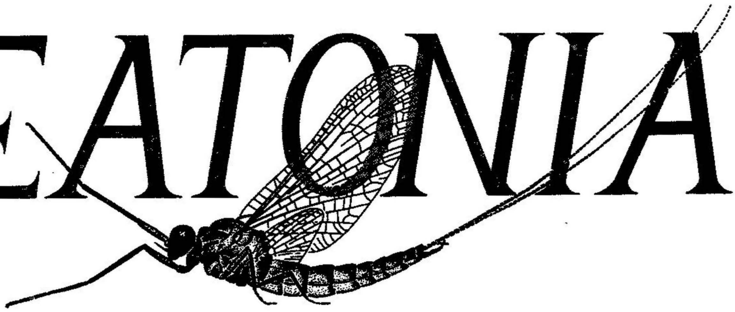
3-5-1975

Eatonia No. 20, May 05, 1975

William L. Peters

Janice Peters

EATONIA



No. 20 Florida A & M University, Tallahassee May 5, 1975

Jay R Traver, the first Ephemeroptera specialist in North America, died on 5 September 1974. Mayfly systematics has lost a most careful worker and those who knew Dr. Traver will miss her deeply. We dedicate this issue of Eatonia to her, and thank Dr. and Mrs. Alexander, longtime friends of Jay Traver, for the biographical material they have prepared.

We thank Dr. Jacob for the drawings heading subsections of Eatonia, and all others who have contributed to this issue by sending reprints of their works. We similarly acknowledge the articles by L. Berner and M. T. Gillies, hoping these will inspire discussion and the publication of more lists of types in private, university, or institutional collections.

As one draft of Eatonia # 20 is being typed, Eatonia # 19 is being mailed — some 5 months later than expected. While the only costs involved in producing Eatonia are those of printing and mailing, these costs have risen. Also, printing is done by a backlogged, overworked, university press, commercial printing rates being prohibitive. It seems Eatonia can not appear semiannually, even when it is submitted regularly, and there is some doubt as to whether this university will continue to print the newsletter. As a partial help in meeting costs, the S. H. Coleman Library and the editors have decided to charge $5.00 per set for back issues. In addition, a special fund has been established to receive this money and any contributions a reader might wish to make. Checks should be made out to "Florida A & M University."

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.

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2nd International Conference on Ephemeroptera, 1975

22-28 August, Polish Academy of Sciences, Freshwater Biology Laboratory, 31-016 Kraków, Slakowska 17

with

Post-conference Excursion, 30 August-3 September, to Schlitz-Harz-Plön

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JAY R TRAVER (1894-1974)

By Charles P. Alexander

It has been suggested that I write a short account of the life and achievements of Dr. Jay R Traver, distinguished student of the Ephemeroptera and outstanding teacher, who passed away on September 5th. I had known Jay for sixty years, from the time she first entered Cornell University to study under Anna Botsford Comstock and came under the influence of Dr. James G. Needham, outstanding authority in many groups of aquatic insects, including the mayflies. Two misconceptions concerning Jay should be cleared. It will be noted above that her middle initial, R, has no period following, and is her only middle name, as was the case with her father with the identical name. A second confusing point relates to the exact date of her birth, given as August 2, 1894, but in some early records as being August 3rd. It appears that her birth was almost at midnight and that it was recorded as being early on the 3rd, but her family insisted that she was born on August 2nd, and this date was observed by her.

Jay Traver was born in Willoughby, Lake County, Ohio, an only child of Mabel Matilda Dodd (1868-1954) and Jay R Traver (1864-1894). Her father was a railroad engineer on the Kansas-Missouri railroad and died as the result of the train running off an open switch in Missouri on July 12, 1894, exactly three weeks before Jay's birth. Her mother had an only sister, Miss Sara Dodd (1870-1965), who became Jay's companion in Amherst following her mother's death in 1954.

Jay grew up in Willoughby, living on River Street along the Chagrin River, and in her early years was taught by her mother and Aunt Sara before entering the public schools. During her girlhood she became much interested in nature through reading books written by Mrs. Comstock. When she was planning to go to college, she was influenced by this to attend Cornell, and also by the fact that two of her cousins, Beryl and Dorothy Curtis, of New Jersey, were at Cornell studying under Dr. Needham and Mrs. Comstock. Both of the Curtis girls were in my own class of 1913 at Cornell. Jay was a freshman in 1914 and I met her soon after her arrival, when she took various courses including one in Natural History required of all students in the Agricultural College, and elected by many others. She majored in biology and received the B.A. degree in 1918. She then attained the M.A. degree in 1919 with a thesis on the life history of the black-nosed dace, <u>Rhinichthys atratulus</u> (= <u>R. atronasus</u>).

Jay then lived in New York City from the summer of 1919 to the spring of 1920, working in a cafeteria, later on that summer returning to Cornell for further work with Mrs. Comstock. From the fall of 1920 to mid-1923 she was a supervisor in the elementary schools in Wilmington, Delaware. From the fall of 1923 to June 1924 she was Acting Head of Biology at Shorter College, Rome, Georgia, returning to her home in Ohio for the summer. From September 1924 to June 1930 she taught biology at Women's College, University of North Carolina, Greensboro, and during these six years did considerable work on the mayflies of the state. In September 1930 she returned to Cornell to work for the Ph.D. degree, completing her studies by the fall of 1931 and receiving the degree, her thesis being "The mayflies of North Carolina." From 1931 to 1937 she remained at Cornell on a Carnegie grant, and during this period was a co-author in preparation of the impressive work, <u>The Biology of Mayflies</u>, 1935, with Dr. Needham of Cornell and Dr. Yin-chi Hsu, later Professor of Zoology at Yenching University, China. In 1937 she returned to her home in Ohio, remaining until June 1938. During that summer she was employed as a field secretary with the

EATONIA

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.

Biological Survey of New York, Conservation Department, under Dr. Emmeline Moore, a fellow student at Cornell in the early days. This period of the mid-30's was during the height of the great depression and almost everyone was affected by the resulting conditions. Jay once told me that for a time she was living on $500 per year.

This account of Dr. Traver's life now concerns her coming to Amherst and joining the zoological staff of the then Massachusetts State College, when Dr. Hugh Potter Baker was president, in the summer of 1938. At that time I was in charge of the combined departments of entomology and zoology, and during the summer was notified by President Baker that the department was to receive two new instructorships. I had just received a letter from Jay telling of her difficulties in obtaining a permanent position, and since I knew her and her abilities and qualifications, I took the steps to offer her a position in zoology as instructor, at the modest salary of $1800. She accepted the offer and reported for duties in the fall, remaining in Amherst until her death. Jay was assigned to work in invertebrate zoology, and built up a high reputation as a fine teacher and accomplished student, beloved by a great number of majors in her work. Between her appointment to the faculty in 1938 until her retirement in June 1962, Jay was promoted successively to Assistant Professor, Associate Professor, and finally to Full Professor in 1960. Additional to her teaching and other duties in connection with her work in zoology, she was able to accomplish considerable work on the mayflies.

Her mother died in 1954, and Aunt Sara Dodd was invited to come to Amherst to be with Jay. We had a large lot on which our own home had been built in 1930 and we offered to sell to Jay somewhat less than the back half of this, which offer was accepted and her small attractive home was built in 1954, at 19 Moorland Street. Aunt Sara and Jay lived here together for nearly ten years (August 15, 1955 to March 9, 1965), and were wonderful friends and neighbors to us. After her aunt's death, Jay changed her bedroom into a little laboratory and after her retirement from teaching spent many hours studying her beloved mayflies. About two years ago her sight deteriorated and she was forced to give up these studies, which in recent years had concerned chiefly the mayflies of North and South America. A single paper not concerning mayflies was on the head mite, based on Jay's personal troubles from an infection of this pest (No. 25: 1951).

During the summer of 1971, when having a physical examination, it was found that Jay had an abdominal cancer, already widespread. Her physicians informed her that she had a life expectancy of perhaps six months. To the surprise of all who knew of her ailment, each succeeding examination by the doctors showed very little spread until late in August 1974, when they found the condition had become much more serious and ominous. She felt fairly well until Thursday, August 29th. On Saturday, August 31st, we saw no activities in Jay's home, so Mrs. Alexander went to her window and asked how she felt and Jay replied in a weak voice that she was not feeling at all well. We entered her home and found that she required immediate medical attention. She was taken by ambulance to Cooley Dickinson hospital, in Northampton, Mass., about six miles from Amherst. Her condition deteriorated rapidly and she passed away at 12:05 AM, Thursday, September 5th, just a week after the start of the final illness. We saw her daily, as did various friends, and one of her former students, Miss Margaret Parsons of Ohio, came to her bedside for two days and was with her at the end. Following her wishes, her body was cremated and a grave side service was held on October 6, 1974, attended by many friends and a surviving relative, Mrs. Helen Curtis Keel of Englewood, New Jersey. The grave is on the Alexander plot in Wildwood Cemetery, Strong Street, where it is expected that both Alexanders in due time also will be interred.

During her years of teaching at the University of Massachusetts, Jay trained many capable students in various fields of zoology. Two of these are outstanding workers on the mayflies, Dr. Richard W. Koss, who worked on the eggs of these insects, and Dr. George F. Edmunds, Jr., outstanding student of the mayflies of the world. In the late 1940's George wrote to us concerning the possibilities of his coming to the University of Massachusetts in order to complete work for the Ph.D. degree and to study under Dr. Traver. At that time I still was head of the combined department, and since no Ph.D. degree was available in zoology at that period, it was arranged that Jay could supervise his work and that he could obtain the degree from the department of entomology. He was in Amherst for one and one-half years, completing his work and the degree in 1952, his thesis including the outstanding work, "The mayflies of Utah." In September 1966 Jay visited Salt Lake City, Utah, and was entertained by Dr. and Mrs. Edmunds, William and Janice Peters, Steve Jensen, and other workers on the mayflies.

