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A TABULAR SUMMARY OF THE BIOLOGY
OF NORTH AMERICAN MAYFLY
NYMPHS (EPHEMEROPTERA)

Lewis Berner



UNIVERSITY OF FLORIDA
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A TABULAR SUMMARY OF THE BIOLOGY OF NORTH AMERICAN MAYFLY NYMPHS (EPHEMEROPTERA)¹

LEWIS BERNER²

At the request of the Director of the Committee on the "Handbook of Biological Data", National Research Council, I compiled a summary of the biology of immature mayflies in tabular form. These tables were to have been a part of a larger compilation, "A Handbook of Aquatic Biology." However, the editors, after examining the contributions from many sources, reluctantly concluded that a suitable and adequate basis for a useful handbook on aquatic biology was lacking and cancelled plans for publication. Inasmuch as these tables represent the first compilation of this sort for mayfly nymphs, it was my feeling that they should be published for the use of biologists and students, even though the projected larger work will not appear.

The geographic divisions were chosen rather arbitrarily as a matter of convenience.³ All columns should be checked for distribution as some species may be listed for two or more geographic sections. No Mexican species are included as the data on the ephemeropteran fauna of this area are too fragmentary.

¹ The preparation of this paper was supported in part by Research Grant No. RG-4058 from the National Institutes of Health, Public Health Service.

² The author is Professor of Biological Sciences at the University of Florida, Gainesville. He is also a Research Associate of the Florida State Museum. Manuscript received 21 May 1958.—ED.

³ This footnote applies to all tables. The United States is divided into geographic areas as follows:

Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia (in part), West Virginia.

Southeast: North Carolina, South Carolina, Tennessee, Mississippi, Louisiana, Alabama, Georgia, Florida, Virginia (in part).

Central: Ohio, Kentucky, Michigan, Indiana, Wisconsin, Illinois, Arkansas, Missouri, Iowa, Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas.

Southwest: Colorado, New Mexico, Utah, Arizona, Nevada, California.

Northwest: Washington, Oregon, Idaho, Montana, Wyoming.

Canada is subdivided as follows:

East: Newfoundland, Nova Scotia, New Brunswick, Labrador, Quebec, Eastern Ontario.

Central: Western Ontario, Manitoba, Saskatchewan.

West: Alberta and British Columbia.

Only previously published records are included in the tabulation. The column headed "characteristics of nymphs" lists major generic characteristics and references to readily available illustrations.

The column on taxonomy includes the publication in which the genus was described, the name of the type species, and the type locality. Complete citations for most generic descriptions can be found in Edmunds and Allen (1957). As this paper is meant to be a summary of the biology of mayfly immatures, I do not believe that it is pertinent to include a key. Several good ones are available, the most recent being those of Day (1956), Pennak (1953), and Burks (1953). These keys include all except the most recent modifications in the systematics of the Ephemeroptera.

FAMILIES AND GENERA OF NORTH AMERICAN MAYFLIES
NORTH OF MEXICO^{4, 5}

Superfamily Heptagenioidea	Subfamily Anepeorinae
Family Siphonuridae	<i>Anepeorus</i> McDunnough
Subfamily Siphonurinae	Subfamily Pseudironinae
<i>Acanthametropus</i> Tshernova	<i>Pseudiron</i> McDunnough
<i>Ameletus</i> Eaton	Family Ametropodidae
<i>Edmundsius</i> Day	Subfamily Ametropodinae
<i>Parameletus</i> Bengtsson	<i>Ametropus</i> Albarda
<i>Siphonisca</i> Needham	Subfamily Metretopodinae
<i>Siphonurus</i> Eaton	<i>Metretopus</i> Eaton
Subfamily Isonychiinae	<i>Siphloplecton</i> Clemens
<i>Isonychia</i> Eaton	Family Baetidae
Family Oligoneuriidae	Subfamily Baetinae
Subfamily Oligoneuriinae	<i>Apobaetis</i> Day
<i>Homoeoneuria</i> Eaton	<i>Baetis</i> Leach
<i>Lachlania</i> Hagen	<i>Baetodes</i> Needham and Murphy
Family Heptageniidae	<i>Callibaetis</i> Eaton
Subfamily Heptageniinae	<i>Centroptilum</i> Eaton
<i>Arthroplea</i> Bengtsson	<i>Cloeon</i> Leach
<i>Cinygma</i> Eaton	<i>Neocloeon</i> Traver
<i>Cinygmula</i> McDunnough	<i>Paracloeodes</i> Day
<i>Epeorus</i> Eaton	<i>Pseudocloeon</i> Klapalek
<i>Heptagenia</i> Walsh	Superfamily Leptophlebioidea
<i>Rhithrogena</i> Eaton	Family Leptophlebiidae
<i>Stenonema</i> Traver	

