museum of Natural History, Geneva. Puthz (1975) [132].

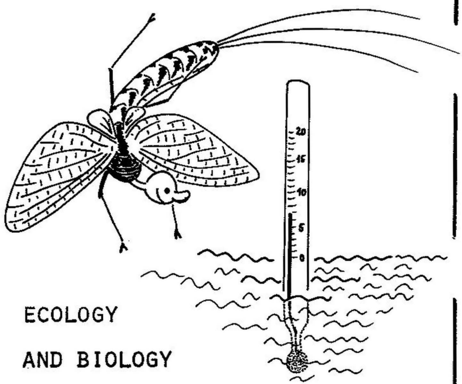
CLASSIFICATION AND PHYLOGENY

Principles of zoogeography and importance of an accurate phylogeny in zoogeography. Discussion is based on examples from Ephemeroptera, including: derivation and phylogeny of lineages of Siphlonuridae; Isonychia-Chromarcys-Elassoneuria; Pentagenia and the Palingeniidae; Caenidae and Neoephemeridae. Edmunds (1975) [41].

Phylogeny and relationships among families of Ephemeroptera as indicated from evolution of morphological characters in the egg stage. Koss & Edmunds (1974) [93].

Phylogeny of selected genera of the Leptophlebiidae showing Gondwanian or southern continental affinities, as interpreted from comparative thoracic morphology. Tsui & Peters (1975) [156].

Phylogeny of genus Heterocloeon. McCafferty & Provonsha (1975) [107].



ECOLOGY AND BIOLOGY

ECOLOGY AND BIOLOGY - life histories

Life cycle of Baetis macani in 2 lakes in Norway. Eggs hatch in June as ice breaks, development is rapid, and emergence occurs from mid-August to the formation of ice in early October. Gut analysis showed a diet of detritus, diatoms, and vascular plant material. Brittain (1975) [19].

Life cycle and production of Deleatidium sp. in a New Zealand river. Deleatidium sp. appeared to have a poorly synchronized winter generation which declined in numbers and biomass through the year and a rapid-growth, high-production summer generation. Highest densities occurred during February while biomass was highest in March-April. Microdistribution and problems in estimating production are considered. Life cycle of Stenoperla prasina, a predator, forms part of the study. Winterbourn (1974) [163].

Biology of Tricorythodes atatus in northern Minnesota, USA. Eggs hatched and nymphs developed in summer months with first emergence peak in mid-July, continued emergence and a 2nd peak later. T. atratus is a herbivore, living on algae, desmids, diatoms, and plant tissue. Drift activity was highest after sunset. Males emerged after sunset, females before sunrise; emergence occurred underwater. Swarming patterns and oviposition in early morning are described. Hall, Berner & Cook (1975) [67].

Life cycles and growth of species of Ephemeroptera and Plecoptera in lakes of southern Norway. Univoltine species were Ameletus inopinatus, Siphlonurus lacustris, Heptagenia fuscogrisea, Leptophlebia vespertina and L. marginata, and Caenis horaria and C. moesta. Centroptilum luteolum was multivoltine, Cloeon dipterum multi- and univoltine. Ecological factors affecting the distribution of these species in lakes are discussed. Brittain (1974) [18].

Life cycles and growth rates of 3 species of Ephemeroptera in a small lake in Sweden. Growth and development of Ephemera vulgata required 2 years, that of Leptophlebia vespertina and Cloeon dipterum one year, although C. dipterum did exhibit a bivoltine pattern in one of the years under study. Growth was reduced in winter. Kjellberg (1973) [92].

Developmental cycles of Plecoptera, Trichoptera, and Ephemeroptera from 4 stations in the Yoshino River drainage, Japan. Of Ephemeroptera species limited to 1-2 stations, 15 were univoltine and 7 bivoltine: Paraleptophlebia chocolata, Choroterpes trifurcata, Ephemerella rufa, Baetis yamatoensis, Baetiella japonica, Isonychia japonica, and Epeorus uenoi. E. latifolium occurred at all stations and was univoltine at the coldest and bivoltine at the 2 warmest stations. The accumulated month-degree temperatures necessary to produce 1, 3/2, or 2 generations/year in E. latifolium are analyzed. Gose (1973) [64].

Parthenogenesis in Stenonema femoratum, S. interpunctatum, S. pulchellum, and S. vicarium. In S. femoratum 95% of fertilized eggs hatched while the rate for unfertilized eggs varied from 0.5-36.5% for different individual females. Huff & McCafferty [(1975)1974] [75].

ALSO SEE: Rutter & Wissing [138] life cycle of Hexagenia limbata in an Ohio pond; Norland & Mulla [122] growth rate of Callibaetis pacificus (13-15 apparent nymphal instars) at different temperatures; Jażdżewska [82] notes on life cycle and biology of Neoephemera maxima in Poland; Langford [95] life cycles of Ephemeroptera species of an English river; Okazawa [123] life cycle data on representative species of Ephemeroptera, Plecoptera, Trichoptera, and Diptera in a stream on Hokkaido; Tsuda et al. [155] life cycles of aquatic insect species in a Japanese river; Karlstrom [89] increase in growth of Ephemerella ignita, E. mucronata, and Heptagenia dalecarlica over the last half of 1973 in a Swedish river.

ECOLOGY AND BIOLOGY — adult activity

Categorization of adult Ephemeroptera flight behavior: 1) shifting flights such as those made by emergent subimagos seeking shelter or imagos moving to a place to begin another behavior; 2) nuptial dances; 3) oviposition flights. Physical factors affecting nuptial dances are discussed and species are grouped by whether or not they display the typical "pendular" nuptial flight, with discussion of behavioral-morphological-anatomical differences in the atypical group. Grandi (1973) [66].

Theory concerning the retention of the subimago stage in Ephemeroptera as an absence of selective pressure causing synchronous maturation of wings and genitalia in adults of short-lived, mass-emerging insects. Schaefer (1975) [140].

Compensatory upstream flights of Rhithrogena loyolaea and Baetis alpinus in 2 Pyrenees mountain streams, France. By calculating the distance and altitude between the point on a stream where mature nymphs were collected with the collection localities for female imagos, the minimum upstream distance of flight was estimated at 400-1200 m with an altitude gain of 350 m for R. loyolaea (probably 1-2 km with altitude gain of 500 m). For B. alpinus minimum distance was 800 m, minimum altitude 170 m (probably more than 1 km upstream, 350 m altitude gain). Thomas (1975) [151].

Emergence patterns of species of Ephemeroptera, Trichoptera, and Megaloptera in the River Severn, England-UK, 1969-1971. Emergence was studied above and below a cooling water outfall from a power station which caused an increase in degree-hrs at the downstream station of up to 27.6% in 1969-70 and 19.3% the next year. While some species emerged a few days earlier downstream, there was no significant pattern of early emergence downstream. High temperature did not suppress emergence. Most species emerged at temperatures of 12-28°C with detailed data for each species given. High water and low temperatures suppressed mayfly emergence. Other factors affecting emergence are discussed. Langford (1975) [95].