Jay Traver was one of the better mayfly taxonomists. In her lifetime she established 14 genera and subgenera of mayflies, and described about 235 species. She was honored by other mayfly workers by having two genera and six species of mayflies named in her honor.

I will close this short account of the life and achievements of one of America's outstanding entomologists. I purposely have not included any record of her publications on the mayflies, since this is in preparation. An account of the First International Conference on Ephemeroptera, held at Florida A & M University, Tallahassee, on August 17-20, 1970, has been discussed in an earlier issue of <u>Eatonia</u>. At that time Jay was made the Honorary Chairman of the

Conference, and was presented with a beautiful bronze plaque reading "In recognition of her many years of distinguished research on the Ephemeroptera." It is believed that this plaque, together with her collection of mayflies, is willed to Dr. Edmunds and will be transferred to Salt Lake City in due course.

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PUBLICATIONS of JAY R TRAVER

Compiled by Michael Hubbard and Mabel Alexander

1. Traver, J. R. 1919. Ecological relations of the Lepidopterous genus Depressaria (Oecophoridae). Psyche, 26:73-80.
2. ———. 1925. Observations on the ecology of the mayfly, Blasturus cupidus. Can. Entomol., 57:211-218.
3. ———. 1929. The habits of the black-nosed dace, Rhinichthys atronasus (Mitchell). J. Elisha Mitchell Sci. Soc., 45:101-129, 4 figs., 2 tables.
4. ———. 1931a. The ephemerid genus Baetisca. J. N. Y. Entomol. Soc., 39: 45-67, plates V-VI (34 figs.).
5. ———. 1931b. A new mayfly genus from North Carolina. Can. Entomol., 63: 103-109, plate 7 (15 figs.).
6. ———. 1931c. Seven new southern species of the mayfly genus Hexagenia, with notes on the genus. Ann. Entomol. Soc. Am., 24:591-621, plate I (23 figs.).
7. ———. 1932a. Mayflies of North Carolina. J. Elisha Mitchell Sci. Soc., 47:85-161, plates 5-12 (184 figs.).
8. ———. 1932b. Mayflies of North Carolina. [Continued]. J. Elisha Mitchell Sci. Soc., 47:163-236.
9. ———. 1932c. Neocloeon, a new mayfly genus (Ephemerida). J. N. Y. Entomol. Soc., 40:365-373, plate XIV (18 figs.)
10. ———. 1933a. Mayflies of North Carolina: Part III. The Heptageninae. J. Elisha Mitchell Sci. Soc., 48:141-206, plate 15 (16 figs.).
11. ———. 1933b. Heptagenine mayflies of North America. J. N. Y. Entomol. Soc., 41:105-125.
12. ———. 1934. New North American species of mayflies (Ephemerida). J. Elisha Mitchell Sci. Soc., 50:189-254, plate 16 (19 figs.).
13. ———. 1935. Two new genera of North American Heptageniidae (Ephemerida). Can. Entomol., 67:31-38, 6 figs.
14. Needham, J. G., J. R Traver and Y.-C. Hsu. 1935. The Biology of Mayflies with a Systematic Account of North American Species. Comstock Publ. Co., Ithaca, New York. xiv + 759 p., 168 figs., plates I-XL.
15. Traver, J. R. 1937. Notes on mayflies of the southeastern states (Ephemeroptera). J. Elisha Mitchell Sci. Soc., 53:27-86, pl. 6 (19 figs.).
16. ———. 1938. Mayflies of Puerto Rico. J. Agric. Univ. P. R., 22:5-42, plates I-III (50 figs.).

17. Traver, J. R. 1939. Himalayan mayflies (Ephemeroptera). Ann. Mag. Nat. Hist., Ser. 11, 4:32-56, 22 figs.

18. ———. 1940. Compendium of entomological methods: Part I. Collecting mayflies (Ephemeroptera). Ward's Nat. Sci. Establ., Rochester, New York. 7 p. + 17 figs. (unnumbered).

19. ———. 1943. New Venezuelan mayflies. Bol. Entomol. Venez., 2:79-98, 8 figs.

20. ———. 1944. I. — Notes on Brazilian mayflies. Bol. Mus. Nac., Zool., Rio de J., Nova Sér., 22:2-53, 8 figs.

21. ———. 1946. Notes on Neotropical mayflies. Part I. Family Baetidae, Subfamily Leptophlebiinae. Rev. Entomol. (Rio de J.), 17:418-436, 30 figs.

22. ———. 1947a. Notes on Neotropical mayflies. Part II. Family Baetidae, Subfamily Leptophlebiinae. Rev. Entomol. (Rio de J.), 18:149-160, 22 figs.

23. ———. 1947b. Notes on Neotropical mayflies. Part III. Family Ephemeridae. Rev. Entomol. (Rio de J.), 18:370-395, 39 figs.

24. ———. 1950. Notes on Neotropical mayflies. Part IV. Family Ephemeridae (continued). Rev. Entomol. (Rio de J.), 21:593-614, 22 figs.

25. ———. 1951. Unusual scalp dermatitis in humans caused by the mite, Dermatophagoides. Proc. Entomol. Soc. Wash., 53:1-25, plates 1-3 (19 figs.).

26. Edmunds, G. F., Jr. and J. R Traver. 1954a. An outline of a reclassification of the Ephemeroptera. Proc. Entomol. Soc. Wash., 56:236-240.

27. ———. 1954b. The flight mechanics and evolution of the wings of Ephemeroptera, with notes on the archetype insect wing. J. Wash. Acad. Sci., 44: 390-400, 14 figs.

28. Traver, J. R. 1956a. A new genus of Neotropical mayflies (Ephemeroptera, Leptophlebiidae). Proc. Entomol. Soc. Wash., 58:1-13, 18 figs.

29. ———. 1956b. The genus Asthenopodes (Ephemeroptera). Comun. Zool. Mus. Hist. Nat. Montev., 4(75):1-10, 2 plates (9 figs.).

30. ———. 1958a. The subfamily Leptohyphinae (Ephemeroptera: Tricorythidae) Part I. Ann. Entomol. Soc. Am., 51:491-503, plates I-II (23 figs.).

31. ———. 1958b. Some Mexican and Costa Rican mayflies. Bull. Brooklyn Entomol. Soc., 53:81-89, plate (6 figs.).

32. Edmunds, G. F., Jr., L. Berner and J. R Traver. 1958. North American mayflies of the family Oligoneuriidae. Ann. Entomol. Soc. Am., 51:375-382, 31 figs.

33. Traver, J. R. 1959a. The subfamily Leptohyphinae. Part II: Five new species of Tricorythodes (Ephemeroptera, Tricorythidae). Proc. Entomol. Soc. Wash., 61:121-131, 12 figs.

34. ———. 1959b. Uruguayan mayflies. Family Leptophlebiidae: Part I. Rev. Soc. Urug. Entomol., 3:1-13, plates I-III (27 figs.).

35. Edmunds, G. F., Jr. and J. R Traver. 1959. The classification of the Ephemeroptera. I. Ephemeroidea: Behningiidae. Ann. Entomol. Soc. Am., 52:43-51, 32 figs.

36. Traver, J. R. 1960a. Uruguayan mayflies. Family Leptophlebiidae: Part II. Rev. Soc. Urug. Entomol., 4:19-28, 1 fig., plate I (19 figs.).

37. ———. 1960b. Uruguayan mayflies. Family Leptophlebiidae: Part III. Rev. Soc. Urug. Entomol., 4:73-86, 1 fig., plate I (19 figs.).

38. Traver, J. R. 1960c. Some Mexican and Costa Rican mayflies. Bull. Brooklyn Entomol. Soc., 55:16-23, plate (10 figs.).

39. ———. 1962. Cloeon dipterum (L.) in Ohio (Ephemeroptera: Baetidae). Bull. Brooklyn Entomol. Soc., 57:47-50.

40. ———. 1963. Uruguayan mayflies. Family Leptophlebiidae: Part IV. Rev. Soc. Urug. Entomol., 5:25-31.

41. ———. 1964. A new species of Thraulodes from Uruguay (Ephemeroptera: Family Leptophlebiidae). Rev. Soc. Urug. Entomol., 6:33-37, 4 figs.

42. ———. 1964-1965. A new species of the subgenus Iron from Mexico (Ephemeroptera: Heptageniidae). Bull. Brooklyn Entomol. Soc., 59-60:23-29, plate I (8 figs.).

43. Traver, J. R and G. F. Edmunds, Jr. 1967. A revision of the genus Thraulodes (Ephemeroptera: Leptophlebiidae). Misc. Publ. Entomol. Soc. Am., 5: 349-395, 83 figs.

44. ———. 1968. A revision of the Baetidae with spatulate-clawed nymphs (Ephemeroptera). Pac. Insects, 10:629-677, 91 figs.

45. Traver, J. R. 1971. Four new species of Neotropical Baetis (Ephemeroptera: Baetidae). Proc. Entomol. Soc. Wash., 73:58-63, 8 figs.

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MAYFLY TYPE SPECIMENS IN THE FLORIDA STATE COLLECTION OF ARTHROPODS

By Lewis Berner

Occasionally a mayfly worker needs to see, or know the location of, type specimens to assist him in determining the correctness of identifications. Because these specimens are so widely scattered, it occurred to me that it would be useful to have listed in one place the location of the depositories of types whenever it could be determined. To initiate the project, I have prepared a list of all types deposited in the Florida State Collection of Arthropods, Division of Plant Industry, Gainesville, Florida 32602; I have listed as well the citation for the species description. Those specimens in the Florida collection, the place of deposition of the holotype and allotype is also given. Collections other than the Florida State Collection of Arthropods are represented by the initials of the Collection as follows: AMNH = American Museum of Natural History; BMNH = British Museum (Natural History); CAS = California Academy of Sciences; CNS = Canadian National Collections; CU = Cornell University Collections; INHS = Illinois Natural History Survey; MCZ = Museum of Comparative Zoology, Harvard University; UM = University of Michigan Museum of Zoology; UU = University of Utah collections; ZSZM = Zoologisches Staatsinstitut und Zoologisches Museum.

