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Distribution of Mayfly Nymphs (Ephemeroptera) in Streams of Dallas County, Texas[1]

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Introduction

Although mayflies are of common occurrence in the Southwest, but little work has been done here on them. Most investigations on this group of insects have been done in New York, the Great Lakes Region, and Canada. Some work has been done in the Rocky Mountain area, and also along the Atlantic coast. Berner (1950) has published an extensive work on the mayflies of Florida. This is the first major work in this field since the book, *Biology of Mayflies*, by Needham, Traver, & Hsu (1935). Besides these, many minor papers on this group have appeared; but for Texas only a few scattered records are available.

Since we know so little of the mayflies of the Southwest, I have made a survey of mayfly nymphs in Dallas County, Texas. Systematic collections were made from July, 1949 through March, 1950. Notes on habitat and a key have been prepared for genera found in Dallas County. I have also recorded Texan species collected at major streams between Dallas and San Antonio. These collections were made on two trips, one in July and the other in November, 1949.

Mayflies are seldom seen in the adult form, because their aquatic larvae emerge as sexually mature adults only twice a year. They would not be seen so often were it not for the fact that we have two distinct generations running at the same time; one that reaches maturity in the spring, and one that reaches maturity in the fall. Most Ephemeroptera remain in the nymphal stage for one or two years, depending on the species. At the end of their times they emerge as the winged sub-imagos. These possess adult form, but

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lack sexual maturity. After a few hours the sub-imagos moult and the sexually mature adult emerges. Copulation followed by oviposition usually occurs upon emergence, and shortly thereafter the adults die. Mouth-parts do not develop in the adults, so feeding cannot occur. The ovaries in the female "take over" most of the body, so that the mature female is little more than an animated sac of eggs.

As mayflies spend most of their lives in the immature aquatic stage, and usually occur in great abundance, it is easy to see what a great part they must play in the ecological balance of a body of water. Most mayfly nymphs feed on algae (diatoms, desmids, and filamentous forms). Only *Isonychia* has been accused of taking in animal matter for food. It is thought that such animal matter is ingested quite by accident, as the nymph faces upstream, and takes in whatever flows along.

In a sense, mayflies might be considered the "cattle" of an aquatic habitat, since they convert plant into animal tissue, for the consumption of aquatic carnivores. Mayfly nymphs are not only the food of carnivorous invertebrates, but also serve as important food organisms for fish. They have been found in stomach-analyses of bass, trout, and various minnows.

Methods of Approach

I selected collecting stations for diversity of habitat and distribution over the county. These stations represented all major streams in the county. Collections at most of these stations were made by turning over rocks, boards, sticks, and other debris. Most of the insect larvae were found clinging to the lower sides of these objects. In muddy areas, burrowing specimens were collected with the aid of a Peterson dredge and screen. In rapid water, successful collections were made by holding one side of a sieve against the floor of the stream, while a second collector turned over all rocks and gravel in the area immediately upstream from the sieve. The dislodged specimens were swept into the sieve and held there by the current. They were then easily separated from the debris in the sieve. This method proved especially good in collecting species of Baetidae, but was rather rough on the more fragile Heptageniidae. Usually

I turned over rocks and pebbles by hand, to obtain the more delicate species.

All specimens were preserved in 70% alcohol as collected, and complete field data taken for each collection.

Laboratory study involved separation of the various types, and keying[3] down to genus and species when possible. Many ephemerids cannot be keyed to species on the basis of nymphal characters alone. Therefore, future collection and study of adult forms will give a more adequate picture of the mayfly population of this region.

Location and Evaluation of Stations[4]

Station 1. Duck Creek at Buckingham Road: limestone bottom with shallow, sluggish, clear water, few rocks, and few specimens collected.

Station 2. Duck Creek at Miller Road: bare limestone bottom, with shallow, sluggish, clear water. No specimens collected.

Station 3. Duck Creek at Belt Line Road and Centerville Road: limestone bottom, with many rocks, water shallow, swift, and clear. Ideal habitat, but no specimens collected.