Weekly emergence patterns of species of Ephemeroptera, Trichoptera, Chironomidae, and other insects from an oligotrophic lake in southern Finland, as measured by emergence traps over 2 emergence seasons. Habitat preferences for emergence of each species are described and total yearly energy output for different zones of the lake is estimated. Paasivirta (1975) [126].

ALSO SEE: Hall, Berner & Cook [67] adult activity of Tricorythodes atratus; Keller [90] experiments with tethered flight of Ecdyonurus venosus in flight-mill indicating a mean flight range of 2547 m for female imagos and 3164 m for male imagos; Lévêque et al. [98] note on lunar emergence rhythm of Povilla adusta in Lake Chad; Bajkova [7] biological data (fecundity, emergence, swarming) on Ephemerella basalis and other species of Ephemerella in Amur and Ussuri Basins; Bajkova [8] data on emergence and swarming for species of Rhithrogena and Heptagenia in Amur and Ussuri Basins; Hodkinson [73] emergence of Ephemeroptera and other insects from a beaver pond, Alberta; Langford & Daffern [96] patterns of seasonal emergence of Ephemeroptera and other aquatic insects in an English river.

Experimental studies on drift and upstream movement of Ecdyonurus venosus in an adjustable laboratory stream. Seasonal changes in drift patterns (30 min samples compared with 2 hr samples) indicated reduced drift activity in the last nymphal instar. Mean distances travelled in drift and distances Ecdyonurus moved back upstream are calculated. The dominant factor initiating drift is food availability, and drift patterns can be affected by sudden temperature changes, respiratory difficulties, and substrate movement under high flow conditions. Neither predators nor competitors influenced drift. Keller (1975) [90].

Summary results of experiments with invertebrate fauna in the Estaragne, a mountain stream in France. Baetidae were dominant (especially in winter) and Rhithrogena loyolaea was common. Drift occurred in summer and winter, but peaks of insect drift activity disappeared in winter under heavy snow (no light) conditions. Upstream movements of mature insect larvae were small compared with downstream drift. Younger stages of some species were collected up to 35 cm in the substrate, especially in winter, but this faunal component was not large. Décamps & Lavandier (1972) [36].

Daily drift patterns (by hour) of Deleatidium spp., Coloburiscus humeralis, Nesameletus ornatus, Zephlebia scita, and other aquatic insects in the Glentui River, New Zealand. Feeding of Galaxis vulgaris coincided with drift activity; feeding of another species of fish did not show such a pattern. Cadwallader (1975) [26].

Microdistribution of Palingenia longicauda at a locality without significant fluctuation in water level, Tisza River, Hungary. Young nymphs occurred near the river bank or in the upper 20 cm of mud 3-7 m from the river bank. Intermediate nymphs were uniformly distributed. Large nymphs were more frequent 4-7 m from the bank in mud 30-50 cm deep. Csoknya & Halasy (1974) [34].

Vertical distribution of non-mayfly zoobenthos (Oligochaeta especially) in the Tisza River, Hungary. Percentage representation of Palingenia longicauda at different depths in mud is included. Ferencz (1974) [50].

Distribution and abundance of Hexagenia limbata in a small pond, Ohio, USA, in relation to oxygen, temperature, wind, and substrate preferences. Abundance was greatest in yellow clay-gravel substrate, but varied greatly between different areas of the same substrate: density decreased with depth; density was highest on the eastern shore (increased wave action). Average population abundance was 473 individuals/m^2, average biomass 2.15 g dry weight/m^2. Rutter & Wissing (1975) [138].

Experimental study of substrate choice for 5 species of aquatic insects. Diameters of substrates were: fine (1-1.5 mm) and coarse (2.5-6 mm) sand, small (6-12 mm) and large (12-25 mm) pebbles, and cobble (stones of 64-256 mm diameter). Ephemerella grandis showed a preference for exposed (not embedded) cobble and this preference increased as size of the surrounding substrates decreased. Results are compared with field data from streams in Idaho, USA. Brusven & Prather (1974) [23].

Substrate preferences of aquatic insects in a river in Colorado, USA, by colonization of experimental trays. Results showed Epeorus longimanus preferred substrates >64 cm, Rhithrogena hageni those from 32-64 cm, and Ephemerella inermis those from 16-32 cm in diameter, although occurring on other sizes. Other species were considered. Baetis bicaudatus colonized the trays rapidly and declined in abundance as other organisms increased. More species colonized trays of mixed substrates than those of a single substratum. In spite of the significance of substrate size, longitudinal zonation was more important in overall distribution of species. Allan (1975) [3].

Substrate preferences of genera of aquatic invertebrates in a Kentucky stream, USA. Ephemeroptera were most abundant. Isonychia occurred in moderate density on each substrate (boulder = diameter >30 cm, rubble = 7.5-30 cm, sand and gravel <7.5 cm); Stenonema was abundant on rubble and boulders; Paraleptophlebia was only on boulders. Baetis, Caenis, and Heptagenia were present in too small numbers to determine preferences. Channelization of the stream during the study reduced standing crop of invertebrates. Crisp & Crisp (1974) [33].

ALSO SEE: Hall, Berner & Cook [67] drift and nymphal activity of Tricorythodes atratus; Gale [61] seasonal migration and substrate selection of Hexagenia in Pool 19 of the Mississippi River; Fittkau et al. [52] notes on habitat preference and migration activities of Campsurus notatus in the Amazon River; McClellan [111] notes on ecology of certain New Zealand species of aquatic insects.

ECOLOGY AND BIOLOGY — communities and trophic relationships

Definition of 2 groups of freshwater invertebrates: holohydrobionts, organisms spending their entire life in water; hemihydrobionts, organisms which are aquatic during the developmental stages of their life cycle (Ephemeroptera, etc.). Discussion and examples of ecology, zonation, and production of these groups are given for Hungarian waters. Berczik (1973) [12].

Community structure of insect fauna of an abandoned beaver pond, Alberta, Canada. Seven faunal elements were recognized: 2 Callibaetis spp. were representative of the ubiquitous element, Ephemerella sp. was representative of stream dwellers near the pond inflow, and Paraleptophlebia was unclassified. Other elements were also arranged according to distribution on substrates. Important sediment variables included particle size and organic components. Seasonal emergence and gut analysis of dominant species is included: Callibaetis sp. A was a collector detritivore. Hodkinson (1975) [73].

Trophic relationships and predation of benthic invertebrate fauna at 2 sites in Altahoney River, Ireland. Data is included on distribution, Ephemeroptera spp. being more abundant at the low altitude and trophically rich locality. Fahy (1972) [47].

Caloric values of 18 invertebrate species from 2 small woodland streams near Bonn, Germany-DBR. Dry weight values for Ephemeroptera were: Rhithrogena semicolorata, 4955 cal/g; Leptophlebia marginata, 5647 cal/g; Baetis rhodani, 6044 cal/g. Caspers (1975) [27].

Caloric values of phytophilous invertebrates of Dnieper reservoirs, USSR, ranging from 4.8-6.18 kcal/g organic matter. Values for Cloeon dipterum were 5.25-5.81 and for Caenis robusta 5.33-5.34 kcal/g organic matter. Sherstyuk & Zimbalevskaya (1973) [143].