Mayfly Type Specimens in the Florida State Collection of Arthropods (F)

Citation	Species	Holotype	Allotype	Paratype
1940. Fla. Entomol. 23(4):52-57	Baetis spiethi Berner	(MCZ)	(MCZ)	F
1963. Fla. Entomol. 46(2):183-187	Baetisca becki Schneider & Berner	F		F
1955. J. Fla. Acad. Sci. 18(1):2,4-8,10-11	Baetisca escambiensis Berner	F		F
1955. J. Fla. Acad. Sci. 18(1):11-14	Baetisca gibbera Berner	F		F
1940. Can. Entomol. 72:156-160	Baetisca rogersi Berner	(MCZ)	(MCZ)	F
1938. J. Agric. Univ. P. R. 22(1):18-20	Borinquena carmencita Traver	(CU)	(CU)	F
1946. Fla. Entomol. 28(4):76-77	Brachycercus maculatus Berner	(MCZ)		F
1955. Ann. & Mag. Nat. Hist., Ser. 12, 8:879-880	Caenis berneri Kimmins	(BMNH)	(BMNH)	F
1953. Ill. Nat. Hist. Surv. Bull. 26(1):53-54	Caenis gigas Burks	(INHS)	(INHS)	F
1961. Am. Midl. Nat. 66(2):332-336	Campylocia dochmia Berner & Thew	F	F	F
1946. Fla. Entomol. 28(4):77-79	Centroptilum hobbsi Berner	(MCZ)		F
1940. Fla. Entomol. 23(3):39-42	Centroptilum viridocularis Berner	(MCZ)	(MCZ)	F
1946. Fla. Entomol. 28(4):65-67	Choroterpes hubbelli Berner	(MCZ)	(MCZ)	F
1955. Ann. & Mag. Nat. Hist., Ser.12, 8:863-865	Cloeon scitulum Kimmins	(BMNH)	(BMNH)	F
1957. Bull. Brit. Mus. (Nat. Hist.), Entomol., 6(5):130-132	Dicercomyzon costale Kimmins	(BMNH)	(BMNH)	F
1958. J. Kans. Entomol. Soc. 31(3):222-224	Ephemerella berneri Allen & Edmunds	(INHS)		F
1961. Fla. Entomol. 44(4):149-152	Ephemerella carolina Berner & Allen	F		F
1946. Fla. Entomol. 28(4):71-72	Ephemerella choctawhatchee Berner	(MCZ)		F
1963. Pac. Insects 5(1):17	Ephemerella coheri Allen & Edmunds	(UU)		F
1934. J. Elisha Mitchell Sci. Soc. 50(1-2): 208-211	Ephemerella doris Traver	(CU)		F
1959. Can. Entomol. 91:57-58	Ephemerella hecuba pacifica Allen & Edmunds	(UU)		F
1946. Fla. Entomol. 28(4):70-71	Ephemerella hirsuta Berner = E. attenuata McDunnough	(MCZ)		F
1963. Pac. Insects 5(1):20-22	Ephemerella nepalica Allen & Edmunds	(UU)		F

1961. Fla. Entomol. 44(4):152-153	Ephemerella spiculosa Allen & Berner	F		F
1946. Fla. Entomol. 28(4):67-70	Ephemerella trilineata Berner	(MCZ)	(MCZ)	F
1914. Proc. Acad. Nat. Sci. Phila. 66:614	Habrophlebia jocosa Banks = H. vibrans Needham	(MCZ)		F
in press	Habrophlebiodes celeteria Berner	F		F
1948. Entomol. News 59(5):117-120	Isonychia tusculanensis Berner	(UM)	(UM)	F
1970. Proc. Entomol. Soc. Wash. 72(1):55-61	Lachlania dencyanna Koss	(UU)	(UU)	F
1951. Proc. Entomol. Soc. Wash. 53(6):327-330	Lachlania powelli Edmunds	(UU)	(UU)	F
1925. Can. Entomol. 57:168-169	Neoephemera bicolor McDunnough	(CNC)		F
1956. Ann. Entomol. Soc. Am. 49(1):34,36,38	Neoephemera compressa Berner	F	F	F
1953. Fla. Entomol. 36(4):145-148	Neoephemera youngi Berner	F	F	F
1938. J. Agric. Univ. P. R. 22(1):9-12	Neohagenulus julio Traver	(CU)	(CU)	F
1955. Pan-Pac. Entomol. 31(3):122-123	Paracloeodes abditus Day	(CAS)		F
1955. Proc. Entomol. Soc. Wash. 57(5):245-247	Paraleptophlebia jeanae Berner	F	F	F
1955. Ann. & Mag. Nat. Hist., Ser. 12, 8:865-866	Procloeon cylindroculum Kimmins	(BMNH)		F
1940. Fla. Entomol. 23(4):58-62	Pseudocloeon alachua Berner	(MCZ)	(MCZ)	F
1946. Fla. Entomol. 28(4):79-81	Pseudocloeon bimaculatus Berner	(MCZ)	(MCZ)	F
1924. Bull. Mus. Comp. Zool. 65(12):426	Pseudocloeon carolina (Banks)	(MCZ)		F
1974. Ann. Entomol. Soc. Am. 67(4):562-565	Rheobaetis berneri Müller-Liebenau	(ZSZM)		F
1974. Ann. Entomol. Soc. Am. 67(4):555,558, 561-562	Rheobaetis petersi Müller-Liebenau	(ZSZM)		F
1974. Ann. Entomol. Soc. Am. 67(4):565-566	Rheobaetis traverae Müller-Liebenau	(ZSZM)		F
1938. Am. Mus. Novit., No. 1002:1-4	Siphloplecton costalense Spieth	(AMNH)	(AMNH)	F
1932. J. Elisha Mitchell Sci. Soc. 47(2):191-194	Siphloplecton speciosum Traver	(CU)	(CU)	F
1935. The Biology of Mayflies. p. 286-287	Tortopus incertus Traver	(CU)	(CU)	F
1946. Fla. Entomol. 28(4):72-76	Tricorythodes albilineatus Berner	(MCZ)	(MCZ)	F
1960. Pan-Pac. Entomol. 36(3):126-128	Ulmeritus adustus Thew	(INHS)	(INHS)	F

WINTER SWARMING OF <u>CLOEON</u> IN THE TROPICS

By M. T. Gillies

I wonder whether any of your readers can offer a solution to a problem that has been puzzling me for many years. It is this. Mayflies of the genus Cloeon are abundant and ubiquitous throughout the Old World Tropics. The nymphs are everywhere one of the commonest aquatic insects in ponds and swamps, and the adults are a familiar sight on walls and screens near lamps at night. Swarms of dancing males can often be seen too, but the curious thing here is that I have never seen them during the summer months.

I first noticed this in the winter of 1945 in India and Burma, and on one occasion on the streets of Bangkok. In East Africa it proved to be the same. On the plains of Tanzania the cool, dry season lasts from May to October, and during this period of the year swarms of Cloeon males are often to be seen in well-watered areas. I remember one morning in September, 1962, driving through countless swarms of males, and a net held out of the window with one hand (while driving with the other) was soon filled with mayflies. The terrain was a belt of arid thorn-bush country lying between a great expanse of swamps on one side and an abrupt range of mountains on the other. Over the whole area, which measured something like 5 miles long by 2-3 miles broad, every open space had its cloud of dancing spinners. The total numbers must have been prodigious. On two mornings in July in the same area I recorded swarms continuously present right through the morning up till 12 or 1 p.m., by which time the air temperature was 27-28° C and the humidity down to 35-45 per cent. As the hot season comes on they disappear from the lowlands, but in the cooler climate of the highland plateaux swarming still takes place.

In recent years I have spent several summers in West Africa living near the marshy banks of the River Gambia. Both sexes of adults are common round lights at night but, with one exception, I have never seen swarming males. By November, however, when the nights begin to cool and the minimum temperature drops below 21° C, males make their appearance again soon after dawn. It seems likely, though I cannot confirm it, that this activity continues throughout the dry, cool, winter months. The only exception to this pattern was one morning in July when abundant swarms of two different species were present for an hour soon after sunrise. On this occasion there had been heavy rain the previous afternoon and the night had been exceptionally cool with the temperature down to 21° C.

There are two problems here. The first is, what are the factors responsible for this change in behaviour? There seems to be a clear correlation with temperature, and a circadian rhythm is doubtless involved. But do temperature conditions at night determine whether the activity will take place the following day? Or is it simply that, when it is hot, too few survive till the following morning? The subimagines hatch at dusk and transposition of imagines occurs during the night. To swarm in the morning means they must survive 12 hours or so in the winged form, and it could well be that high minimum temperatures prevent this.

The second problem is part of a much wider one, namely, if swarming does not occur, where does mating take place? For many genera, particularly for those species that only live as adults for an hour or two, mating must take place at dusk or possibly by the light of the moon. For others it is possible it happens at dawn. With populations as large as they are in Cloeon, one would have expected to see mating at this time, at least on occasions; and this I never have. It must also be admitted that I have never seen mating with females in the dry season swarms of Cloeon, which supports the school of thought that swarming in insects is not primarily epigamic in nature and has evolved independently of the need to bring the sexes together. But it could be in this case that mating indeed takes place at first light, and the males, their reproductive role fulfilled, are now expendable. Natural selection would not be called in to protect them from the hazards of continued swarming in the hours of full daylight, and so they dance on until exhaustion or predators remove them from the scene.

News and Notes

A recent letter from J. O. Solem reported the death of Reidar Brekke of Trondheim, Norway. Dr. Brekke had worked for many years on the Ephemeroptera, Plecoptera, and Trichoptera of Norway — his most significant mayfly paper being The Norwegian mayflies (Ephemeroptera) (Norsk Entomol. Tidsskr., 5:55-73, 1938). He later published two supplements to this work in the same journal: Trichoptera og Ephemeroptera nye arter for Norge (6:232-233, 1943) and Bidrag til kunnskapen om Norges døgn-, sten- og vårfluer (Ephemeroptera, Plecoptera, Trichoptera) (13:11-15, 1965).