Station 4. Duck Creek at Oates Road: gravel bottom with some sand and silt, water swift, up to 18 inches deep, clear. Specimens collected on submerged logs.

Station 5. Duck Creek at Belt Line Road north of New Hope: limestone bottom covered with heavy mud, water sluggish, muddy. Good only for burrowing forms.

Station 6. Duck Creek at New Hope Road: limestone bottom covered with heavy silt layer, limestone exposed in midstream. Good only for burrowing forms.

Station 7. North Mesquite Creek at crossing east of Edwards School: dried up.

Station 8. South Mesquite Creek at Mercury Road: dried up.

Station 9. White Rock Creek at Preston Road: limestone bottom with shallow, sluggish, clear water. Many rocks, very little silt. Collecting good.

Station 10. White Rock Creek at Hillcrest Road: limestone bottom covered with many rocks, and much filamentous algae. Water was shallow, swift, and clear, collecting excellent.

Station 11. White Rock Creek at Coit Road: bottom rocky and loose, with some silt near banks, water up to one foot deep, swift, and clear. Collecting good.

Section 12. White Rock Creek—¾ mile downstream from station 11: rocky bottom, with swift, shallow, clear water. The collecting was poor.

Station 13. White Rock Lake, channel below spillway: rocky bottom covered with much algae, water swift, clear, up to 12 inches deep. Collecting was poor (only one specimen).

Station 14. Denton Creek—upstream from bridge on county road due north out of Grapevine (just inside Denton County): heavy mucky silt bottom, water sluggish, very turbid. Collecting was excellent for burrowing forms.

Station 15. Denton Creek at Belt Line Road: bottom rocky near shore, heavy silt in midstream, water sluggish and turbid. Collecting good.

[3]The keys by Traver, in *The Biology of Mayflies*, 1935, were used.
[4]Unless otherwise stated, all collections were made in Dallas County.

Station 16. Trinity River (Elm Fork), riffles below Carrollton Dam: limestone substrate with a few large rocks. Water swift, shallow, slightly turbid, collecting excellent.

Station 17. Bachmans Creek, ½ mile upstream from lake: gravel substrate, slow, shallow, clear water, collecting fair.

Station 18. Elam Creek at Camp Woodland Springs: limestone bottom exposed in some places, heavy sand deposits in others. This is a swift spring-fed stream; water up to 12 inches deep. Collecting only fair.

Station 19. Trinity River-Belt Line Road at Bois d'Arc Island: heavy silty bottom, with water deep, sluggish, and muddy. This area was excellent for burrowing forms.

Station 20. Cottonwood Creek at Belt Line Road: dried up.

Station 21. Mountain Creek at Duncanville-Florence Hill Road: creek had recently been oiled, and no specimens were collected.

Station 22. Walnut Creek at Belt Line Road: dried up.

Station 23. Mountain Creek at Belt Line Road: no specimens collected; this area had also recently been oiled.

Station 24. Five Mile Creek at Kiest Park: limestone bottom with many rocks, and in some areas, heavy silt. Slow, clear water up to 12 inches deep. Collecting at this station was particularly good.

Station 25. Cedar Creek at Beckley, one block south of Clarendon Drive: limestone substrate with many rocks, shallow, swift, clear water. Collecting was only fair.

Station 26. Ten Mile Creek at U.S. Hwy. 67: limestone substrate with few rocks, and much algae, shallow, swift, clear water. Collecting was good.

Station 27. Ten Mile Creek at U.S. Hwy. 77: limestone substrate with many large rocks, shallow, swift, clear water. Collecting was good.

Station 28. Ten Mile Creek at U.S. Hwy. 75: bottom covered with heavy silt, water sluggish, muddy. Excellent for burrowing forms.