ALSO SEE: Sowa [147] seasonal changes in community structure of Ephemeroptera in Carpathian mountain rivers; Winterbourn [163] predator-prey relationships between Stenoperla prasina and Deleatidium sp. in a New Zealand river.

FAUNAL STUDIES — geographical

New distribution records for species of Ephemeroidea in USA. McCafferty (1975) [106].

Distribution of species of Heptageniidae in Wisconsin, USA. Flowers & Hilsenhoff (1975) [54].

Distribution records for species of Leptophlebiidae occurring in the southeastern USA. Berner (1975) [13].

Distribution of species of Stenonema and Stenacron in North America. Lewis (1974) [99].

Record of Arthroplea bipunctata from Ohio, USA. McElravy & Foote (1975) [109].

Species list of Ephemeroptera from Kaltisjokk region, Sweden, with months of imago flight. Paraleptophlebia cincta is new for Sweden. Jensen (1974) [84].

Records and distribution of species of Baetis in Finland and 2 localities in northern Norway. Baetis subalpinus is a new record for Finland. Müller-Liebenau & Savolainen (1975) [119].

Report of Baetis atrebatinus from Wales-UK. Jenkins (1974) [83].

Records and distribution of species of Ephemeroptera and Plecoptera from North Wales-UK with many new county records. Brittain [(1975)1974] [20].

First record of Neoephemera maxima from Poland. Jażdżewska (1975) [82].

Ephemeroptera species and distribution in Carpathian Mountain region of Poland, with the following new records for Poland: Baetis digitatus, Baetopus tenellus, Centroptilum nemorale, Cloeon cognatum, Ecdyonurus quadrilineatus, and Brachycercus pallidus. Sowa (1975) [147].

Distribution of Calliarcys humilis and other genera of Leptophlebiidae in Portugal. Peters & Terra [(1975)1974] [128].

New records of species of Ephemeroptera from the Lucania region of Italy and comparison with other regions. Gaino & Spanò (1974) [59].

First record of Thraulus bellus from Italy. Gaino & Spanò (1975) [60].

Ephemeroptera species and their distribution in Servia, Yugoslavia, with remarks on zoogeography. Filipović (1975) [51].

Species of freshwater invertebrates and their distribution in lakes and streams of the Rhodope Mountains, southern Bulgaria. New records for Bulgaria include Baetis pavidus, B. sinaicus, B. vernus, B. fuscatus, B. atrebatinus, B. niger, Heptagenia longicauda, Ecdyonurus forcipula, E. austriacus, and Paraleptophlebia werneri. Russev & Janeva (1975) [137].

Distribution records for species of Ephemerella in the Amur and Ussuri basins, USSR. Bajkova (1972) [7].

Distribution records for species of Rhithrogena and Heptagenia from eastern USSR. Heptagenia chinensis was found for the first time. Bajkova (1972) [8].

Distribution records for species of Cinygma and Cinygmula from eastern USSR. Bajkova (1974) [9].

FAUNAL STUDIES — limnological

Aquatic plants and invertebrates from the Mackenzie and Porcupine River watersheds, Northwest Terr. and Yukon, Canada. A species list of Ephemeroptera is included. Wiens, Rosenberg & Snow (1975) [161].

Ephemeroptera, Plecoptera, Trichoptera, and Diptera of the Yellowstone River, Montana, USA, with longitudinal distribution of genera and species diversity. Newell (1975) [121].

Survey of species of aquatic insects, fish, and vascular plants from 3 intermittent and 5 permanent streams in eastern South Dakota, USA. McCoy & Hales (1974) [108].

Bottom fauna of Pool 19, a dammed section of the Mississippi River, USA. Gale (1975) [61].

Invertebrate species of 4 streams in Moor House Nature Reserve, England-UK, with comparison between fauna of these streams and streams of adjacent areas. Four Ephemeroptera species are new for the Reserve. Armitage, MacHale & Crisp (1975) [5].

Preliminary study on physico-chemical and biological characteristics of Bas-Bugey Park, France. Most common Ephemeroptera species were Ecdyonurus venosus, Baetis rhodani, and Habroleptoides modesta. Nelva (1972) [120].

Pre-impoundment study at 4 sites on the upper Olţet River, Romania. Dominant species included Rhithrogena semicolorata, Ecdyonurus fluminum, and certain species of Plecoptera, Trichoptera, and Chironomidae. Rogoz (1973) [135].

Aquatic insect species of the Glentui River, Canterbury, New Zealand, and study of fish diet. Cadwallader (1975) [25].

ALSO SEE: Hodkinson [73] insect species of a beaver pond, Alberta, Canada; Mendelson [113] invertebrate species of a Wisconsin creek, USA; Müller [118] Ephemeroptera, Plecoptera, and Trichoptera species of rivers in the Messaure region, northern Sweden; Brittain [18] relative abundance, distribution, and factors affecting distribution of Ephemeroptera and Plecoptera in lakes of southern Norway; Fahy [48] invertebrate species of Altahoney River, Ireland; Hughes [76] list of invertebrate species of River Cynon, Wales-UK; Langford [95], Langford & Daffern [96] Ephemeroptera, Plecoptera, Megaloptera, and Trichoptera of River Severn, England-UK; Bogoescu & Rogoz [15] Ephemeroptera species and their distribution in streams of the Olţet River basin, Romania; Okazawa [123] aquatic insect species of Hoshioki stream, Hokkaido, Japan; Tsuda et al. [155] distribution of aquatic insect species in the Yoshino River, Japan; Cadwallader [26] aquatic insects of the Glentui River, Canterbury, New Zealand.

GENERAL

Report on the 2nd Symposium on Aquatic Insect Groups in Guttau, Germany-DDR, May, 1974. Joost (1974) [86].

Description of kit for school children enabling them to estimate water quality from presence of indicator fish and invertebrates. Mellanby (1974) [112].

HYDROBIOLOGY — running waters

Effects of increased sedimentation caused by mudslides and road construction on rivers in Northwest Terr. and Yukon, Canada. Experimentally, controlled addition of sediments to streams caused an increase in drift of macrobenthos at all experimental concentrations of suspended sediment used. Ephemeroptera were represented among macrobenthos. Rosenberg & Snow (1975) [136].

Effects of channelization on fish and macroinvertebrates of an Iowa river, USA. For macroinvertebrates, numbers of Ephemeroptera and other insects collected on substrate samplers (colonized 7 days) and in drift samples were greater in the channelized than in the unchannelized section of the river. This result is attributed to a lack of suitable substrate for macroinvertebrates in the channelized section. Hansen (1973) [68].

Distribution of aquatic invertebrates of Altahoney River, Ireland, compared with water depth, substrate size, and detrital content. Detritus was the most demonstrable factor affecting distribution, and an estimated 2000 herbivores supported 100 carnivore/omnivores. Six assemblages of species were identified, representing a downstream zonation in several respects. Fahy (1975) [48].

Effect of fluctuating flow from Messaure power station discharge on insect fauna of a river in Sweden. Comparing light trap results from discharge canal with surrounding rivers, Trichoptera have adapted to fluctuating flow while Plecoptera species were reduced by 24%. Ephemeroptera were reduced from 22 to 16 species, but total abundance was about the same, apparently because those species with maximum growth in winter (when water flow is more constant) increased in abundance. A discussion is included on the future development of the River Magasin as a fishing lake. Müller (1975) [118].