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Some copies of Eatonia # 19 and Eatonia Supplement # 1 were printed with bad pages, missing pages, duplicate pages, or blank pages. We tried to discover and remove these bad copies before mailing, but were not entirely successful. Please write if you received a defective copy and we will send another. We apologize for the mistake and the inconvenience to our readers. We also apologize for the inversion of Fig. 7 in the supplement, but we can not correct this error.

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System of Water Quality from the Biological Point of View, by V. Sládeček, 1973, Arch. Hydrobiol. Beiheft, Ergeb. Limnol. 7, E. Schweizerbart'sche, Stuttgart, iv + 218 p.

In this book, V. Sládeček presents a review of the saprobic system of biological indicators of water quality, complete with history, criticisms, revisions, and definitions. While the classical saprobic system is given in full, there is also a presentation of other indicator index systems of biological stream classification with methods of converting them into the saprobic nomenclature, or vice versa. A system of toxicity is given, and a system for characterizing levels of radioactivity is proposed. Of special interest is Table 64, a list of aquatic organisms in Czechoslovakia, which includes all species of Ephemeroptera with their saprobity indicated by letter, number, range, and indicative weight and with selected physico-chemical factors included. The book lacks an index, which can be a problem when checking a definition, and rather more space is devoted to higher (more polluted) levels of saprobity than to lower (cleaner) levels.

The saprobic system is by no means universally accepted or even understood. The book will certainly help in ending the latter condition, if not the former. Dr. Sládeček does not pretend his book will answer all criticism or end discussion. He does argue for a standardized system of water quality and attempts to establish the fundamentals of such a system, recognizing that it will be supplemented and modernized.

* * * * *

The Entomological Society of America has recently prepared a loose-leaf catalog of teaching and audio-visual aids entitled _Entomology: Catalog of Instructional Materials_. The catalog lists the following films, loops, and slides which appear to be of interest. Except for the film, _The Mayfly — Ecology of an Aquatic Insect_ (_Eatonia_ #18-19), we have not reviewed these materials.

1. 16 mm Films:

   Aquatic Insects. 11 min, black & white, 1968. (Coronet Instructional Films, 65 East South Water St., Chicago, Illinois 60601, USA)

   Ephemera. 10 min, color, 1971. (BFA Educational Media, 2211 Michigan Ave., Santa Monica, California 90404, USA)

   River Insects. 20 min, color, 1967. (UniJapan Films, 9-13 Ginza, 5-Chome, Chuo-Ku, Tokyo 104, Japan)

   The Mayfly — Ecology of an Aquatic Insect. 15 min, color, 1973. (Encyclopedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Illinois 60611, USA)

2. 35 mm Slides:

   Collecting Insects in Water. 35 frames, color, 1967. (Encyclopedia Britannica Educational Corp., address above)

   Life in a Stream. 49 frames, color, 1967, record included. (Eye Gate House Inc., 146-01 Archer Ave., Jamaica, New York 11453, USA)

   Small Freshwater Animals and Insects. 65 frames, color, 1948. (Jam Handy School Service, Inc., 2781 East Grand Blvd., Detroit, Michigan 48211, USA)

3. Super 8 mm Film Loops and Movies (Ed. note: Super 8 and 8 mm film loops are cartridge-cassette types of films, and require a special projector)

   Animals from a Freshwater Stream. 4 min, color, silent, 1972. (Visual Education Inc., no address given)

   Collecting and Recognizing Stream Organisms. 5 min, color, 1967. (Encyclopedia Britannica Educational Corp., address above)

The Mayfly — Metamorphosis. 3+ min, color, date not given. (Encyclopedia Britannica Educational Corp., address already given)

Stream Environment — Aquatic Insects. Parts 1 (5 min), 2 (4 min), and 3 (3 min), color, no date given. (Thorne Films, Inc., 1229 University Ave., Boulder, Colorado 80302, USA, and Scott Education Division, 104 Lower Westfield Road, Holyoke, Massachusetts 01040, USA)

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Recent Ephemeroptera Literature

Compiled by

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

Adámek, Z.

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

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

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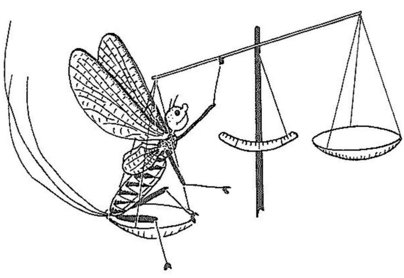
EATONIA INDEX

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 bundyi Lehmkuhl
SEE Baetis bundyae

Baetis bundyae Lehmkuhl (spelling emended) Edmunds (1974) [27] p. 289.

Baetis cingulatus McDunnough, 1925 NEC Stephens, 1835
SEE Baetis quebecensis

Baetis estrelensis sp. n. (nymph; Portugal) Müller-Liebenau (1974) [63] p. 21.

Baetis liebenauae sp. n. (male & female imagos, nymph, egg; Poland) Keffermüller (1974) [48] p. 183.

Baetis melleus Needham & Murphy, 1924 NEC Curtis, 1834
SEE Baetis murphyi

Baetis murphyi *nomen novum* (new name for Baetis melleus Needham & Murphy, 1924 NEC Curtis, 1834) Hubbard (1974) [40] p. 358.

Baetis navasi sp. n. (nymph; Portugal) Müller-Liebenau (1974) [63] p. 29.

Baetis poeyi (Eaton) (transferred from genus Centroptilum) Edmunds (1974) [27] p. 289.

Baetis quebecensis *nomen novum* (new name for Baetis cingulatus McDunnough, 1925 NEC Stephens, 1835) Hubbard (1974) [40] p. 358.

Baetodes arizonensis Koss (= Baetodes sigillatus Allen & Chao syn. n.) Edmunds (1974) [27] p. 289.

Baetodes sigillatus Allen & Chao
SEE Baetodes arizonensis

Genus Callibaetis Eaton (= genus Neobaetis Navas syn. n.) *
Edmunds (1974) [27] p. 289.

Callibaetis paulinus (Navas) (transferred from genus Neobaetis) Edmunds (1974) [27] p. 289.

Centroptilum poeyi Eaton
SEE Baetis poeyi

Cloeon brunneum Esben-Petersen, 1909 NEC Rambur, 1842
SEE Cloeon peterseni

Cloeon kimminsi *nomen novum* (new name for Cloeon viridis Kimmins, 1947 NEC Schneider, 1885) Hubbard (1974) [40] p. 358.

Cloeon peterseni *nomen novum* (new name for Cloeon brunneum Esben-Petersen, 1909 NEC Rambur, 1842) Hubbard (1974) [40] p. 357.

Cloeon viridis Kimmins, 1947 NEC Schneider, 1885
SEE Cloeon kimminsi

Genus Neobaetis Navas
SEE genus Callibaetis

Neobaetis paulinus Navas
SEE Callibaetis paulinus

Paracloeodes minutus (Daggy) (transferred from genus Pseudocloeon) Edmunds (1974) [27] p. 289.

Pseudocloeon minutum Daggy
SEE Paracloeodes minutus

Genus Rheobaetis gen. n.
Müller-Liebenau (1974) [64] p. 555.

* The statement "Pseudocloeon (? Genus Neobaetis Navas)" in Packer (1966, Ceiba, Tegucigalpa, 12:9) was an error. Edmunds (1974) [27].

Rheobaetis berneri sp. n. (male & female subimagos, nymph; Georgia, USA) Müller-Liebenau (1974) [64] p. 562.

Rheobaetis petersi sp. n. (male & female imagos, nymph; Georgia, USA; type species of genus) Müller-Liebenau (1974) [64] p. 555.

Rheobaetis traverae sp. n. (male & female imagos, nymph; Georgia, USA) Müller-Liebenau (1974) [64] p. 565.

CAENIDAE **

Caenis lactea (Burmeister) (designation of lectotype; = Caenis nocturna Bengtsson syn. n.) Jacob (1974) [44] p. 95.

Caenis luctuosa (Burmeister) [designation of lectotype; = Caenis moesta Bengtsson syn. n.; = Caenodes felsinea (Grandi)] Jacob (1974) [44] p. 94.

Caenis moesta Bengtsson
SEE Caenis luctuosa

Caenis nocturna Bengtsson
SEE Caenis lactea

Caenodes felsinea (Grandi)
SEE Caenis luctuosa

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Ephemerella (Drunella) borakensis Allen
SEE Ephemerella submontana

Ephemerella (Drunella) submontana Brodsky [= Ephemerella (Drunella) borakensis Allen syn. n.] Allen (1974) [2] p. 1227.

** Ed. note: These Caenis synonyms were first published by Jacob (1974) in Entomol. Nachr. 18:5-6.

HEPTAGENIIDAE, Heptageniinae

Ecdyonurus fasciculatus sp. n. (male & female imagos, nymph, egg; Poland) Sowa (1974) [82] p. 316.

Ecdyonurus indicus *nomen novum* [new name for Ecdyonurus subfuscus Kimmins, 1937 NEC (Stephens, 1835) (Baetis)] Hubbard (1974) [40] p. 358.

Ecdyonurus mazedonicus (Ikonomov) * (transferred from genus Heptagenia) Sowa (1974) [82] p. 322.

Ecdyonurus quadrilineatus (Landa) (transferred from genus Heptagenia) Sowa (1974) [82] p. 322.

Ecdyonurus subfuscus Kimmins, 1937 NEC (Stephens, 1835) SEE Ecdyonurus indicus

Ecdyonurus trimaculatus (Ikonomov) (transferred from genus Heptagenia) Sowa (1974) [82] p. 322.

Heptagenia mazedonica Ikonomov SEE Ecdyonurus mazedonicus

Heptagenia quadrilineata Landa SEE Ecdyonurus quadrilineatus

Heptagenia trimaculata Ikonomov SEE Ecdyonurus trimaculatus

Genus Stenacron gen. n. Jensen (1974) [45] p. 225.