⁴ Phylogenetic arrangement that of Edmunds and Allen (1957).

⁵ Georges Demoulin (1958) published a new classification of higher categories after my manuscript had gone to press. The citation is as follows: Nouveau schema de classification des Archodonates et des Ephéméroptères. Inst. Roy. des Sci. Natur. de Belg., Bull. XXXIV (27): 1-19.

- Subfamily Leptophlebiinae
 - Choroterpes* Eaton
 - Habrophlebia* Eaton
 - Habrophlebiodes* Ulmer
 - Leptophlebia* Westwood
 - Paraleptophlebia* Lestage
 - Thraulodes* Ulmer
 - Traverella* Edmunds
- Family Ephemerellidae
 - Subfamily Ephemerellinae
 - Ephemerella* Walsh
- Family Tricorythidae
 - Subfamily Leptohyphinae
 - Leptohyphes* Eaton
 - Tricorythodes* Ulmer
- Superfamily Caenoidea
 - Family Caenidae
 - Subfamily Caeninae
 - Brachycercus* Curtis
 - Caenis* Stephens
 - Family Neophemeridae
 - Subfamily Neophemerinae
 - Neophemera* McDunnough
- Superfamily Ephemeroidea
 - Family Potamanthidae
 - Subfamily Potamanthinae
 - Potamanthus* Pictet
 - Family Behningiidae
 - Dolania* Edmunds and Traver
 - Family Ephemeridae
 - Subfamily Ephemerinae
 - Ephemera* Linnaeus
 - Hexagenia* Walsh
 - Pentagenia* Walsh
 - Family Polymitarcidae
 - Subfamily Polymitarcinae
 - Ephoron* Williamson
 - Subfamily Campsurinae
 - Campsurus* Eaton
 - Tortopus* Needham and Murphy
- Superfamily Prosopistomatoidea
 - Family Baetiscidae
 - Subfamily Baetiscinae
 - Baetisca* Walsh

ACANTHAMETROPUS TSHERNOVA

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>pecatonica</i> (Burks)	o	o	x	o	o	o	o	o
Characteristics of Nymphs	Body streamlined. Head rounded, eyes lateral; a pair of short, submedian horns near the antennal bases. A pair of projecting, finger-like lobes on the lateral margins of pro- and mesonotum. A hook-like projection on each segment of thoracic sternum, and a median, dorsal, hook-like spur on each abdominal segment. Claws long and slender. Abdominal segments with a pair of acute projections at postero-lateral angles; 7 pairs of deeply fissured gills, each gill consisting of a dorsal member with a recurved, ventral flap and another ventral member. Three short caudal filaments. Body length 20 mm. or more. Illustration: Burks, 1953, fig. 312.							
Habitat of Nymphs	Rapid, shallow, moderate-sized streams with sand and rock bottoms. Apparently very rare as only a single specimen has been taken in North America.							
Life History	Unknown.							
Taxonomy	Tshernova, 1948. Dokladi Ak. Nauk. N. S. 60(8): 1453. Type species: <i>A. nikolskyi</i> Tshernova; type locality: Transbaikal, Amur Basin.							