Some areas yielded few or no specimens. This was particularly true of stations like those along Duck Creek, where a flash flood during August thoroughly scoured the stream bed, and removed the more permanent inhabitants. At the time these collections were made (Dec., 1949) I found chiefly short-lived blackfly larvae; while the long-term dragonfly and mayfly nymphs were either absent (at most stations) or present only in small numbers. It should be noted, however, that Station 16, just below Carrollton Dam, underwent at least three major floods during the fall and winter, and collections there showed little effect from this scouring. The major difference between these two areas, and possibly the explanation, is that the rocks at Station 16 are large slabs of faulted limestone, which the flood waters do not easily move. I believe, however, that this is only a partial explanation, and that the real reason is something else.

I include the stations where no specimens were collected merely to give a picture of the coverage of the area.

KEY TO THE GENERA OF MAYFLY NYMPHS (EPHEMEROPTERA) OF DALLAS COUNTY, TEXAS

1a. Mandibles with a tusk projecting forward and visible from above the head ..... *Hexagenia*
1b. Mandibles with no such tusk 2
2a. Body flattened, gills on segment 7 reduced to tapered filaments ..... *Stenonema*
2b. Body not flattened (except in Leptophlebiinae), gills on segment 7 not reduced 3
3a. Outer tail filaments with short hairs on both sides 4
3b. Outer tail filaments with a heavy fringe of hairs on the inner side only; may have a few short hairs on the outer side 6
4a. Gills present on abdominal segments 1-7; upper and lower gill lamellae identical; gills on segment 2 not elytroid .. *Choroterpes*
4b. Gills present on segments 1-6 only; rudimentary on segment 1; gill on segment 2 elytroid, covering all those behind it 5
5a. Gills on segment 2-6 single; the operculate gill on segment 2 quadrate; those on 3-6 with deeply fringed margins ..... *Caenis*
5b. Gills on segments 2-6 double; the operculate gill on segment 2 triangular; those on 3-6 not fringed; margins entire ..... *Tricorythodes*
6a. Large conspicuous apical spines on fore tibia; about ½ as long as tarsus; lateral extensions of abdominal segments 8 and 9 terminate in long sharp spines ..... *Isonychia*
6b. Fore tibia lacking large apical spine; postero-lateral margins of abdominal segments usually without backward projecting spines 7
7a. Middle tail filament shorter and weaker than outer filaments; distal joint of labial palp rounded ..... *Baetis*
7b. Middle tail filament similar to outer filaments; distal joint of labial palp dilated apically 8
8a. Gill lamellae symmetrical, with normal pinnate branching; second pair of wing buds present ..... *Centroptilum*
8b. Gill lamellae asymmetrical, pinnately branched on inner side only, second pair of wing buds absent ..... *Neocloeon*

ECOLOGY AND SYSTEMATIC REPORT

Family EPHEMERIDAE

Subfamily Ephemerinae

Genus *Hexagenia* Walsh

Members of this genus are fossorial. They have been found only in areas with a mud or heavy silt substrate. Lyman (1943) showed that *Hexagenia* nymphs can burrow in mud, and that they cannot build and maintain burrows in sandy or gravelly substrates.

Hexagenia was collected generally over the county. Adaptations for burrowing make it more commonly a lake rather than a stream form. Specimens collected in Dallas County were identified as *H. bilineata* Say. They were collected at Stations 5, 6, 14, 15, 19, 24, and 28.

Family HEPTAGENIIDAE

Subfamily Heptageniinae

Genus *Stenonema* Traver

Nymphs of *Stenonema* are flattened forms, usually found on the under sides of rocks in shallow streams. There seemed to be no correlation between stream-flow and the presence of this genus. Specimens were collected from both sluggish and swift flowing streams.

In relative abundance, nymphs of *Stenonema* were by far the most plentiful in the area. Specimens were keyed to species by Traver's keys[5]. The species identified were:

Stenonema birdi Traver.—Nymphs were found only at Station 26 in Dallas County. Here it was found in close relationship with *S. tripunctatum.*

Stenonema candidum Traver.—Collected at Stations 4, 10, 15, 16, and 24. Abundant at all stations.