Stenacron areion (Burks) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenacron canadense (Walker) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenacron candidum (Traver) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

* Ed. note: The original spelling was mazedonica. Thus, the subsequent emendation to macedonica has no validity.

Stenacron carolina (Banks) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenacron floridense (Lewis) (transferred from genus Stenonema) Lewis (1974) [57] p. 347.

Stenacron frontale (Banks) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenacron gildersleevei (Traver) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenacron heterotarsale (McDunnough) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenacron interpunctatum (Say) (transferred from genus Stenonema; type species of genus) Jensen (1974) [45] p. 227.

Stenacron minnetonka (Daggy) (transferred from genus Stenonema) Jensen (1974) [45] p. 227.

Stenonema areion Burks SEE Stenacron areion

Stenonema canadense (Walker) SEE Stenacron canadense

Stenonema candidum Traver SEE Stenacron candidum

Stenonema carlsoni sp. n. (male & female imagos, nymph; South Carolina — also Georgia, Kentucky, USA) Lewis (1974) [57] p. 347.

Stenonema carolina (Banks) SEE Stenacron carolina

Stenonema floridense sp. n. (male & female imagos, nymph; Florida, USA) Lewis (1974) [57] p. 350. SEE Stenacron floridense

Stenonema frontale (Banks) SEE Stenacron frontale

Stenonema gildersleevei Traver SEE Stenacron gildersleevei

Stenonema heterotarsale (McDunnough)
SEE Stenacron heterotarsale

Stenonema interpunctatum (Say)
SEE Stenacron interpunctatum

Stenonema minnetonka Daggy
SEE Stenacron minnetonka

Stenonema quinquespinum sp. n. (male & female imagos, nymph; Ohio — also Wisconsin, Georgia, USA) Lewis (1974) [57] p. 353.

HEPTAGENIIDAE, Subfamily Spinadinae subfam. n. Edmunds & Jensen (1974) [28] p. 495.

Genus Spinadis gen. n. Edmunds & Jensen (1974) [28] p. 495.

Spinadis wallacei sp. n. (male nymph; Georgia, USA) Edmunds & Jensen (1974) [28] p. 496.

LEPTOPHLEBIIDAE

Genus Terpides Demoulin (imago) Peters & Harrison (1974) [69] p. 178.

Terpides jessiae sp. n. (male imago, female subimago, nymph; St. Vincent) Peters & Harrison (1974) [69] p. 179.

OLIGONEURIIDAE

Elassoneuria congolana Navas (male imago, nymph; female imago redescribed; removed from synonymy with Elassoneuria trimeniana) Gillies (1974) [35] p. 78.

Elassoneuria disneyi sp. n. (male subimago, female imago, nymph; West Cameroon — also East Cameroon; = Elassoneuria sp. of Disney 1971) Gillies (1974) [35] p. 74.

Elassoneuria grandis sp. n. (male & female imagos; Tanzania) Gillies (1974) [35] p. 77.

Elassoneuria kidahi sp. n. (male & female imagos; Tanzania) Gillies (1974) [35] p. 77.

Elassoneuria sp. of Disney 1971
SEE Elassoneuria disneyi

OTHER TAXONOMY

Examination of types of Caenis species originally described by Burmeister in Oxycypha, a synonym of Caenis. These species were misidentified by Eaton and others; Pictet and authors following him were probably correct. * Jacob (1974) [44].

Information on Baetidae of Southern France, Spain, and Portugal. A new species group of Baetis, the muticus-group, is established to include B. muticus and B. navasi sp. n. Müller-Liebenau (1974) [63].

Description of egg and early instars of Tortopus incertus. Tsui & Peters (1974) [91].

Notes on intergrade population of Hexagenia munda marilandica and H. m. elegans. Walker & Burbanck (1973) [99].

BIOGRAPHY

Obituary of Kaj Berg. Steemann Nielsen (1973) [85].

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* Ed. note: If so, Caenis lactea (Burmeister, 1839) = C. lactea of Pictet, 1843-45 = C. lactella Eaton, 1884.

BIOLOGY — life histories

Longitudinal study of seasonal growth patterns of Baetis rhodani along 2 Danish streams. Growth curves do not give growth rates; they give the results of population movements probably caused by drift, as evidenced by data on size and population frequency from the source to the end of the study streams. Thorup (1973) [89].

Potential fecundity of mayfly fauna of the Bigoray River, Alberta, Canada, calculated at 300,000 eggs/m^2/year, from egg counts of 158 specimens representing 12 species. Potential fecundity is reviewed: average egg production of a female = 100-200 eggs/mm body length (Leptophlebia cupida = 362 eggs/mm); early emerging specimens of a species are larger, more fecund; smaller species produce more eggs per unit volume. Mortality in the Bigoray River was 99.8% (934 eggs necessary to produce an adult). Clifford & Boerger (1974) [13].

Parthenogenesis in Stenonema femoratum. After 24-29 days, 1.23% of eggs extracted from virgin female imago hatched. Mayfly parthenogenesis is discussed. McCafferty & Huff (1974) [59].

Embryological development, first, and 2nd instars of Tortopus incertus. Eggs developed more rapidly at 19.5° C than at 23° C; morphogenesis was blocked at 13.6° C. Mandibular tusks were well formed in the embryo, and first instar nymphs showed a preference for mud substrate. Tsui & Peters (1974) [91].

Growth rates of selected amphipods, Plecoptera, and Ephemeroptera (Baetis sp., Ephemerellidae, Ecdyonurus sp., Rhithrogena sp.) in a cold (mean water temperature = 11° C) mountain stream, Germany-DBR. These data provide a comparative basis for an extensive study on Gammarus fossarum which follows. Teckelmann (1974) [87].

Feeding of commercial fish in Black Volta River and Volta Lake, Ghana, with comments on populations and eggs of Povilla adusta. Newly laid eggs absorb water and expand into rubber-like packets. Such packets are rejected by fish. Petr (1974) [71].

ALSO SEE: Cummins [24] general functional categorization of common invertebrate family life cycles by trophic level, growth time, and generation time; Lehmkuhl [55] data on temperature requirements in life cycles of Paraleptophlebia debilis and Ephoron album.

BIOLOGY — adult activity

Emergence of aquatic insects, particularly Chironomidae, from 2 ponds in Hertfordshire, England-UK. The emergence of Cloeon dipterum was univoltine in one pond and bivoltine in the other. This difference probably resulted from higher temperatures in the 2nd pond. Learner & Potter (1974) [54].

Flight activities of insects as measured by attraction to an ultraviolet light trap near Kiel, Germany-DBR, over 2-year study. Flights were correlated with endogenous and exogenous factors. Laboratory experiments were also made with Musca, Lepidoptera, and Coleoptera. Data on Ephemeroptera included date, time, and duration of flight activity and sex ratios for Caenis horaria, C. robusta, and Cloeon dipterum. Kurtze (1974) [51].

ALSO SEE: Metz [60] daily surface drift patterns (emerging and ovipositing adults) of Baetis, Ephemerella, and Caenis in the Vöckla, an Alpine stream in

Germany-DBR; Verneaux [96] seasonal patterns of Ephemeroptera imagos in the Doubs basin, France; Cloud & Stewart [14] drift of exuviae in Brazos River, Texas, USA.

BIOLOGY — nymphal activity

Experimental artificial stream study of drift activity as related to population density and food level. Drift increased as populations exceeded natural densities (determined from Pigeon River, Michigan, USA). For *Ephemerella needhami*, *E. serrata* gp., and Hydropsychidae, drift increased with lower food level; this did not occur in *Tricorythodes* sp. Periphyton was the experimental food, which may account for the result with *Tricorythodes*, a detritivore. Diel drift patterns are included for some species in Pigeon River. Hildebrand (1974) [39].

Drift of aquatic invertebrates in the Snake River, Wyoming, USA. For Ephemeroptera at station without moon, mature nymphs of *Ephemerella inermis* showed a peak after sunset which declined the rest of the night. At 2nd station: young nymphs of *E. inermis* did not drift; *Baetis bicaudatus* and *B. tricaudatus* showed a *bigeminus*-pattern; other species showed an *alternans*-pattern with the 2nd peak appearing after moonset; *Ephemerella tibialis* drifted during the day. Drift indices are calculated for all species. Kroger (1974) [49].

Daily and seasonal drift patterns of *Neochoroterpes mexicanus*, *Tricorythodes* sp., *Baetis* sp., *Caenis* sp. *Heptagenia* sp., and *Isonychia sicca manca* in the Brazos River, Texas, USA. Drift density was highest during summer months and all species showed activity peaks immediately after sunset. Drift of exuviae was an indicator of emergence. Cloud & Stewart (1974) [14].

Biocoenoses of *Palingenia longicauda* in the Tisza and Maros rivers, Hungary. Substrate composition, depth (1 to 2-4 m), population density, association with species of Oligochaeta, and active avoidance of sewage pollution are discussed. Csoknya & Ferencz (1972) [20].

Factors affecting the distribution of *Hexagenia munda* subspecies intergrades in a Georgia reservoir, USA. Depth, depth of burrows, light avoidance, tube preference, oxygen requirements, predation, and migration are discussed. Walker & Burbanck (1973) [99].

Comments on ecology of *Hexagenia munda* intergrades in a Georgia reservoir, USA. Walker & Burbanck (1972) [98].

ALSO SEE: Müller [62] review of stream drift in relation to diel and seasonal activity; Ulfstrand et al. [93] habitat selection and colonization of artificial substrates, Sweden; Stanford & Reed [84] comments on life cycle and distribution of *Rhithrogena* spp. in stream and in its substratum, Colorado, USA; Griffith [37] drift data on insect families in 4 Idaho streams, USA; Larimore [52] general drift data on genera of insects in some Illinois streams, USA.

