SEASONAL DISTRIBUTION OF ADULT EPHEMEROPTERA IN NORTHWESTERN ARKANSAS[1]

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ABSTRACT

The seasonal distribution of thirty-four species of adult mayflies in Northwestern Arkansas is given. All thirty-four species may be seasonally restricted at the study site; however, data indicate that the emergence of five species may be rhythmic. A review of the literature on the seasonal distribution of adult mayflies in North America is included. Twenty-three species are listed as new to the state.

The seasonal occurrence of adult mayflies is known for only a few species in North America. Even for these, it is reported for only one to several localities. Little or none of the available information is applicable to the Ozark Mountains, an area relatively rich in aquatic insect fauna including Ephemeroptera. Herein are presented data on the seasonal distribution of 34 species of adult mayflies in Northwestern Arkansas. It includes the first list, although only partial, of mayflies known to occur in the state.

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Neave (1932) reported the seasonal distribution of *Hexagenia limbata occulta* Walker and *H. rigida* McDunnough on Lake Winnipeg, Canada. Ide (1935) presented data concerning the effect of temperature on the seasonal occurrence of mayflies on the Nottawasaga River system in Central Ontario. Spieth (1936) published on the seasonal occurrence of *Ephemera simulans* Walker on Lake Wawasee, Indiana. Later, Spieth (1938) published on coloration and its relation to seasonal emergence of various species primarily from the Eastern United States. Seasonal distribution was reported by Ide (1940) on four species of *Leptophlebia* in Ontario, by Hunt (1953) on *Hexagenia limbata occulta* in several Southern Michigan lakes, by Lyman (1955) on 22 species on Douglas Lake, Michigan. Judd in several papers (1949, 1953, 1960, 1961, and 1962) reported the seasonal distribution of various species occurring at various localities in Ontario. Leonard and Leonard (1962) published the seasonal occurrence of 28 species on the Pere Marquette River, Lake County, Michigan. Berner (1950) listed the seasonal emergence of 40 species of mayflies in Florida. Fremling (1964) reported on rhythmic emergences of *Hexagenia bilineata* (Say) and the environmental factors which influence them. Numerous papers that are primarily taxonomical also include many seasonal records or summaries of seasonal occurrence. Recently, Corbet (1964) published on the temporal patterns of emergence in aquatic insects. He noted examples of mayflies for four basic temporal patterns of emergence—continuous, rhythmic, sporadic, and seasonal.

The majority of the specimens obtained during this study were collected using a light trap with a single 15-watt black light lamp. The light trap was located near the junction of Low Hollow and Cove Creeks, 15 miles south of Prairie Grove, Washington County, Arkansas, in a corner of a small field in the valley floor with good exposure in all directions. These two creeks are spring fed with intermittent pools and riffles. The valley formed by these creeks is narrow with steep wooded slopes. The beds of both streams are variable in composition. Portions are composed of solid, coarse conglomerate, while other portions are composed of coarse sand to small conglomerate rubble. Frequently, there are pools with sand, silt and organic debris or leaf mold. The water flow varies in width from two to 30 feet, depending on seasonal rainfall. The depth likewise is variable, up to seven or eight feet during flood periods, but normally ranging from a few inches in riffle areas to four feet in pools. Stream velocity ranges from zero to 0.4 foot per second except when heavy rains occur. About 100 feet northwest of the light trap, two earthen dam ponds one-fourth to one-half acre in size hold water the year around. These ponds range up to five feet in depth. The bottoms are covered with coarse silt washed in from the slope above. The margins are lined very sparsely with vegetation, mostly grass and sedges.