AMELETUS EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>aequivocus</i> McDunnough	o	o	x	o	o	o	o	o
<i>alticolus</i> McDunnough	o	o	o	o	o	o	o	x
<i>amador</i> Mayo	o	o	o	x	o	o	o	o
<i>browni</i> McDunnough	o	o	o	o	o	x	o	o
<i>celer</i> McDunnough	o	o	o	o	o	o	o	x
<i>celeroides</i> McDunnough	o	o	o	o	o	o	o	x
<i>connectus</i> McDunnough	o	o	o	o	o	o	o	x
<i>connectina</i> McDunnough	o	o	o	o	o	o	o	x
<i>cooki</i> McDunnough	o	o	o	o	x	o	o	o
<i>dissitus</i> Eaton	o	o	o	x	o	o	o	o
<i>exquisitus</i> Eaton	o	o	o	o	x	o	o	o
<i>facilis</i> Day	o	o	o	x	o	o	o	o
<i>falsus</i> McDunnough	o	o	o	x	o	o	o	o
<i>imbellis</i> Day	o	o	o	x	o	o	o	o
<i>lineatus</i> Traver	x	o	x	o	o	o	o	o
<i>ludens</i> Needham	o	x	x	o	o	o	o	o

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>monta</i> Mayo	o	o	o	o	o	o	o	x
<i>oregonensis</i> Eaton	o	o	o	o	x	o	o	x
<i>querulus</i> McDunnough	o	o	o	o	o	o	o	x
<i>shepherdi</i> Traver	o	o	o	x	o	o	o	o
<i>similior</i> McDunnough	o	o	o	o	o	o	o	x
<i>sparsatus</i> McDunnough	o	o	o	o	x	o	o	x
<i>subnotatus</i> Eaton	o	o	x	o	o	o	o	x
<i>suffusus</i> McDunnough	o	o	o	o	o	o	o	x
<i>tertius</i> McDunnough	o	o	o	o	o	x	o	o
<i>tuberculatus</i> McDunnough	o	o	o	o	o	o	o	x
<i>validus</i> McDunnough	o	o	o	x	o	o	o	x
<i>vancouverensis</i> McDunnough	o	o	o	o	o	o	o	x
<i>velox</i> Dodds	o	o	x	x	o	o	o	x
<i>vernalis</i> McDunnough	o	o	o	o	o	o	o	x

Characteristics of Nymphs Body streamlined. Head rounded, eyes lateral; maxilla with broad crown bearing many long, pectinate spines. Prominent spines usually present at postero-lateral angles of abdominal segments 4-9. Seven pairs of platelike gills; single, oval, and small. Three caudal filaments, usually with a wide, dark, transverse band at middle and narrow, dark band at apex. Body length: 8-14 mm. Illustration: Day, 1956, fig. 3: 1.

Habitat of Nymphs Usually found in small, rapidly flowing streams where they live among pebbles or at banks, attached to vegetation or debris. Have been found in streams at altitudes as high as 11,000 feet. Sometimes found in lakes and ponds with clean rock or gravel bottoms.

Habits of Nymphs Strong swimmers; will swim in water flowing at rate of 2 to 3 feet per second, but seek quieter water before coming to rest on bottom.

Life History Probably takes one year to develop from egg to adult. Number of instars unknown. One species, *A. ludens*, demonstrated to be parthenogenetic. Emerges as early as February in southeast to August in Canada. Nymph leaves water to emerge. Eggs laid few at time, scattered. Eggs of some species laid in streams which become dry during part of year and can withstand dessication; eggs hatch after stream flow recommences.

Taxonomy Eaton, 1885. Trans. Linn. Soc. London. 2nd Ser. 3: 210. Type species: *A. subnotatus* Eaton; type locality: Colorado.