Abundance and biomass of invertebrates from stones in the River Rickleå, Sweden, over the last part of 1973. Production estimates are given for 2 species of Trichoptera, and growth rates for some Ephemeroptera, Plecoptera, and Trichoptera. Karlström (1974) [89].

Distribution, zonation, and community composition of Ephemeroptera (97 species) in streams of the Carpathian Mountain region of Poland. Six longitudinal-altitudinal zones were distinguished, varying slightly by stream type and region. Example: the high mountain zone was dominated by Rhithrogena loyolaea, Ameletus inopinatus, and Baetis alpinus in one region and by B. alpinus, B. rhodani, and Ecdyonurus subalpinus in another. Detailed distributions are given for 5 river systems, with supplementary data from other systems. Abundance, microhabitat, and seasonal changes in community composition are analyzed from stations in the Raba River catchment area. Sowa (1975) [147].

Effects of a wave of deoxygenated water on drift of invertebrates in a Pyrenees stream, France. Normal oxygen fluctuations did not affect drift, but at an oxygen level below 4 parts per million drift increased significantly. For Centroptilum luteolum, 15 min drift samples at normal O_2 levels captured 3-18 individuals; at O_2 concentrations of 3.9 ppm 37 individuals; at O_2 concentrations of 1.1 ppm 5950 individuals. While results were more spectacular at lowest O_2 levels, a continual decreased O_2 level (< 4 ppm) might eventually have the same effect. Lavandier & Capblanq (1975) [97].

Distribution of Ephemeroptera species in streams of the Olţet River basin, Romania. Zonation was influenced by altitude, current, oxygen, and other factors, with Habroleptoides modesta and species of Ecdyonurus dominant in the high mountain zones. The greatest variety of species occurred in the middle zones, while Cloeon dipterum and Baetis bioculatus were dominant in the hill + plains zone. Bogoescu & Rogoz (1973) [15].

Categorization of the Hoshioki stream, Hokkaido, Japan, by seasonal occurrence and longitudinal distribution of aquatic insect species. Among dominant species were Baetis sp. A, Cinygma sp., Epeorus latifolium, E. ikanonis, E. uenoi, Ephemerella trispina, E. yoshinoensis, and Ephemerella sp. A. Insect fauna was reduced in April to to spring floods. Okazawa (1974) [123].

Results of studies on the productivity of the Yoshino River system, Japan, including primary production, fish production, and trophic relationships. Studies on secondary production included life cycles of aquatic insect species, their annual rate of production, and turnover ratios. Total annual production of dominant Ephemeroptera species was 22.4 gm/m^2 with a turnover ratio of 4.1-4.3 for univoltine species and 5.5-7.7 for bivoltine species. Data are included on process of recovery of benthic fauna over a 10-year period following total destruction by a typhoon. Tsuda, Ueda, Gose & Maki (1975) [155].

Annual changes, by month, of standing crop of aquatic insect species in a tributary of the Yoshino River, Japan. Biomass of dominant species of Ephemeroptera was highest in April and lowest in December, with mayflies representing 2.5% in winter to 8% in spring of the total insect fauna. Gose (1973) [63].

Seasonal changes in recolonization of Pawmpawm River, an intermittent river in Ghana. Among Ephemeroptera, Centroptilum reappeared first, followed by Centroptiloides, Baetidae nymph A, Tricorythus, and Leptophlebiidae sp. 1. Results varied for Austrocaenis, which seemed capable of surviving short periods without water flow in damp algae-moss. Recolonization was apparently the result of eggs laid by flying adults. Life cycles were generally short and tied to alteration of flow and non-flow conditions. Hynes (1975) [77].

Production of the Kalengo, a mountain stream in Zaïre, as measured by 16-month study of insect emergence with tent trap covering 8.9 m^2 of stream. Total biomass (dry weight) was 3955 mg/m^2/year, of which 50% were Ephemeroptera (order only). Highest average daily number of mayfly individuals was 110.3 in early April 1972; lowest was 34.6 in late July 1973. Seasonal changes (wet-dry) did not seem to affect production. Factors which affected production are undetermined. Böttger (1975) [16].

Effects of electric fishing upon drift of Zephlebia sp., Coloburiscus humeralis, Deleatidium sp., and other invertebrates in a small stream on South Island, New Zealand. Net reduction of benthic fauna was estimated at close to 10%, but most drifting animals returned to the bottom after only a short distance. Fowles (1975) [55].

ALSO SEE: Newell [121] longitudinal distribution and diversity of aquatic insects in the Yellowstone River; Allan [3] longitudinal distribution of insects in a river in Colorado as a result of gradient and faunal replacement rather than distinct zonation; Crisp & Crisp [33] decline in macroinvertebrate standing crop following channelization of a Kentucky stream; Junk [87] ecology of fauna of floating vegetation in Amazon River basin and Amazon lakes; Fittkau et al. [52] physical and biological characteristics of Amazon waters, including production, biomass, and population dynamics; Fahy [47] data on distribution of mayfly species in an Irish river in relation to abundance of allochthonous material; Langford [95] effects of heated water from a power station on emergence of aquatic insects in an English river; Winterbourn [163] production and biomass of Stenoperla prasina and Deleatidium sp. in a New Zealand river.

HYDROBIOLOGY — still waters

Effects of a reduction in fall drawdown from 10-12 m to 6-7 m in a South Dakota reservoir, USA. The decrease in drawdown apparently increased available winter habitat, as spring abundance of invertebrates increased threefold, especially chironomids, oligochaetes, ceratopogonids, Hexagenia and Caenis. Benson & Hudson (1975) [11].

Changes in bottom fauna of a bay of Oneida Lake, New York, USA, between 1916 and 1967. Tubificidae and Amphipoda increased. Other groups decreased. Among Ephemeroptera, Hexagenia, Heptagenia, and Baetis disappeared; only a small number of Caenis remained. Changes probably resulted from eutrophication and shoreline development. Clady (1975) [29].

Annual fluctuations in distribution of fauna and biomass (generally to order only) found in association with floating meadows of Paspalum and Echinochloa in the Amazon River and tributaries, Brazil. Three characteristic meadow biotopes were distinguished: 1) flowing whitewater rich in suspended solids, in which current speed affected distribution; 2) Lago Type A or lakes with sedimented white water and high oxygen levels in the meadows; 3) Lago Type B or lakes like Type A with little to no oxygen in the vegetation. Asthenopus sp. was frequently found in the lakes. Junk (1973) [81].

Summary results on production of 2 Karelian subarctic lakes, Lake Krivoe and Lake Krugloe, USSR, including physico-chemical conditions, primary and secondary production. Production, growth rates, efficiency of utilization of food for growth, oxygen requirements, and energy budgets are given for different biocoenoses including that of Ephemera vulgata. Alimov et al. (1972) [2].