The light trap was run more or less regularly throughout the entire

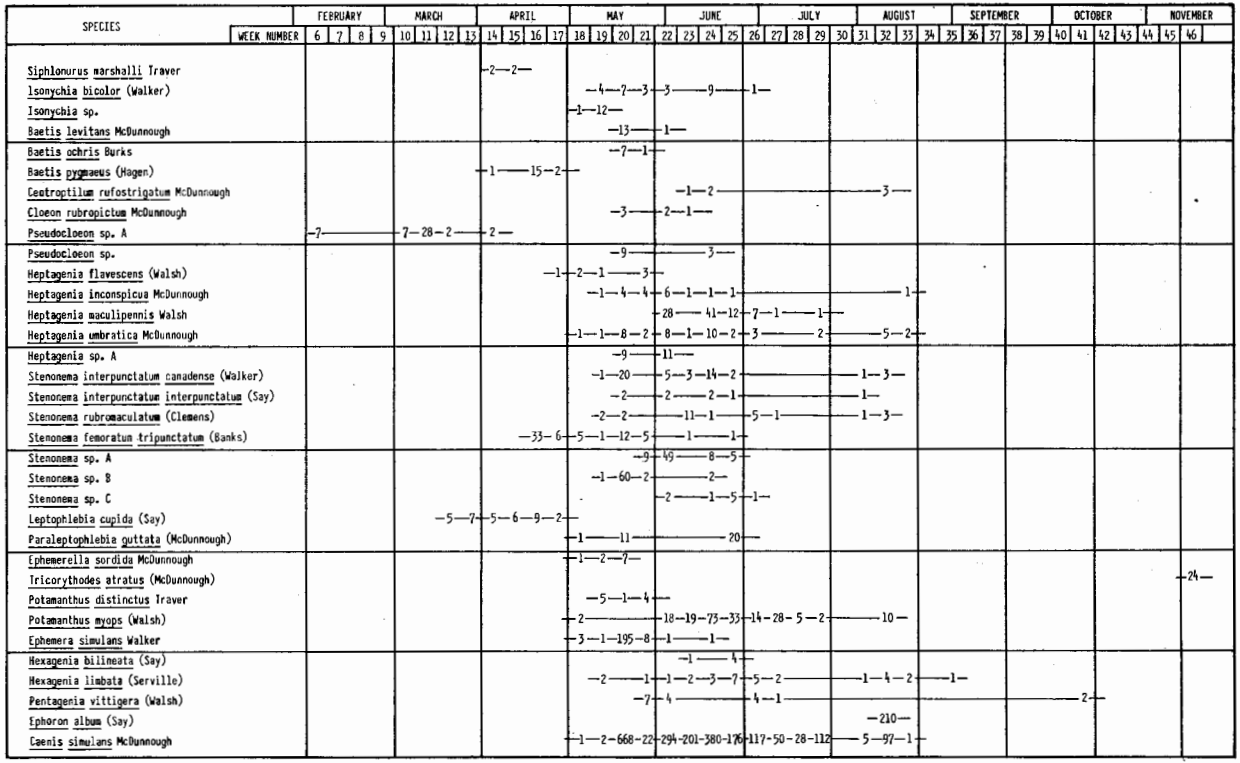

TABLE 1. Seasonal distribution of thirty-four species of adult Ephemeroptera in Northwestern Arkansas.

calendar year of 1960. Samples of insects were removed each morning and preserved in 70% alcohol.

Table 1 presents the seasonal distribution of the 34 species. Data were compiled on a 52-week basis, of which weeks 6 to 46 are shown on Table 1, because adult mayflies were not collected from January 1 to February 4 and November 19 to December 31 of the calendar year. The seasonal distribution of each species is represented by a horizontal line. The total number of specimens collected each week is indicated for each species.

One species of *Isonychia* and one species of *Pseudocloeon* are not named to species in Table 1. In both cases only females were obtained. They could not be identified to species from the available specimens. However, these two species are not representatives of the named species of their respective genera listed in Table 1.

Reliable specific identification could not be made of the females of *Heptagenia* and *Stenonema*. For this reason, only males were used in compiling the seasonal distribution of the species of these genera. But there is no evidence to suggest that exclusion of the females would alter the data.

The seasonal occurrence of 28 of the 34 species was confined to the period April 16 to September 2. The greatest number of species was obtained between May 14 and June 17. *Siphlonurus marshalli, Baetis pygmaeus, Pseudocloeon* sp. A and *Leptophlebia cupida* occurred early in the spring. The appearance of *Tricorythodes atratus* was late in the year and all specimens were collected within the week of November 12 to 18. All thirty-four species may be seasonally restricted at the study site in Northwestern Arkansas.

It is interesting that the 210 specimens of *Ephoron album* were collected only within the week of August 6 to 12. Also 24 specimens of *Tricorythodes atratus* were collected within one week. The seasonal distribution of *Siphlonurus marshalli, Isonychia* sp. and *Baetis ochris* lasted only two weeks. The emergence of all five of these species may not be seasonally restricted, but regulated and maintained by an "internal clock" (the endogenous or circadian rhythm) which is "set" by responses to external time-cues (exogenous factors) as pointed out by Corbet (1964).

The duration of emergence varied greatly among the 34 species. *Baetis ochris* emerged for only 14 days, while *Heptagenia umbratica* emerged almost continuously for 112 days. The number of specimens collected per week of some species was quite consistent. However, the abundance of other species varied greatly per week and data indicated distinct peak emergences in some species. The total number of specimens trapped varied greatly among the species; however, no correlation seems to exist between density and length of emergence period.