Stenonema majus Traver.—Collected at Stations 16, 24, and 26. They were not abundant at any station.

Stenonema proximum Traver.—Only one specimen, collected at Station 24.

Stenonema pulchellum Walsh.—Nymphs were collected at Station 16. Although found only at this station, they were in abundance.

Stenonema terminatum Walsh.—Nymphs were collected at Stations 10, 16, and 24. Not abundant at any station.

Stenonema tripunctatum Banks.—Of all species of *Stenonema* collected in this county, *S. tripunctatum* was by far the most common. It was collected at Stations 1, 9, 10, 11, 17, 18, 24, 26, and 27.

Family BAETIDAE

Subfamily Leptophlebiinae

Genus *Choroterpes* Eaton

Choroterpes, typical of lotic habitats in this area, has nymphs with flattened bodies and greatly depressed heads. Species-identification of this and most of the following genera is impossible on the basis of nymphal characters alone. *Choroterpes* was collected at Stations 9, 10, 16, 17, 24, and 27.

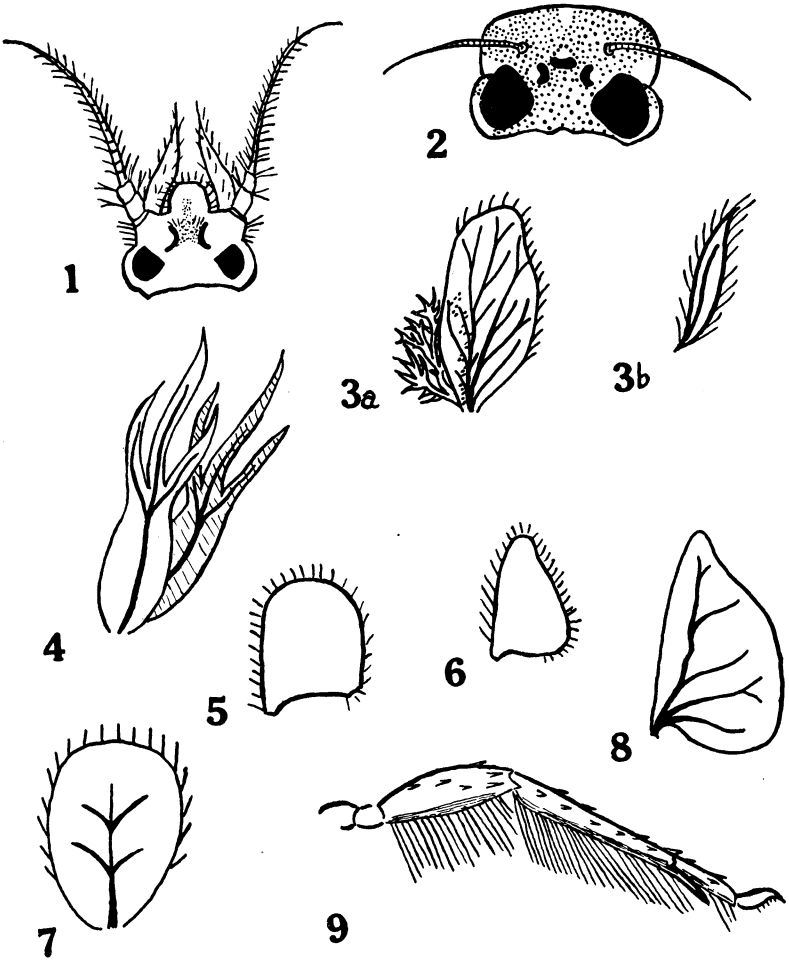
Subfamily Caeninae

Genus *Caenis* Stephens

Caenis nymphs were found only in areas ranging from

[5]Needham, Traver & Hsu, *The Biology of Mayflies,* 1935.

light silt to heavy mud. At Station 14 (which had about three feet of mud covered by one foot of very slow, turbid water) *Caenis* was dredged with burrowing nymphs. At Station 24 where the water was swift and clear, with only a light silt layer, *Caenis* nymphs were in abundance on the under sides of algae and silt-covered rocks. This genus has a wide habitat-range, compared with *Isonychia* (which I