Summary results comparing physico-chemical conditions, biomass and production of different trophic levels in 3 lakes, Byelorussian SSR, USSR. Average fresh weight biomass of Ephemeroptera was .04 gm/m^2 in the mesotrophic lake, .01 gm/m^2 in an intermediate-type lake, and non-existent in the eutrophic lake. Winberg et al. (1972) [162].

Summary results of hydrobiological research on Lake Chad, north-central Africa, including physico-chemical conditions, plants, zooplankton, benthos, fish, production, and trophic relationships. Ephemeroptera were 10% of the benthic fauna by number with a fresh weight biomass of 3 kg/hectare in the eastern section of the lake (of total 5.2 kg/ha). Lévêque et al. (1972) [98].

Role of aquatic plants in recovery of Lake Chilwa, Malawi, after drought. As lake refilled, plants provided substrate for 40 insect species including Cloeon and Baetis. Floating macrophytes were more important than emergent species, and dead floating macrophytes more important than living. Much of the increase in biomass on dead plants resulted from the appearance of Povilla adusta for the first time in Lake Chilwa. Experimental data are included on salinity tolerances of 2 species of Chironomidae. McLachlan (1975) [110].

ALSO SEE: Hodkinson [73] faunal and organic sediment structure of an abandoned beaver pond, Alberta; Gale [61] biomass of Hexagenia in Pool 19 of Mississippi River; Rutter & Wissing [138] distribution, abundance and biomass of Hexagenia limbata in an Ohio pond; Paasivirta [126] biomass and annual output of incorporated energy from littoral (4-13 kcal/m^2) and epiprofundal (.06-1.1 kcal/m^2) zones of the oligotrophic Lake Pääjärvi, Finland, as measured from insect emergence; Petr [129] factors associated with initial high fish production in African man-made lakes.

METHODS

A comparison of invertebrates collected by Surber sampler, box sampler, electric shock sampler, and artificial substrate samplers in the River Cynon, Wales-UK. Comparison between any 2 samplers showed no significant differences for Ephemeroptera. Overall, artificial substrates yielded the greatest number of species and electric shock the fewest; however, electric shock was selective for Ephemeroptera. Surber and box samplers gave similar results and are valuable for studying community structure. Hughes (1975) [76].

Preliminary studies on use of colonization basket samplers as a quantitative method of sampling bottom fauna in the River Rickleå, Sweden. Abundance of certain species picked from stones differed from their abundance in baskets, although total biomass sampled by the 2 methods was similar. Source of the stones used and mesh size affected results. Karlström (1974) [88].

New designs for portable light trap, rearing cages, and subimago rearing chambers for field collecting and associating adults and nymphs of Ephemeroptera. Provonsha & McCafferty (1975) [130].

New design for an underwater light trap. Larvae of many groups are captured in this way. Engelmann (1973) [45].

Improved design for an air bubble and water elutriator to sort stones and gravel from aquatic insects in alcohol-preserved quantitative samples. Most organisms (100% of Ephemeroptera) were elutriated in 6 min. Stewart (1975) [149].

A new subsampler designed to separate benthic organisms. Statistical analysis of subsamples obtained showed random distribution. Hickley (1975) [71].

ALSO SEE: Langford & Daffern [96] design for 3 models of floating emergence traps for use in large rivers, with comparison of insects collected in each and discussion of effects of trap design on apparent emergence; Huff & McCafferty [75] forced copulation of imagos and techniques for rearing eggs of Ephemeroptera.

MINOR REFERENCES

(referring only to incidental data on Ephemeroptera, not to the entire paper)

Discussion of evolution of insects in relation to atmospheric oxygen, geology, and the evolution of plants. Smart & Hughes (1972) [144].

Distribution of fish, benthic invertebrates, and zooplankton in Great Bear Lake, Northwest Terr., Canada. Ephemeroptera were among forms restricted to water less than 5 m deep. Johnson (1975) [85].

Invertebrate drift by season and locality on the Matamek River, Quebec, Canada, in relation to salmonid biomass. Fish were most abundant at station with greatest drift. Ephemeroptera comprised <.1-24% of drift at upper station, .7-10.5% of drift at lower station. Gibson & Galbraith (1975) [62].

Feeding relationships among 4 species of Notropis in a Wisconsin stream, USA. Benthic fauna and invertebrate drift were also studied. Baetis sp. was present. Mendelson (1975) [113].

Effects of acid mine pollution on an Alabama stream, USA, as indicated by physicochemical parameters, total number of species, and species diversity. Seven species of Ephemeroptera were present in the stream. Dills & Rogers (1974) [38].

Changes in ecology of the Norfolk Broads, shallow man-made lakes in England-UK, with emphasis on flora. Fauna included Cloeon dipterum and/or Caenis horaria in 5 of the 28 broads. Mason & Bryant (1975) [104].

Invertebrate fauna of moss (Cratoneuron commutatum and C. filicinum) in a Danish spring, including horizontal and vertical distribution and life cycles of dominant species. Baetis rhodani occurred in the zone between the moss and stones in the outflow stream at a density of 178 specimens/m. Lindegaard, Thorup & Bahn (1975) [100].

List of Heteroptera and Coleoptera collected by underwater light trap, Germany-DDR. Other groups, including Ephemeroptera, were also captured. Engelmann & Tobisch (1972) [46].

Invertebrate fauna of lakes and ponds in Western Taimyr, RSFSR, USSR. Baetis sp. and Cloeon sp. were recorded. Shalaeva (1974) [142].

Hydrological characteristics and macrobenthos of lakes of Khazarasp region, Uzbek SSR, USSR. Caenis macrura [Ordella] and Cloeon dipterum are reported. Embergenov (1974) [44].

Fauna of underground and spring waters in Northern Tien-Shan and Southern Kisilkum, Kirgiz SSR and Uzbek SSR, USSR. Ephemeroptera and Odonata nymphs were found occasionally among interstitial fauna collected from holes dug on banks of a stream. Jankovskaya (1972) [81].

Results and discussion concerning use of a modified Malaise trap to study rice paddy agroecosystems in Thailand, Hong Kong, and the Philippines. Order Ephemeroptera was occasionally collected. Yano et al. (1975) [164].

Study on plankton, invertebrates, and fish of lakes of Fraser Island, Queensland, Australia. Species of Ulmerophlebia and Cloeon were present in littoral vegetation of many lakes. Bayly, Ebsworth & Wan (1975) [10].

Limnology of 3 volcanic lakes, south Australia. Caenis sp. was represented in benthos of 2 of the lakes. Timms (1974) [152].

MORPHOLOGY AND PHYSIOLOGY

Comparative morphology of nymphal and adult thorax, nymphal tentorium, and nymphal abdominal spination for 19 nominal genera of Leptophlebiidae showing southern continental (Gondwanian) affinities. Tsui & Peters (1975) [156].

Morphology of head and mouthparts of nymph of Ephemera danica. Head morphology of E. danica is compared with that of Palingenia. Strenger (1975) [150].

Record of the presence of coxal sense organs on all examined insect orders, including Ephemeroptera (Cloeon sp.). The inner coxal hair plate lies between the coxa and the trochantin and the outer coxal hair plate is on the episternal face of the coxal process. Lombardo (1973) [102].