No specimens were collected during certain weeks within the seasonal occurrence of some species. As data were collected for only one year, such periods to some extent may indicate adverse weather condi-

tions for mayfly emergence and flight. Lyman (1944) showed that lowering temperature in laboratory conditions prolonged the subimago stage. During this prolonged stage, the specimens became inactive and ceased practically all movement. Corbet (1964) points out that the environmental factors affecting emergence of adults still require critical investigations.

Additional seasonal emergence data from the study site in Arkansas would indicate more precisely the pattern of emergence for the various species and the possibility of two or more generations of a species per year. If such data were recorded simultaneously with records of several possibly influencing environmental factors, it might indicate which ones control emergence and flight of mayfly adults.

NEW MAYFLY RECORDS FOR ARKANSAS

Little has been written on the mayflies of Arkansas. Traver (1934) described a new species, *Siphlonurus marshalli*. Burks (1953) listed several species as occurring in Arkansas. Included in the present paper are 23 species of mayflies new to the state. They are *Isonychia bicolor, Baetis levitans, B. ochris, B. pygmaeus, Centroptilum rufostrigatum, Cloeon rubropictum, Heptagenia flavescens, H. inconspicua, H. maculipennis, H. umbratica, Stenonema interpunctatum interpunctatum, S. rubromaculatum, Leptophlebia cupida, Paraleptophlebia guttata, Ephemerella sordida, Tricorythodes atratus, Potamanthus distinctus, P. myops, Ephemera simulans, Hexagenia bilineata, H. limbata, Ephoron album* and *Caenis simulans*. Also listed in this paper are one apparently undescribed species of *Heptagenia*, three apparently undescribed species of *Stenonema* and one apparently undescribed species of *Pseudocloeon*.

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LITERATURE CITED

Berner, L. 1950. The mayflies of Florida. Univ. Florida Studies, Biol. Sci. Series 4: 267 p.

Burks, B. D. 1953. The mayflies, or Ephemeroptera, of Illinois. Bull. Illinois Natur. Hist. Surv. 26(Art. 1): 216 p.

Corbet, P. S. 1964. Temporal patterns of emergence in aquatic insects. Canad. Entomol. 96:264–279.

Fremling, C. R. 1964. Rhythmic *Hexagenia* mayfly emergences and the environmental factors which influence them. Verh. Internat. Verein. Limnol. 15:912–916.

Hunt, B. P. 1953. The life history and economic importance of a burrowing mayfly, *Hexagenia limbata*, in Southern Michigan lakes. Bull. Inst. Fish. Res. Univ. Michigan 4: 151 p.

Ide, F. P. 1935. The effect of temperature on the distribution of the mayfly fauna of a stream. Publ. Ontario Fish. Res. Lab. 50:3–76.

———. 1940. Quantitative determination of the insect fauna of rapid water. Publ. Ontario Fish. Res. Lab. 59:1–20.

Judd, W. W. 1949. Insects collected in the Dundas Marsh, Hamilton, Ontario, 1946–47, with observations on their period of emergence. Canad. Entomol. 81:1–10.

———. 1953. A study of the population of insects emerging as adults from the Dundas Marsh, Hamilton, Ontario, during 1948. Amer. Midl. Natur. 49:801–824.

———. 1960. A study of the population of insects emerging as adults from South Walker Pond at London, Ontario. Amer. Midl. Natur. 63:194–210.

———. 1961. Studies of the Byron Bog in Southwestern Ontario. XII. A study of the population of insects emerging as adults from Redmond's Pond in 1957. Amer. Midl. Natur. 65:89–100.

———. 1962. A study of the population of insects emerging as adults from Medway Creek at Arva, Ontario. Amer. Midl. Natur. 68:463–473.

Leonard, J. W., and F. A. Leonard. 1962. Mayflies of Michigan Trout Streams. Cranbrook Inst. Sci., Bull. 43: 139 p.

Lyman, F. E. 1944. Effect of temperature on the emergence of mayfly imagoes from the subimago stage. Entomol. News 55:113–115.

———. 1955. Seasonal distribution and life cycles of Ephemeroptera. Ann. Entomol. Soc. Amer. 48:380–391.

Neave, F. 1932. A study of the mayflies (*Hexagenia*) of Lake Winnipeg. Contr. Canad. Biol. and Fish., No. 15 (Ser. A, Gen. No. 12) 7:177–201.

Spieth, H. T. 1936. The life history of *Ephemera simulans* Walker in Lake Wawasee. Canad. Entomol. 68:263–266.

———. 1938. Studies on the biology of Ephemeroptera. I. Coloration and its relation to seasonal emergence. Canad. Entomol. 70:210–218.

Traver, J. R. 1934. New North American species of mayflies. J. Elisha Mitchell Sci. Soc. 50:189–254.