CLASSIFICATION AND PHYLOGENY

Evolution of flight apparatus in 13 families of Ephemeroptera. The most general type of wing apparatus (thoracic musculature and axillary sclerites) belongs to the Siphlonuridae, Ametropodidae, and Metretopodidae. Heptageniidae deviate from this general form. The 2nd type of wing evolution occurs in Baetidae, Leptophlebiidae, and Ephemerellidae. Another branch contains the Ephemeroidea, but changes in wing apparatus are accompanied by a distinct shift in behavior only in Palingeniidae and Polymitarcidae. Oligoneuriidae and Behningiidae show the greatest changes. Caenidae exhibit other specializations. The basic evolutionary changes in wing apparatus are caused by changes in flight behavior, a movement towards a 2-wing condition, and a decrease in body size. Brodsky (1974) [9].

ECOLOGY

Experimental studies of leaf processing, or rate of weight loss, of different species of tree leaves. Basic processes studied included: 1) leaching, 2) initial microbial processing, 3) animal-microbial processing. Dominant invertebrates associated with the latter process are listed: all Ephemeroptera species listed were fine particle feeders. A review comparison gives leaf decay coefficients for other studies on leaf decomposition. Petersen & Cummins (1974) [70].

Summary results of study on ecological characteristics of species of zooplankton and zoobenthos in 2 arctic lakes, Lake Krivoe and Lake Krugloe, USSR. Metabolism, food consumption, growth, efficiency of utilization of food for growth (K_2), and ratio of production to biomass (P/B) are calculated. Metabolism, K_2, and P/B values are given for _Ephemera vulgata_ or the _E. vulgata_ biocoenosis. Ivanov & Alimov (1973) [42].

Overview of trophic relationships in stream ecosystem with presentation of functional terminology. Discussion includes kinds of organic matter present in or entering stream (food particle size), subdivisions of collector organisms (macro- and micro- filterers and gatherers), shredders, predators, categorization of life cycles, and implications of ecological theory for stream management. Cummins (1974) [24].

Colonization process on artificial substrates in a South Swedish stream. Among Ephemeroptera, _Heptagenia sulphurea_ colonized rock-filled trays at a constant rate, _Baetis rhodani_ colonized the trays early, and _Caenis rivulorum_ appeared in abundance toward the end of the 32-day experiments. Discussion of colonization rates in relation to habitat selection, drift, diversity, and equilibrium. Ulfstrand, Nilsson & Stergar (1974) [93].

Study of the hyporheic fauna ("hyporheos") of the Speed River, Ontario, Canada. Current, temperature, substrate composition, and physico-chemical conditions were also measured, suggesting that the surface action of Speed River extends about 30 cm into the substrate. Among Ephemeroptera, _Paraleptophlebia_, _Ephemerella deficiens_, and _E. excrucians_ were found at depths to 30 cm, while _Caenis_ occurred to 70 cm - although it was usually found above 40 cm. Williams & Hynes (1974) [104].

Report of hyporheic invertebrate fauna collected from infiltration-gallery water system located on flood plain of Tobacco River, Montana, USA, a river with loose, gravel substrata. The wells were 30-50 m away from the river. Species of Plecoptera, Chironomidae, Coleoptera, mites, leeches, _Ameletus_, and _Rhithrogena_ were found 4.2 m below water level. Stanford & Gaufin (1974) [83].

Phytophilous (plant-loving) invertebrate communities of reservoir at Goczałkowice, Poland. Ephemeroptera, particularly _Baetis rhodani_ and _B. pumilis_, were the most common group on _Elodea canadensis_. Species of

Caenis were common on other plants. Species composition of fauna on plants was compared with that from the bottom. Ephemeroptera comprised 0.3-2.1% of bottom fauna and 0.5-15% of the fauna on plants. Kuflikowski (1974) [50].

ALSO SEE: O'Connor [66] Paraleptophlebia in hyporheic zone of a Quebec river, Canada; Verneaux [96] ecological groupings of species in the Doubs river system, France; Hynes et al. [41] review of current research on stream ecology at University of Waterloo, Canada.

FAUNAL STUDIES — geographical

First record of Heptagenia fuscogrisea in Scotland-UK. Shires & Wallace (1973) [78].

Second record of Procloeon pseudorufulum from Moravia, Czechoslovakia. Adámek (1972) [1].

New records and distribution of species of Baetidae in Southern France, Spain, and Portugal. Müller-Liebenau (1974) [63].

New records of Ephemeroptera species from Liguria region of Italy. Gaino & Spanò (1973) [31].

New records of Ephemeroptera species from the Piemonte, Italy. Potamanthus luteus is a new record for Italy. Gaino & Spanò (1974) [32].

FAUNAL STUDIES - limnological

Species of bottom fauna of Lake Lille-Jonsvann, Norway, an intermediate oligotrophic-eutrophic lake. Leptophlebia vespertina, Caenis horaria, and Ephemera vulgata were abundant. Greatest density of Ephemeroptera occurred at depths between 0.2 and 1.0 m, with E. vulgata occurring to 5 m. Solem (1973) [81].

Two-year preimpoundment survey of invertebrate fauna of 6 small streams in Cow Green Reservoir basin, England-UK. Of 20 Ephemeroptera species, Rhithrogena semicolorata, Heptagenia lateralis, and Baetis rhodani together represented 49% of total fauna. Armitage, Machale & Crisp (1974) [3].

Benthic fauna of the Oslava River, Moravia, Czechoslovakia. Most abundant species of Ephemeroptera were Baetis vernus, B. lutheri, B. rhodani, and Potamanthus luteus. Adámek (1972) [1].

Species of Ephemeroptera and their distribution at over 100 stations in the Doubs River and its tributaries, Jura Massif, France. Verneaux (1972) [95].

ALSO SEE: Stern & Stern [86] species of phytoplankton, zooplankton, macrobenthos, and fish of Lake Jacomo and Lake Prairie Lee, Missouri, USA; Potter & Learner [72] species list of phytoplankton and fauna of Eglwys Nunydd Reservoir, Wales-UK; Brooker & Edwards [12] macroinvertebrate species from Barry Reservoir, Wales-UK, with habitats; Kuflikowski [50] species of invertebrates found on plants and in bottom fauna of Goczałkowice Reservoir, Poland; Tuša [92] Ephemeroptera species from 3 Moravian streams, Czechoslovakia; Verneaux [96] species lists of macrophytes, fish, Ephemeroptera, Trichoptera, Plecoptera, and other invertebrates from ecological zones in the Doubs river system, France.

GENERAL

General encyclopedia article on Ephemeroptera. Leonard (1974) [56].

HYDROBIOLOGY — running waters

Competition and selectivity in feeding of 2 species of trout in Idaho streams, USA. Young trout of both species showed a selectivity for Ephemeroptera and Diptera. Older Salvelinus fontinalis included mayflies among selected food in allopatric situations, but results varied when species were together in streams. Older Salmo clarki utilized Ephemeroptera more heavily in sympatric than in allopatric stream situations. Both species normally fed on drift. Griffith (1974) [37].

Seasonal changes in temperature and biological, physical, and chemical factors in a Colorado river, USA, below a dam with a hypolimnion drain. The fauna was impoverished in macroinvertebrate species, but rich in biomass. This indicated a stressed ecosystem, apparently caused by altered temperatures (higher than normal in winter, lower in summer, with a seasonally displaced maximum). For may-flies, only Ephemerella inermis and Baetis sp. were present below the dam; 6 species occurred 8.5 m downstream. Their density was highest in spring. Ward (1974) [101].

Biotypology of the Doubs river system, France. Results of a long-term study of its biological (fish, Ephemeroptera, Plecoptera, Trichoptera, and others) and its physical characteristics. Geographical, geological, climatic, physical, and chemical data are given in detail. Computer analysis defined biocoenotypes. This ecological zonation is correlated with non-biological factors. General considerations include the relation of temperature to flight period, pollution sensi-tivity, eutrophication vs. pollution, and ecological requirements of individual species. Verneaux (1973) [96].

Biological structure of the Loue, a river in the Jura Mountains, France, as determined by computerized factor analysis of 5 years' distribution data on Ephemeroptera (33 species), Plecoptera, Trichoptera, and fish. Four major ecological groupings were evident, each grouping having 3 subgroups. Ephemeroptera were not important at the highest station, but characterized zones in the Nouailles Canyon, mid- and lower courses of the river. Some species extended across zones, and some were transitional. Correlations were made between the typical biological structure and physico-chemical data. Among the important factors affecting distribution were gradient, temperature, and altitude. Verneaux & Rezzouk (1974) [95].

Relationship between diel variations in surface drift (emerging and ovipositing insects) and the feeding of trout in an Alpine stream, Germany-DBR. Species of Ephemeroptera (Baetis and Caenis dominant) comprised about 62% of surface drift. Analysis of fish collected simultaneously showed trout fed on drifting insects. Feeding was somewhat selective by size class, and the significance of this behavior is discussed. Metz (1974) [60].

Seasonal changes in composition, numbers (usually 500-700/m^2), and biomass of species of Ephemeroptera from 3 Moravian streams, Czechoslovakia. Seasonal occurrences are highest from early spring to spring and from late summer to autumn, caused mainly by population changes in common species (Baetis alpinus, B. rhodani, Rhithrogena semicolorata, Epeorus assimilis). Data are compared with other studies on Moravian streams. Tuša (1974) [92].

Effect of fisheries on production of Ephemeroptera in trout streams, Czechoslovakia. The abundance and biomass of each species of Ephemeroptera in current and bank habitats is calculated over 3 years. The absence, presence, or overstocking of trout did not affect the production of mayflies. Zelinka (1974) [106].

Zonation of Issyk and Ak-Bura rivers in Central Asia, USSR, by altitude, temperature, current, geographical features, and insect fauna. All insects were rare in the glacial zone (I); Ameletus alexandrae was among dominant species in glacial brooks (II), Iron montanus in upper reaches (III) with I. rheophilous and Ephemerella submontana in middle reaches (IV), other species of Heptageniidae in lower reaches (V), Baetis issyksuvensis at the change to a brook in the steppes (VI), and no mountain forms at the end of the brook in semi-desert (VII). Brodsky & Omorov (1973) [11].