Ultrastructure of flight muscles in different insect orders with emphasis on Hemiptera. Data is included on synchronous flight muscles of Ephemera vulgata. Cullen (1974) [35].

Analysis of motion of mayfly wing in flight from study of tethered flight of Ephemera vulgata in wind tunnel. Brodsky (1975) [21].

Comparison of zinc and iron accumulated by chloride cells of Baetis rhodani with concentrations of these metals in the river Sülz, Germany-DBR. Using energy-dispersive X-ray microanalysis, it was found that concentrations of iron and zinc in the mayfly chloride cells corresponded with those in the river. Heuss & Wichard (1975) [70].

Accumulation of heavy metals in the chloride cells of 2 mayfly species by X-ray spectrum analysis. Analysis of gills and chloride cells of Baetis rhodani from a German-DBR stream containing heavy metals showed the presence of these metals. An isotope of zinc was used to experimentally trace the uptake of a heavy metal in Cloeon dipterum. Chloride cell analysis can serve as a method to monitor water quality. Wichard & Schmitz (1974) [160].

Gill chloride cell numbers from Baetis rhodani populations collected from 3 localities of differing salinities in a German-DBR stream. There was a significant decrease in the number of cells as the salinity of the stream increased. Wichard & Heuss (1975) [159].

Chloride cell numbers and osmoregulatory adaptations in Cloeon dipterum and other aquatic insects from the Neusiedlersee region of Austria. Numbers of chloride cells varied according to the salinity of the habitats where the insects were collected. Wichard (1975) [158].

Effects of trematode infection with Allopodocotyle lepomis (?) on hemolymph of Hexagenia recurvata and Sialis sp. Disc electrophoresis of hemolymph showed loss of protein in infected insects. Staining of hemolymph for tyrosinase activity was negative in Hexagenia, positive in Sialis; similar staining of hemocytes showed some tyrosinase activity in both insects. Interpretation and significance of results in host defense reactions are discussed. Chambers, Hall & Hitt (1975) [28].

ALSO SEE: Koss & Edmunds [93] morphological characters of Ephemeroptera eggs; Grandi [66] morphological adaptations in flight apparatus of certain Ephemeroptera with atypical flight behavior; Alimov et al. [2] oxygen consumption value for Ephemeroptera (principally Ephemera vulgata) of 34.44 mg O_2/24 hrs at wet weight of .803 g; Miura & Takahashi [114] effects of insect growth inhibitor on molting of Callibaetis sp.; Lo et al. [101] hemocyte response of Litobrancha recurvata to trematode infection.

PARASITES AND SYMBIOTIC ASSOCIATES

Description of Zygopolaris ephemeridarum, new genus and species of Trichomycetes (Genistellaceae), from anus of Ephemerella inermis and Baetis parvus in Rocky Mountains, USA. Moss, Lichtwardt & Manier (1975) [115].

Variations in colors produced by different vital stains on primite and satellite of gregarines Enterocystis fungoides and E. racovitzai (from Baetis vernus), E. palmata (from B. buceratus), and E. rhithrogenae (from Rhithrogena semicolorata). Resulting coloration was affected by age and cytoplamic sexualization of the gregarines. Codreanu-Bălcescu (1973) [32].

Ultrastructure data on Spiriopsis adipophila indicating this mayfly parasite is a member of the Sporozoea, possibly a new representative of the family Barrouxiidae. Desportes & Delage-Darchen (1975) [37].

Report of an infection of Microsporida (Thelohania sp.) in abdominal cavity of Rhithrogena semicolorata, Ireland. Effects of parasite on host are discussed. Percentage of infected Rhithrogena increased with increase in size of nymphs. Fahy (1975) [49].

Life cycle of the trematode (Allocreadiidae) fish parasite Macrolecithus papilliger in France. Oculate xiphidiocercariae penetrated and encysted in nymphs of Caenis sp. Similar experiments with Ecdyonuridae and Baetidae were negative. Lambert (1974) [94].

Life cycle of *Plagioporus shawi*, a trematode (Opecoelidae) parasite of salmonid fishes in northern Idaho, USA. Second intermediate hosts included Trichoptera, Plecoptera, Chironomidae, *Heptagenia* sp. and *Paraleptophlebia* sp. Schell (1975) [141].

Scanning electron microscope study of a trematode (Opecoelidae) cercaria, probably *Allopodocotyle lepomis*, showing changes after penetration and encystment in *Litobrancha recurvata* and encapsulation by hemocytes of the mayfly intermediate host. Lo, Hall, Allender & Klainer (1975) [101].

Histochemical studies of enzymes of a trematode virgulate xiphidiocercariae (Lecithodendriidae), *Cercaria polypyreta*. The enzyme N-acetyl-β-glucosaminidase was found in mucoid glands, virgula organ, and outer mucoid coat. Further tests showed the enzyme was used in penetrating the cuticle of *Litobrancha recurvata*. A discussion of enzyme action is included. Babu & Hall (1975) [6].

Experimental study of growth, development, and effects on intermediate host of the nematode fish parasite *Spinitectus micracanthus* in *Hexagenia*. Record of natural infection of *Spinitectus gracilis* in *Hexagenia* from a Missouri lake, USA. Keppner (1975) [91].

Discussion of the evolution of Diptera-arthropod associations, with emphasis on phoretic Simuliidae of Africa found on prawns, crabs, and Ephemeroptera. Disney (1974) [39].

ALSO SEE: Chambers, Hall & Hitt [28] effect of trematode infection on hemolymph of *Hexagenia recurvata*; Riek [134] records of larvae and pupae of the chironomid *Symbiocladius* sp. found attached to nymphs of *Atalonella* and *Atalophlebioides* in Australia.

Pesticides and Pollution

Discussion of importance of using macroinvertebrates identified to species level in monitoring water quality. Resh & Unzicker (1975) [133].

General discussion on importance of mayflies in streams and information needed to use them as indicator organisms. Britt (1975) [17].

Description of method used in constructing water quality maps for Baden-Württemberg, Germany-DBR, including computation of biochemical oxygen demand, concentrations of NH_4^+, NO_2^-, O_2, and biological indicators. Among the latter, Ecdyonuridae and *Ephemera* are indicators of the highest class of water quality. Besch (1973) [14].

Results from and examples of a simple kit used by school children to estimate water pollution in England, Scotland, Wales-UK. Mellanby (1974) [112].

Experimental study on colonization of artifiical substrates dipped in crude oil under different river conditions, Northwest Terr. and Yukon, Canada. For Ephemeroptera, colonization by Heptageniidae in a low discharge-low sediment river was reduced on oil substrates. In high discharge-high suspended sediment rivers, *Heptagenia* colonization seemed unaffected by presence of oil, *Ephemerella* was more abundant on substrates without oil, and Baetidae were only found on oily substrates. Snow & Rosenberg (1975) [145].

Study of residues in water, sand, mussels, insects, and fish after single 15 min injection of .309 parts per million methoxychlor in North Saskatchewan River, Canada, 1972. Among insects, only Plecoptera, Diptera, and Ephemeroptera disabled by the passage of pesticide contained residues — an average of 17.5 ppm methoxychlor. Residues were present in one fish species after 8-9 days, but absent after 17 weeks. Methoxychlor did not persist in the river. Fredeen, Saha & Balba (1975) [57].