AMETROPUS ALBARDA

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>albrighti</i> Traver	o	o	o	x	o	o	o	o
<i>navet</i> McDunnough	o	o	o	o	o	o	o	x

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral; head very small; frontal margin cut away on each side almost to bases of antennae so that mouthparts are almost entirely exposed. Membranous flap extends upward and backward from posterior margin of the prosternum. Membranous appendage attached to inner margin of fore coxa; apical portion densely clothed with hairs; legs slender, fore leg shortest. Tarsal claw of fore leg slender and slightly curved, bearing 4 or 5 long spines; similar spines on tarsus and tibia. Claws of middle and hind legs longer and straighter, each fully as long as tarsus and about twice length of tibia. Flattened lateral extensions on abdominal segments 2-9, with short postero-lateral spines on segments 8 and 9. Gills single, obovate. Three caudal filaments; median filament with heavy fringe of hairs on both sides, laterals heavily fringed on inner margins. Maximum body length at least 17 mm. Illustration: Needham, Traver and Hsu, 1935, pl. XXXV.

Habitat of Nymphs In streams, on bottom amid rocks and sand. Only nymphs recorded from North America taken at altitude of 5400 feet.

Life History Unknown. An adult taken in July.

Taxonomy Albarda, 1878. Ent. Mo. Mag. 15: 129. Type species: *A. fragilis* Albarda; type locality: Arnhem, Holland.

ANEPEORUS McDUNNOUGH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>rusticus</i> McDunnough	o	o	o	x	o	o	o	o
<i>simplex</i> (Walsh)	x	o	x	o	o	o	o	o

Characteristics of Nymphs Body flattened. Head flattened; eyes dorsal, located near posterior margin of head; mouthparts those of predator; mandibles with long, slender incisors, molar surfaces absent. Legs flattened; dense fringe of long hairs along posterior margins of femora and middle and hind tibiae; claws long and slender. Abdomen flattened dorso-ventrally and broad; tergites covered with dense, woolly hairs. Gills ventral, composed of numerous filaments radiating out from a central plate. Three caudal filaments of approximately equal length. Caudal filaments rela-

tively bare. Body length: probably 6-8 mm. Illustration: Burks, 1953, fig. 394.

Habitat of Nymphs	Unknown.
Habits of Nymphs	Unknown.
Life History	Unknown. Adults have been collected June, July, and September.
Taxonomy	McDunnough, 1925. Can. Ent. 57: 190. Type species: <i>A. rusticus</i> McDunnough; type locality: Saskatoon, Saskatchewan.

APOBAETIS DAY

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>indepressus</i> Day	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body rounded; head rounded; eyes lateral; labrum with a straight, unmodified anterior margin; labial palp with 2 segments, distal margin of terminal segment squarely truncate and set with stiff spines, a sharp and V-shaped slot on inner apical margin. Tarsal claws of all legs very long and fine, fully as long as tarsus, almost straight, and without denticles. Gills ovate and single. Three caudal filaments; median filament often as long as laterals. Middle filament heavily margined with fine hairs on each side, and lateral filaments heavily margined with hairs on medial side. Body length: 4 mm. Illustration: not illustrated in full; parts in Day, 1955, figs. 1-6.

Habitat of Nymphs Warm-water species from a river which has been dredged, diverted, dammed, and partially polluted from irrigation runoff, crop dusting, sewage, and industry. One collection indicated water temperatures as high as 82 degrees. Found in small groups over widely scattered areas, occurring at depths of 18-24 inches in rather fast-flowing water over fine sand.

Life History Length of time required for development unknown. Adults have been reared in August.

Taxonomy Day, 1955. Pan-Pacific Ent. 31(3): 127. Type species: *A. indepressus* Day; type locality: Tuolumne River, Stanislaus County, California.