ALSO SEE: Geen [34] review article on effects of hydroelectric impoundments on ecosystems of Canadian rivers; Williams & Hynes [104] estimates of biomass and chemical, physical, and faunal characteristics of the hyporheic zone of Speed River, Canada; Csoknya & Ferencz [20] biomass of Palingenia longicauda in the Maros River (average 89.74 individuals/m^2) and Tisza River (17.4/m^2), Hungary.

HYDROBIOLOGY — still waters

Limnological study of 2 eutrophic lakes, Missouri, USA, with heavy recreational use. Benthos of Prairie Lee Lake was characterized by high mollusc population as a result of high bacterial population. Lake Jacomo had a large macrobenthic population, including Hexagenia limbata, Caenis, and Callibaetis. Suggestions are included for controlling rapid eutrophication. Stern & Stern (1974) [86].

Comparison of changes in composition and abundance of invertebrates in the littoral vegetation of Gołysz carp ponds, Poland, filled over summer or over winter. Cloeon dipterum was an important component of the fish food fauna, especially in autumn and winter. Zięba & Srokosz (1974) [107].

Ecology and seasonal patterns of occurrence of zoocoenoses of rice fields and their associated irrigation-drainage system in Hungarian lowlands. Cloeon dipterum and Caenis macrura were abundant. Berczik (1973) [7].

ALSO SEE: Cook & Johnson [15] review of research on macroinvertebrates of Greak Lakes, Canada-USA; Jackivicz & Kuzminski [43] review of research on effects of outboard motors on lakes; Walker & Burbanck [99] population and biomass of Hexagenia munda subspecies intergrades in a Georgia reservoir, USA; Solem [81] biomass and vertical distribution of fauna in Lake Lille-Jonsvann, Norway.

METHODS

Comparison between 2 artificial substrate samplers (colonized 32 days) and 2 bottom sampling methods. Bottom kick samplers gave higher indices of diversity than did a Surber sampler, and bottom substrate samplers filled with rock approached the results of the kick sample. Floating substrate samplers of styrofoam and webbing gave poorest results, but were selectively colonized by Coleoptera, Trichoptera, and Ephemeroptera. Crossman & Cairns (1974) [17].

Comparison of fauna collected by 2 artificial substrate samplers with standard net collections.

Both samplers distorted the relative importance of Diptera and Trichoptera and both depressed diversity index values. Conservation webbing (#200, 3M) collected greatest numbers; concrete cones collected more taxa. Ephemeroptera were represented better on cones than on webbing. Benfield, Hendricks & Cairns (1974) [6].

New design for subsurface substrate sampler, more efficient than a Surber sampler and measuring greater depths than a buried can sampler. Thirty Paraleptophlebia were collected between 17.5 and 60 cm into the substrate. O'Connor (1974) [66].

New design for a bottom basket substrate sampler with enclosure net to prevent loss of young larvae, sand, and fine gravel. A new subsampler is also illustrated. Results were compared with those obtained by use of a Surber sampler. Stanford & Reed (1974) [84].

New design for a subsampler used in sorting large bottom samples. Södergren (1974) [80].

Statistics to show that small mesh nets (.20-.25 mm) are more efficient in collecting small specimens and young instars than are coarser (.5 mm) nets. Barber & Kevern (1974) [5].

ALSO SEE: Laville [53] new design for a bottom rock-filled substrate sampler; Williams & Hynes [104] new methods of sampling the hyporheic fauna and methods of measuring its physical and chemical characteristics; Armitage et al. [3] discussion and method of quantifying kick samples in gravel streams (10½ 60 sec kick samples = 1 m^2).

MINOR REFERENCES

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

Patterns of insect dispersal in Alaska, USA, with records of Baetidae from Cape Thomson. Gressitt & Yoshimoto (1974) [36].

Invertebrate population changes following removal and reintroduction of trout in a high altitude Colorado lake, USA, with computer simulation of fish production. Ameletus sp. was recorded from the lake. Walter & Vincent (1973) [100].

Environmental quality of Cedar Creek Basin, Kansas, USA, given as a list of diversity indices. Ephemeroptera were among dominant groups of benthic organisms. Ransom & Prophet (1974) [73].

Description of drift net, a useful technique for collecting small insect adults — Ephemeroptera included. Sisk (1974) [79].

Limnological study of 14 lakes in Guatemala. Ephemeroptera were present in bottom of one lake with high oxygen level. Brezonik & Fox (1974) [8].

Species list and production estimates of zoobenthos in Loch Leven, Scotland-UK. Historical review of zoobenthos of the eutrophic lake lists Centroptilum luteolum and Cloeon simile last found in 1952 and Caenis horaria last found in 1966-1972. No Ephemeroptera occur there now. Maitland & Hudspith (1974) [58].

Two year study on production, emergence, and life histories of benthic macroinvertebrates, Eglwys Nunydd Reservoir, Wales-UK. Baetis fuscatus was present in emergence traps in July and August. Potter & Learner (1974) [72].

Three year study on abundance and life cycles of taxa (excluding Protozoa, Microcrustacea, and Chironomidae) of a Lancashire pond, England-UK. Only 3 nymphs of Cloeon dipterum were found. Young (1974) [105].

Invertebrate grazers in littoral of Mikołajskie Lake, Poland. Order Ephemeroptera was present in benthic, old and young reed communities. Opaliński (1971) [68].

Colonization of a rock-filled substrate sampler in the rocky shore, littoral zone of a French mountain lake. Chironomidae were most abundant; Cloeon simile was also collected. Laville (1974) [53].

Limnology and fauna of Lake Tali Karng, Victoria, Australia. Atalonella sp. was present in weed beds. Timms (1974) [90].

MORPHOLOGY AND PHYSIOLOGY

Comparative morphology of flight apparatus (thoracic musculature and axillary sclerites) for 20 species representing 13 families of Ephemeroptera. Most data represents original work but all studies on thoracic morphology are tabulated. The discussion covers functional morphology of the flight apparatus, its correspondence to swarm behavior, and its evolution. Brodsky (1974) [9].

Dependence of parasite drag coefficient on Reynolds number (an abstract number reflecting relative magnitude of flow forces) in flight mechanics of insects. Lowest parasite drag was found in Ephemera vulgata. Brodsky & Ivanov (1973) [10].

Ultrastructure of campaniform sensillae in gills of Palingenia longicauda. Csoknya & Halász (1972) [21].

Ultrastructure of gill lamellae and filaments of Palingenia longicauda. Csoknya & Halász (1973) [22].

Ultrastructure of the digestive tract in young larvae of Palingenia longicauda with differences in cellular structure of foregut, midgut, and hindgut. Csoknya & Halász (1973) [24].

Ultrastructure of sensory cells in the pedicel of antennae of imagos of Cloeon dipterum, Baetis sp., and Epeorus sp. and nymphs of Ephemera sp. Two types of sensilla are present forming an inner and an outer ring. Sensory cells of the inner ring are probably homologous with the Johnston organ. Schmidt (1974) [77].

Gravity orientation of species of 8 orders of aquatic insects as measured by minimum time and angle at which they begin to move down an inclined plane. Times were different for each species. Among Ephemeroptera, nymphs of Cloeon rufulum and Epeorus did not move, Ephemera and Ecdyonurus moved downward at low angles (5-6°) in a relatively short time, and Leptophlebiinae moved only after 70 min at 45°. Rupprecht (1972) [75].

Oxygen consumption of Palingenia longicauda at different body weights, temperatures, and light conditions. Values of O_2 consumed from filtered river water at 20° C for nymphs between 200 and 800 mg body weight ranged from 1.3-2.7 ml O_2/hr/gr live weight (QO_2). The QO_2 was higher in young nymphs, decreased with age, and increased again with sexual maturity (nymphs over 600 mg body weight). Consumption increased with temperature and was greatest at 25° C. Csoknya (1973) [19].

Median tolerance limits (TLm) of selected species of aquatic insects to low oxygen concentrations. For mayflies, TLm for Ephemerella grandis was 3 mg/l O_2 after 96 hrs at flow of 1000 cm^3/sec; after 18-21 days there was 50% survival at 3.3-3.5 mg/l O_2; after 30 days 30% survival at 4.6 mg/l O_2. Speed of gill beats for E. grandis increased as O_2 concentrations decreased. TLm for E. doddsi was 5.2 mg/l O_2 at 500 cm^3/sec flow, for Callibaetis montanus 4.4 mg/l O_2 at 500 cm^3/sec flow, for Hexagenia limbata 1.8 mg/l O_2 at 1000 cm /sec^3 flow. Long term tests were also conducted with Rhithrogena robusta and Baetis bicaudatus. Gaufin, Clubb & Newell (1974) [33].

Summary information on respiration, calorific value, production, and efficiency of utilization of food for growth for Perlodes intricata. Cloeon dipterum is also considered. The rate of increase in oxygen consumption per 10° C for C. dipterum approached Krogh's normal curve. This mayfly species is capable of exhausting O_2 from water with a low initial concentration. Kamler (1973) [47].

Toxicity of cadmium to selected aquatic invertebrates. The median lethal concentration of Cd causing 50% mortality in Atalophlebia australis after 96 hrs was 0.84 mg/l (range 0.44-2.25 mg/l Cd). Trichoptera (Leptoceridae) larvae were unaffected, Odonata (Ischnura heterosticta) more resistant, and crustaceans (Paratya tasmaniensis and Austrochiltonia subtenuis) more sensitive. Combined effects of Cd and zinc were tested in Paratya. Thorp & Lake (1974) [88].

Toxicity of phthalate esters, used in making flexible plastics, to aquatic invertebrates (5 Crustacea and 3 insect species). Toxicity levels were very low; however, test animals rapidly concentrated phthalate residues. Concentrations in Hexagenia bilineata after 4 days were 1900 times greater than concentrations in water. Further experiments with Daphnia magna indicated that equilibrium was reached after 7 days, that loss of residues was rapid when the crustaceans were removed from test water, and that observed toxicity was 700-11000 times greater than concentrations which inhibited reproduction. Sanders, Mayer & Walsh (1973) [76].