Effects of single 7.5 min injection of .6 parts per million methoxychlor to insect fauna on floating artificial substrates over 161 km section of North Saskatchewan River, 1973. Methoxychlor produced long-term (10 week) population decline only in Simulium arcticum; a decline in Isoperla was attributed to change in habitat. Post-treatment population of Ephemeroptera genera exceeded pre-treatment populations after 1-2 weeks. Recommendations are included on use of methoxychlor as a black fly larvicide. Fredeen (1975) [56].

Catastrophic drift of Ephemeroptera, Plecoptera, Trichoptera, and Simuliidae after treatment with methoxychlor in 2 streams, Quebec, Canada. Ground applications (at calculated rate of .075 mg/l for 15 min) and aerial spray technique caused a high rate of drift, Ephemerella sp. being the most common mayfly. Almost 50,000 Ephemeroptera were collected in drift sampled 60-75 min after aerial treatment. Wallace & Hynes (1975) [157].

Effects of fenitrothion (used for control of forest insects) on aquatic invertebrates in a Manitoba stream, Canada. After field application at rate of 4 ounces per acre (resulting in stream concentrations up to 64 μg/l), numbers of organisms in stream drift increased below the treatment site. Standing crop did not change and possible causes are discussed. Laboratory tests on mosquitos and non-insect invertebrates indicated fenitrothion was toxic at low concentrations and after short exposure periods. Flannagan (1973) [53].

Field study of effects of fenitrothion on arthropods in drift and benthos at concentrations up to 6.38 parts per billion in 3 New Brunswick forest streams, Canada. Drifting insects were kept in streams in cages for 24 hr after capture to measure mortality. Insects in drift were more susceptible to pesticide than those in benthos. Affected Ephemeroptera were: Baetis herodes, B. rusticans, B. vagans, Ephemerella (s.s.) species (invaria, rotunda, aurivillii), 3 species of Leptophlebiidae and Heptageniidae. Caenis sp. and Ephemerella (Eurylophella) funeralis seemed unaffected. Differential mortality also occurred with other orders, but benthos was not seriously depleted. Reaction of insects to high water was a major consideration in assessing drift data. Eidt (1975) [43].

Effects of 1974 forest spraying of fenitrothion on fauna of 3 brooks in New Brunswick, Canada. Two brooks were outside the sprayed area. In one of them (peak pesticide concentrations .55 parts per billion) there was an increase in drift of mayflies and stoneflies after spraying. In the others (peak concentrations to 3 and 3.8 ppb) there were no changes in drift patterns. Low peak concentrations declined rapidly. Eidt (1975) [42].

Ten-year study of effects of DDT (stream concentrations 10.2 parts per billion) and methoxychlor (7.5 ppb) applied by aerial spray to New York mountain streams, USA. Non-burrowing mayflies were dominant among stream organisms. Average daily standing crop was reduced 44.2% in DDT-treatment years and 23% in years when methoxychlor was used, indicating a more persistent effect of DDT. Burdick, Dean, Skea & Frisa (1974) [24].

Effects of 4 insect development inhibitors (formulas given) at different concentrations on mosquitos and on non-target insects in experimental rice plots, Louisiana, USA. Results for Baetidae showed no significant reduction in abundance; Baetidae populations actually increased as a result of the reduction of a beetle predator Tropisternus sp. Steelman, Farlow, Breaud & Schilling (1975) [148].

Effects of 2 larvicides against mosquitos and non-target organisms in experimental ponds and irrigated pastures, California, USA. The organophosphate S-2957 at .05 and .10 pounds (lbs) per acre and the pyrethroid FMC-33297 at .10 lbs/acre seriously suppressed Baetidae (mostly Baetis) populations over 16 day study. There was recovery after 16 days with FMC-33297 at dosage of .05 lbs/acre. Mulla, Darwazeh & Majori (1975) [116].

Effects of the insect growth regulator TH-6040 on non-target organisms in experimental irrigated pastures, California, USA. At dosage of .025 pound active ingredient (lbs AI) per acre, populations of Callibaetis sp. were immediately reduced. Death resulted from incomplete cleavage of mid-dorsal suture of mesothorax at post-treatment molt. Field samples showed a rapid recovery of mayfly populations with fluctuations sometimes greatly exceeding original populations. Tests were also run at higher concentrations: results, being similar, are not published but can be obtained from the authors on request. Miura & Takahashi (1975) [114].

Effects of TH-6040 on mosquitos and non-target organisms in experimental ponds, California, USA. Dosages were .025 and .05 pounds active ingredient per acre. Baetis sp. populations were reduced slightly and for only a short time. Mulla, Majori & Darwazeh (1975) [117].

Effects of insect growth regulator Altosid EC_4 on insect species and community structure in experimental ponds, California, USA. In laboratory tests, Altosid was lethal to young instars of Callibaetis pacificus at 0.1 parts per million; at .05 ppm there was 16% Callibaetis mortality after 5 days. Forty percent of nymphs introduced into ponds 4 hrs after Altosid treatment (0.1 ppm) survived to emerge; 50% emerged when introduced into treated ponds 4 days after treatment. Total biomass in treated and untreated ponds did not change significantly, but alterations in community structure were significant and one major predator was eliminated. For Callibaetis, repeated applications of Altosid reduced abundance in winter, but after warmer temperatures in March there were no differences between abundance in treated and untreated ponds. Apparent temperature effects were: more recruitment of early instars, faster development of instars, and increased degradation of Altosid. Norland & Mulla (1975) [122].

Studies on stream recovery from damage caused by acid mine drainage, Virginia and Pennsylvania, USA. Benthic fauna returned to normal levels 19-28 days after 15 min addition of acid to a short experimental section of stream, with drift borne organisms (Baetis sp. dominant) recolonizing most rapidly. Two stream systems receiving acid mine drainage were also studied. The mechanisms of and factors affecting recovery are explained and discussed. Herricks & Cairns (1974) [69].

Seasonal pattern of invertebrates in an effluent channel returning coolant water from steam electric generating plant to reservoir in Texas, USA. While invertebrates, including Hexagenia and Caenis, were common in the effluent channel in winter (mean temperatures of 19-24°C), their density was lower in the effluent channel than in the reservoir. Macroinvertebrates were absent in July and August (36-42°C). Drift samples indicated many organisms (particularly Chaoborus) passed through the condensors of the power plant. Durrett & Pearson (1975) [40].

Two-year study of effects of coolant water from an electricity generating plant on emergence of Ephemeroptera, Plecoptera, and Trichoptera of the River Severn, England-UK. Seasonal patterns of emergence were influenced by water level and seasonal temperature patterns, but no significant changes in insects collected up- or downstream of the power station could be attributed to the heated water. Langford & Daffern (1975) [96].