ARTHROPLEA BENGTTSSON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>bipunctata</i> McDunnough	o	x	o	o	o	x	o	o
Characteristics of Nymphs	Head strongly depressed; eyes dorsal; maxillary palp unique in its extreme length, being more than 6 times as long as galealacinia, curved and provided with long movable setae arranged in 2 rows, forming basket-like apparatus. Normally, maxillary palps held extended posteriorly over the thoracic notum. Tarsal claws short and stout at base. Pair of single gills present on each of first 7 abdominal segments; each gill platelike and pointed at apex. Three caudal filaments. Body length: 7.5-9.5 mm. Illustration: Burks, 1953, fig. 395.							
Habitat of Nymphs	Nymphs recorded in vegetation along edge of millpond and in a deep, rock pool at edge of a stream, where they were seen crawling on vegetation; appears well adapted to living in quiet waters.							
Taxonomy	Bengtsson, 1908. Kungliga Svenska Vetenskapsakademien Arsbok 6: 239. Type species: <i>A. congener</i> Bengtsson; type locality: Värmland, Sweden.							

BAETISCA WALSH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>bajkovi</i> Neave	o	o	x	o	o	o	x	o
<i>callosa</i> Traver	o	x	o	o	o	x	o	o
<i>carolina</i> Traver	x	o	o	o	o	x	o	o
<i>escambiensis</i> Berner	x	o	o	o	o	o	o	o
<i>gibbera</i> Berner	x	o	o	o	o	o	o	o
<i>lacustris</i> Clemens	o	o	x	o	o	x	x	o
<i>laurentina</i> McDunnough	o	o	x	o	o	x	o	o
<i>obesa</i> (Say)	x	x	x	x	o	o	o	o
<i>rogersi</i> Berner	x	o	o	o	o	o	o	o
<i>rubescens</i> Provancher	o	o	o	o	o	x	o	o

Characteristics of Nymphs Stout bodied. Unique among American genera in possessing large mesonotal shield, or carapace, completely covering dorsum of meso- and metathorax and abdominal segments 1-5 as well as basal half of 6; apical margin fits into pyramidal elevation on tergite 6; shield often with prominent lateral spines. Gills present on segments 2-6 and enclosed in gill chamber covered by shield. Head frequently bears prominent frontal projections and spinous projections from the anterior angle of the genae. Legs short; tarsal claws rather long and slender, curved, sharp at

the tip, not denticulate. Postero-lateral spines usually well developed on abdominal segments 6-9. Three caudal filaments; short, approximately equal in length. Body length: 4-13 mm. Illustration: Berner, 1950, pl. XI.

Habitat of Nymphs	In small to moderate-sized streams and along the edges of lakes where there is some wave action. Nymphs live partially buried in sand in lee of rocks or gravel or in pebbly riffles where they are somewhat protected. One species in quiet waters near or at banks of slow-flowing streams. Other species partially buried on sandbars where there is a slight mixture of silt and sand. Chiefly herbivorous.
Habits of Nymphs	When quiet, often hold caudal filaments over abdomen. Swim by pulling legs under body, drawing together and depressing tails and rapidly vibrating the posterior portion of body. Swim in short spurts. When nymphs come to rest, spread legs and seize some supporting object. When at rest on sand, often have their body partially covered and become so well concealed that they are difficult to detect against background.
Life History	Probably require one year to complete development. When ready to emerge nymphs crawl out of water onto any object protruding above surface. Emerge at almost any time of day, but most often in morning. Subimagal life lasts from 18-52 hours.
Taxonomy	Walsh, 1862. Proc. Acad. Nat. Sci. Philad. p. 378. Type species: <i>B. obesa</i> (Say); type locality: Rock Island, Illinois.

BAETIS LEACH.