Relative toxicity of 3 surfactants to Isonychia sp. as expressed by median effective concentrations (EC_{50}). The EC_{50} after 96 hrs for DBS was 5.33 mg/l, for a nonionic surfactant 2.96 mg/l, for TBS 1.36 mg/l. The EC_{50} values are also computed for 24 and 48 hrs, as are the times until death. Chemical names and chemical composition of the 3 surfactants are given, and results are discussed. Dolan, Gregg, Cairns, Dickson & Hendricks (1974) [26].

ALSO SEE: Babu & Hall [4] histochemical study of reaction of Hexagenia recurvata to trematode infection; Wichard [103] schematic diagram of chloride cells and proposal to use these cells in monitoring salinity of running waters; Brooker & Edwards [12] toxicity of paraquat to Cloeon dipterum; Miura & Takahashi [61] toxicity of insect development inhibitors to Callibaetis.

PARASITES AND SYMBIOTIC ASSOCIATES

Ultrastructure of the gregarine (Enterocystidae) Enterocystis fungoides, parasite of Baetidae nymphs in France, as studied by electron microscope. Desportes (1974) [25].

Histochemical study of defense reactions of Hexagenia recurvata against the trematode Cercaria tremaglandis. The pigment in the host capsule surrounding the parasite is positively identified as melanin. Babu & Hall (1974) [4].

ALSO SEE: Gillies [35] taxonomic description of Elassoneuria disneyi sp. n., on which Simulium species have been reported.

PESTICIDES AND POLLUTION

Comparison of data on groups of aquatic organisms with data from all groups in selected stream surveys, USA. Redundancy was apparent. Ephemeroptera had the highest correlation with total insect fauna. Coleoptera also showed high correlations, and would be preferred in acid spill situations; together these 2 orders reveal most information about insect fauna. Snails (Gastropoda) give the best data on non-insect macroinvertebrates. Kaesler, Cairns & Crossman (1974) [46].

Proposal to monitor changes in salinity of running waters by chloride cell counts of selected aquatic insects. The insects can adapt to brief salinity changes, but compensate for changes of longer duration by an increase or decrease in numbers of cells. Wichard (1974) [103].

Comparison of drift samples and benthic samples in Illinois streams, USA. Results were similar although more taxa, including Ephemeroptera families, were taken in drift. Advantages and disadvantages of using drift as a method of monitoring water quality. Larimore (1974) [52].

General article on role of insect assemblages as indicators of damaged or undamaged waters, accompanied by detailed tables of tolerance records for North American insect species to a broad range of physical and chemical factors. Data on roughly 50 species or species-groups of Ephemeroptera from 110 stations are included. These tables are summarized into extreme tolerance lists. For example, no Ephemeroptera were found at extremes of pH below 4.5; only Isonychia sp., Centroptilum sp., and Choroterpes sp. were found above pH 8.5. Roback (1974) [74].

Effects of methoxychlor on Simuliidae and other organisms in the Saskatchewan River, Canada, 1968-1970. Results were monitored by substrate samplers downstream. A single 15 min injection of 0.18-0.24 parts per million of methoxychlor removed 75-99% of black fly larvae. Among non-target organisms, Ephemeroptera losses were about the same as those of Simuliidae; Baetis and Heptagenia seemed more affected than other genera. Recolonization by Ephemeroptera was rapid. Discussion on methods of administering and monitoring methoxychlor is included. Fredeen (1974) [30].

Effects of 3 insect development inhibitor insecticides (chemical formulations given) on non target aquatic organisms in laboratory and irrigated pasture tests, California, USA. In laboratory tests there was 90% Callibaetis mortality at .01 parts per million TH 6040; the mayfly was not affected by a field dosage of .0025 pounds per acre, but dead Callibaetis were found at higher dosages. Some tests were made with Altosid and H 24108. Neither appeared to affect non-target organisms. Miura & Takahashi (1974) [61].

Effects of paper mill effluent on bottom fauna of Lower Sabine River, Texas, USA, as indicated by diversity indices. Indices were slightly lower below outflow of the mill, but they varied more at different sites by date (index values of 2.11-3.24 below mill before discharge of effluent began). Natural conditions of periodic low flow and salt intrusion have contributed to semi-polluted conditions and low diversity. Hexagenia sp. was fairly common. Potential damage to the estuary is also discussed. Hendricks, Henley, Wyatt, Dickson & Silvey (1974) [38].

Effects of 2 types of coolant water discharge systems from nuclear electric generating plant on Mississippi River, Illinois, USA. Neither the side-jet (temperature increases up to 7° C) nor the multi-port diffuser (up to 1.5° C) had as much effect on the fauna as did the dredging operations conducted in installation of the diffuser. Hexagenia spp. represented 21% of the benthos. Some fish were affected by high temperatures. Effects of chlorination are also discussed. Eiler & Delfino (1974) [29].

Effects of sewage wastes and oil-field brine drainage on water quality of an Ohio creek, USA, as measured by Shannon-Wiener diversity index. Diversity decreased downstream below addition of contaminants, and percentage composition of tubificids in samples increased. Ephemera simulans was classified as a pollution-sensitive organism; Caenis sp. was facultative. Olive & Dambach (1973) [67].

Use of cluster analysis in assessing invertebrate recovery from massive, acute pollution of Clinch River, Virginia, USA. Ephemeroptera are among groups chosen to illustrate the method. Dendograms are constructed based on similarities of localities (presence or absence of species). Shifts from normal conditions are thus visualized. Benthic fauna, except molluscs, recovered from a 1967 fly ash spill (pH 12-12.7) by 1969. Ephemeroptera, eliminated by a sulphuric acid spill in 1970, had nearly recovered by the end of the survey. Crossman, Kaesler & Cairns (1974) [18].

Comparison of Carpenter, Lothian, Trent, and Chandler biotic indices and diversity index of Margalef in discriminating low levels of pollution (moorland run-off, farm waste, sewage, cooling water, mild product waste) in the Tamar River catchment, England-UK. The catchment is divided into an organically enriched upper region and a stable environment on its lower tributaries. Only the Chandler index and the diversity index were adequately sensitive to distinguish low levels of pollution. Reasons for preferring the diversity index are discussed, and notes are given on tolerances of species of mayflies. Nuttall & Purves (1974) [65].

Long term effects of paraquat, a herbicide, on fauna ecology of Barry Reservoir, Wales-UK. Only zooplankton and macroinvertebrates closely associated with angiosperms were affected, and changes in community structure were related to this loss of habitat. Laboratory tests defined the incipient lethal dose of paraquat to Cloeon dipterum at 10° C as 29 mg/l; reservoir dosages of 0.6 and 1.0 mg/l did not affect C. dipterum. Brooker & Edwards (1974) [12].

Comparison of tolerances of selected species of aquatic insects to concentrations of NH_4^+ and biochemical oxygen demand after 2 days (BOD_2) in a German-DBR stream. Baetis rhodani showed a greater range of tolerances than Ecdyonurus venosus or Rhithrogena semicolorata. Saprobic values are given and discussed; these insects have a broad range of responses which are difficult to fit into a narrow classification. Unkelbach (1974) [94].

Effects of the molluscicide Frescon on fauna of 2 lakes in West Cameroon. Estimated concentration in treated areas was 2 parts per million of Frescon. Many fish, benthic invertebrates (including Povilla adusta and Baetidae), and zooplankton were found dead shortly after treatment. Long term effects were not so severe, apparently because treated areas were recolonized from untreated areas of the lakes. Corbet, Green & Betney (1973) [16].

ALSO SEE: Tuša [92] water quality of 3 Moravian streams, Czechoslovakia; Verneaux [96] pollution in Doubs basin, France, with indices of pollution, scales of sensitivities for species and communities, and tolerance spectra for selected species; Warner [102] literature review on pollution and macroinvertebrates; Jackivicz & Kuzminski [43] review of effects of outboard motors on freshwater life; Gaufin et al. [33] tolerance of aquatic insects to low oxygen concentrations; Thorp & Lake [88] toxicity of cadmium to aquatic invertebrates; Sanders et al. [76] toxicity and effects of phthalate esters on aquatic invertebrates; Dolan et al. [26] toxicity of 3 surfactant mixtures to Isonychia sp.

REVIEWS

Review of stream drift in relation to diel and seasonal activity. The review covers behavioral drift (a form of locomotor activity), as well as surface drift (emergence and oviposition) and flight activity which are also diel phenomena. The colonization cycle and future research needs are discussed. Müller (1974) [62].

Review and history of research on benthic macroinvertebrates of the Great Lakes (Canada-USA) from 1870 to present. Cook & Johnson (1974) [15].

Review article on effects of thermal pollution on aquatic organisms. Key temperatures which initiate physiological changes can be altered or absent. Lehmkuhl (1974) [55].

Review of effects of hydroelectric impoundments in Western Canada on aquatic ecosystem. Geen (1974) [34].

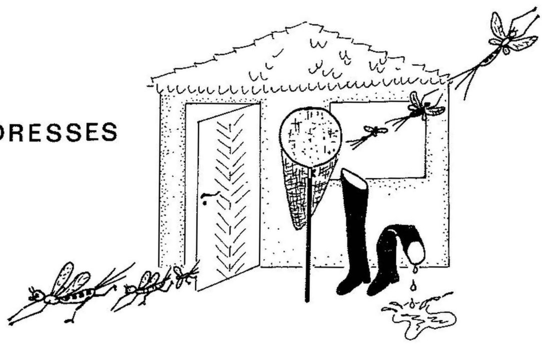
Review of research on effects of outboard motors on freshwater environments. Jackivicz & Kuzminski (1973) [43].

Review of literature published in 1973 concerned with water pollution and freshwater invertebrates. Warner (1974) [102].

Review of recent research on stream ecology at University of Waterloo, Canada. Hynes et al. (1974) [41].

ALSO SEE: Cummins [24] review and synthesis of current research on stream ecosystems with emphasis on food chains; Clifford & Boerger [13] review of potential fecundity of Ephemeroptera species.

ADDRESSES



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