ALSO SEE: Lewis [99] tolerances of species of Stenonema and Stenacron to decomposable organic matter; Russev & Janeva [137] comments on quality of waters in Rhodope Mountains, Bulgaria; Lavandier & Capblancq [97] effect of deoxygenated water on drift of stream invertebrates; Wichard [158], Heuss & Wichard [70], Wichard & Heuss [159], Wichard & Schmitz [160] use of chloride cells as indicators of heavy metal pollution [70,160] and salinity levels [158,159]; Clubb, Gaufin & Lords [30,31] toxicity of cadmium to Ephemerella grandis; Oseid & Smith [124,125] toxicity of hydrogen sulfide to 3 species of mayflies; Fremling [58] toxicity of the lampricide TFM to Hexagenia; Sanders & Walsh [139] accumulation of the lampricide TFM by Stenonema.

REVIEWS

Review and discussion of highlights in research on stream ecology since 1967. Macan (1974) [103].

Review of research concerning Ephemeroptera of Australia published since 1970. Riek (1974) [134].

Review covering present knowledge of zoogeographical relationships and ecology of New Zealand freshwater insects. McClellan (1975) [111].

Review and general description of productivity, biomass, and population dynamics of Amazonian water bodies, Brazil. Primary and secondary production are discussed for each of the 3 major types of Amazon waters. Fittkau et al. (1975) [52].

Summaries of ecological research on running waters accomplished at the Rickleå Field Station, Sweden. Göthberg & Karlström (1975) [65].

Review and discussion of production of lakes in USSR based on IBP results. Alimov (1975) [1].

Review and discussion of high fish catches in new man-made lakes in Africa. Among factors discussed are flooded tree substrates with attached algae and associated fauna (especially Chironomidae and Povilla). Petr (1975) [129].

Review of effects of aquatic herbicides used for weed control. Review covers direct toxicities to animals, crops, and invertebrates and indirect effects caused by alteration of aquatic ecosystem. Brooker & Edwards (1975) [22].

Literature review of current research on macroinvertebrates and water pollution. Ischinger & Nalepa (1975) [79].

ALSO SEE: Thomas [151] review and discussion of literature on upstream migration of mayfly imagos.

TOXICITY

Toxicity of cadmium to 9 species of aquatic insects in continuous flow (25 l/hr) tests at 10°C. For Ephemerella grandis, Cd concentration causing 50% mortality after 4 days was 28 mg/l. There was no 4-day mortality below 4 mg/l. After 7 days there was 50% survival at 17.5 mg/l and 0% survival at 42.5 mg/l. Insects collected in winter were less susceptible to Cd than those collected earlier. Clubb, Gaufin & Lords (1975) [31].

Toxicity of cadmium to 5 species of aquatic insects in continuous flow tests (30 l/hr) at 12°C and low oxygen concentrations. Survival increased as dissolved oxygen (DO) decreased. For Ephemerella grandis after 14 days of Cd concentrations of 2.5 mg/l, there was 20% survival at DO 6.2-7.6 mg/l and 70% survival at DO 4.6-4.9. At Cd concentrations of 5 mg/l, figures were 10% and 40%. Absorption of Cd is apparently related to metabolism, with less Cd uptake at lower levels of metabolic activity. Clubb, Gaufin & Lords (1975) [30].

Influence of oxygen concentrations, pH, substrate, container size, sex, and seasonal factors on toxicity of hydrogen sulfide to 3 species of Ephemeroptera, 2 amphipods, and an isopod. Most factors affected toxicity, indicating that test conditions should try to approximate natural conditions. Concentrations of H_2S killing 50% of test animals in 96 hrs varied with conditions: acceptable estimates were .02 mg/l for Baetis vagans, .111 mg/l for Hexagenia limbata, and .316 mg/l for Ephemera simulans. Levels having no effect were 8-12% of these. Oseid & Smith (1974) [124].

Long-term effects of hydrogen sulfide on Hexagenia limbata. After 138 days, survival and emergence were not affected at H_2S concentrations below .0152 mg/l. Lethal concentrations (50% mortality) were .312 mg/l after 48 hrs, .165 mg/l after 96 hrs, and .06 mg/l after 12 days. Thus, safe concentrations were 9% of the 96 hr LC_{50} value or 25% of the 12 day LC_{50} value. Oseid & Smith (1975) [125].

Toxicity of 2 grades of the lampricide TFM to Hexagenia sp. nymphs at different temperatures, water hardness, and pH for time periods from 6 to 96 hrs. Toxicity was greater in soft water, much greater at low pH, and relatively independent of temperature. Concentrations of field grade TFM causing 50% mortality after 24 hrs were 6.5 µl/l at 17°C in hard water, 4.75 µl/l at 18.2°C in soft water, and 2.5, 3.35, 18.8 and 174.0 µl/l respectively at pH 6.5, 7.5, 8.5 and 9.5 and 22-23°C in soft water. Fremling (1975) [58].

Toxicity, accumulation and dissipation, and effects on reproduction of the lampricide TFM for 6 species of aquatic invertebrates. Toxicities were relatively low for Gammarus pseudolimnaeus and Orconectes nais. However, Gammarus concentrated TFM up to 58 times its concentration in water after 7 days (but eliminated 98% of this in 14 days). Orconectes concentrated TFM at a rate of 2 times and Stenonema sp. 4.4 times the water concentration. Reproduction of Daphnia magna was unaffected at field grade concentrations below 10 mg/l and ceased at 18 mg/l. Sanders & Walsh (1975) [139].

ALSO SEE: Norland & Mulla [122] toxicity of Altosid to Callibaetis pacificus.

ZOOGEOGRAPHY

Principles of zoogeography with examples taken from phylogeny of Ephemeroptera. Included is a discussion of the break-up of Gondwanaland: first separation, Africa-Madagascar-India; then New Zealand-New Caledonia; last Australia-Chile via Antarctica. Also, several mayfly genera show a distribution consistent with the expansion of the Atlantic Ocean. Edmunds (1975) [41].

Zoogeography of genera of Leptophlebiidae with Gondwanian affinities. The most ancient phyletic line represents an African dispersal. The other 2 phyletic lines contain genera from Madagascar, Ceylon, Australia, New Zealand, and South America. The sequence of continental separation and the evolution of each phyletic line are interpreted from comparative thoracic morphology and geological literature. Tsui & Peters (1975) [156].

ALSO SEE: Sowa [147] zoogeographical relationships of Carpathian Mountain species of Ephemeroptera; Filipović [51] zoogeographical relationships of Ephemeroptera species from Serbia, Yugoslavia; McClellan [111] zoogeographical relationships of New Zealand freshwater insects.

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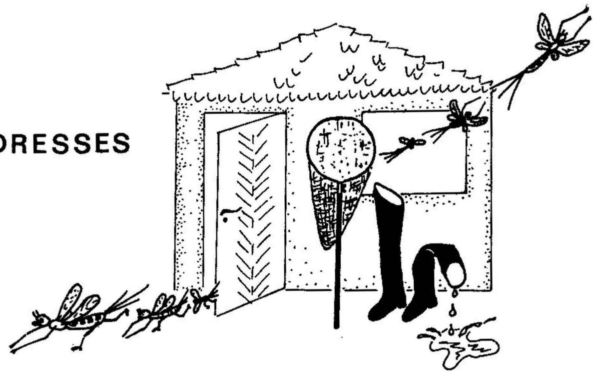

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