EXPLANATIONS OF THE FIGURES

Figs. 1-9. 1. Head of nymph of *Hexagenia bilineata*. 2. Head of nymph of *Stenonema tripunctatum*. 3a. Third gill of *S. tripunctatum*. 3b. Seventh gill of *S. tripunctatum*. 4. Third gills of *Choroterpes*. 5. Elytroid gill of *Caenis*. 6. Elytroid gill of *Tricorythodes*. 7. Third gill of *Centroptilum album*. 8. Fourth gill of *Neocloeon*. 9. Foreleg of *Isonychia aurea*.

always found in swift water).

It was collected at Stations 1, 4, 9, 11, 13, 14, and 24.

Genus *Tricorythodes* Ulmer

Tricorythodes nymphs are sprawling forms very similar to those of *Caenis*. There is, however, a habitat difference: *Caenis* is usually found associated with silt, while *Tricorythodes* is usually associated with either fine sand or gravel in flowing water, or in moss or algal mats on stones. *Tricorythodes* was collected at Stations 9 and 10.

Subfamily Siphlonurinae

Genus *Isonychia* Eaton

Members of this genus are slender, streamlined forms, which typically inhabit swift-flowing, rocky streams. They are running forms which dart over the rocks, orienting their heads upstream, and catch floating algae and small insect larvae as they drift along. Morgan (1930) mentions their habit of taking this mixed diet, and considers it rare among mayflies.

Isonychia nymphs were collected at Stations 11 and 16. These were identified as *Isonychia aurea* Traver.

Subfamily Baetinae

Genus *Baetis* Leach

Baetis and the two following genera superficially resemble *Isonychia* in general body-outline; but scrutiny reveals many differences. *Baetis* is another very common inhabitant of swift streams in this area, notably where the sides of rocks are incrusted with algae. Their distribution was quite general; they were always found either present in great numbers, or entirely absent. Three species of *Baetis* were tentatively identified:

Baetis vagans McDunnough.—Found at Stations 1, 3, 4, 26, and 27.

Baetis cingulatus McDunnough.—Found only at Station 16.

Baetis parvus-brunneicolor group.—Stations 4, 9, 10, 16, 18, 24, and 25.

Genus *Centroptilum* Eaton

These nymphs are very similar in form to *Baetis*, and occupy identical habitats. *Centroptilum album* McDunnough was collected at Stations 16 and 25.

Genus *Neocloeon* Traver

Also similar to *Baetis* in form and habitat. Nymphs of this genus were collected at Station 15.

Addendum

Summary of Collections Made Outside Dallas, County.

I. Bell County. Salado Creek, north of Salado, Texas, U.S. Hwy. 81: swift, clear, shallow, cool water, stream with rocky bottom. Species identified:

Stenonema tripunctatum Banks
Choroterpes, sp.
Isonychia aurea Traver
Baetis parvus-brunneicolor group

II. Williamson County. Second channel of stream north of Georgetown, Texas, on U.S. Hwy. 81: shallow, swift, clear, cold water, rocky bottom. Species identified:

Stenonema tripunctatum Banks
Baetis cingulatus McDunnough
Thraulodes sp.
Choroterpes sp.
Baetis parvus-brunneicolor group

III. Travis County. Onion Creek, U.S. Hwy. 81: clear, shallow, slow, cold water, limestone bottom with many large stones and much algae. Species identified:

Stenonema birdi Traver
Stenonema tripunctatum Banks

IV. Hays County. The spring-fed San Marcos River, at San Marcos, Texas. Collections were made at various points from the ice house down to State Fish Hatchery: clear, swift water, temperature constant (70° F.), rocky bottom. Species identified:

Stenonema tripunctatum Banks
Traverella sp.
Isonychia aurea Traver
Thraulodes sp.
Tricorythodes sp.
Centroptilum album McDunnough

V. Hays County. Cypress Creek at Wimberly, Texas: clear, swift water, limestone bottom with large rocks, and much silt. Species identified:

Isonychia aurea Traver
Stenonema tripunctatum Banks

VI. Comal County. Comal River in Landa Park at New Braunfels, Texas: spring-fed stream, very swift, clear water at 70° F. Species identified:

Tricorythodes sp.

VII. Bexar County. First stream on Sulphur Springs road off U.S. Hwy. 87: shallow, swift clear water; gravel and silt bottom. Species identified:

Baetis sp.
Thraulodes sp.
Caenis sp.

VIII. Bexar County. Second stream on Sulphur Springs road off U.S. Hwy. 87: cold, clear, swift water; 24 inches deep; bottom rocky with much algae. Species identified:

Stenonema majus Traver
S. frontale
Baetis vagans McDunnough
Tricorythodes sp.

Summary and Conclusions

1. A study of stream-dwelling mayfly nymphs of Dallas County has been made (July 1949-March 1950), and bionomic notes presented.

2. The nine genera and twelve species listed for the county include: *Hexagenia bilineata* Say, *Stenonema birdi* Trauer, *S. candidum* Trauer *S. majus* Trauer, *S. proximum* Trauer, *S. pulchellum* Walsh, *S. terminatum* Walsh, *S. tripunctatum* Banks, *Choroterpes* sp., *Caenis* sp., *Tricorythodes* sp., *Isonychia aurea* Trauer, *Baetis vagans* McDunnough, *B. cingulatus* McDunnough, *B. parvus-brunneicolor* group, *Centroptilum album* McDunnough, *Neocloeon* sp. The species-listing

is incomplete since many forms cannot be identified to species on nymphal characters alone, and a lack of time prevented the rearing of these nymphs to adulthood.

3. *Hexagenia bilineata, Stenonema birdi, Choroterpes, Baetis, Caenis,* and *Tricorythodes* have been reported from Texas and Oklahoma, but as far as I can see, no one area has been systematically covered. All other listings here of species comprise new distributional records for the Southwest.

4. Among the stream-forms, the genus *Stenonema* was the most generally distributed, and was usually present in the greatest numbers.

5. Definite correlations between physical adaptations and habitat-preferences were observed and recorded.

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Note

BIRTHPLACE OF FERDINAND RUGEL (1806-79), EARLY SOUTHERN BOTANIST.——In my biographical sketch of Rugel (FIELD & LABORATORY, v. 16, 1948, pp. 113-19), I stated [following Urban, *Symbolae Antillanae,* v. 3, 1902, 115] that Rugel was born near Altdorf (present Weingarten) in Württemberg. Resumés of my paper appeared, by Prof. E. Bünning of the Botanical Institute of the University of Tübingen (*Schwaebisches Tagblatt,* 3 Aug., 1948) and Prof. Dr. Lehmann, also of Tübingen (*Pharmazeutische Zeitung,* 22 June, 1949.) These resumés elicited correspondence from *Apotheker* Paul Braun of Weingarten, who kindly looked up the records in the church books at Weingarten. Ferdinand Rugel's full name was "Ferdinand Ignatius Xavier Rugel," which clearly proclaims the Confession into which he was born. From these records it further appears that Rugel was not born at Weingarten, but at the village of Wolfegg on the Ach, some twelve kilometers east of Weingarten. The date of Rugel's birth was given as "December 24, 1806" both by Urban and the tombstone in the old Westminster graveyard near White Pine, Jefferson Co., Tenn. In my paper (p. 114), a *lapsus calami* gives the month of Rugel's birth as January instead of December, the obviousness of which error appears later (p. 117). Herr Braun of Weingarten informs me that the date of Rugel's birth given in the church records is December *17,* instead of December 24, 1806. A brother of the botanist was long burgomaster of Weingarten; and many members of the Rugel family still live in Weingarten.——S. W. GEISER, Professor of Biology, Southern Methodist University.