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>adonis</i> Traver	o	o	o	x	o	o	o	o
<i>akataleptos</i> McDunnough	o	o	o	o	o	o	o	x
<i>alius</i> Day	o	o	o	x	o	o	o	o
<i>amplus</i> Traver	x	o	o	o	o	o	o	o
<i>anachris</i> Burks	o	o	x	o	o	o	o	o
<i>australis</i> Traver	x	o	o	o	o	o	o	o
<i>baeticatus</i> Burks	o	o	x	o	o	o	o	o
<i>bicaudatus</i> Dodds	o	o	o	x	o	o	o	o
<i>brunneicolor</i> McDunnough	o	o	x	o	o	x	o	o
<i>caurinus</i> Edmunds and Allen	o	o	o	o	x	o	o	o
<i>cingulatus</i> McDunnough	x	x	o	o	o	x	o	o
<i>cleptis</i> Burks	o	o	x	o	o	o	o	o
<i>curiosus</i> (McDunnough)	x	x	o	o	o	x	o	o
<i>devinctus</i> Traver	o	o	o	x	o	o	o	o
<i>diablus</i> Day	o	o	o	x	o	o	o	o

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>elachistus</i> Burks	0	0	x	0	0	0	0	0
<i>endymion</i> Traver	0	0	x	0	0	0	0	0
<i>ephippiatus</i> Traver	x	0	0	0	0	0	0	0
<i>erebus</i> Traver	0	0	0	x	0	0	0	0
<i>flavistriga</i> McDunnough	x	x	0	0	0	x	0	0
<i>foemina</i> McDunnough	0	0	0	0	0	x	0	0
<i>frivolus</i> McDunnough	0	0	x	0	0	x	0	0
<i>frondalis</i> McDunnough	x	0	x	0	0	x	0	0
<i>harti</i> McDunnough	0	0	x	0	0	0	0	0
<i>herodes</i> Burks	0	0	x	0	0	0	0	0
<i>hiemalis</i> Leonard	0	0	x	0	0	0	0	0
<i>hudsonicus</i> Ide	0	0	0	0	0	0	x	0
<i>insignificans</i> McDunnough	0	0	0	x	x	0	0	x
<i>intercalaris</i> McDunnough	x	x	x	0	0	x	0	0
<i>intermedius</i> Dodds	0	0	0	x	0	0	0	0
<i>jesmondensis</i> McDunnough	0	0	0	0	0	0	0	x
<i>lapponica</i> (Bengtsson)	0	0	0	0	0	x	0	0
<i>leechi</i> Day	0	0	0	x	0	0	0	0
<i>levitans</i> McDunnough	x	x	0	0	0	x	0	0
<i>macdunnoughi</i> Ide	0	0	0	0	0	x	0	0
<i>moffati</i> Dodds	0	0	0	x	0	0	0	0
<i>nanus</i> McDunnough	0	0	0	0	0	x	0	0
<i>ochris</i> Burks	0	0	x	0	0	0	0	0
<i>palisadi</i> Mayo	0	0	0	x	0	0	0	0
<i>pallidulus</i> McDunnough	0	0	x	0	0	0	0	0
<i>parallelus</i> Banks	0	0	0	x	0	0	0	0
<i>parvus</i> Dodds	x	0	0	x	x	x	0	x
<i>persecuta</i> McDunnough	0	0	0	0	0	0	0	x
<i>phoebus</i> McDunnough	0	0	0	0	0	x	0	0
<i>phyllis</i> Burks	0	0	x	0	0	0	0	0
<i>piscatoris</i> Traver	0	0	0	x	0	0	0	0
<i>pluto</i> McDunnough	0	x	0	0	0	x	0	0
<i>posticatus</i> (Say)	0	x	0	0	0	0	0	0
<i>propinquus</i> (Walsh)	x	0	x	0	0	0	x	0
<i>pygmaeus</i> (Hagen)	0	x	x	0	0	x	0	0
<i>quilleri</i> McDunnough	0	0	0	x	0	0	0	0
<i>rusticans</i> McDunnough	0	x	0	0	0	x	0	0
<i>spinosus</i> McDunnough	x	x	x	0	0	x	x	0
<i>spiethi</i> Berner	x	0	0	0	0	0	0	0
<i>sulfurosus</i> Day	0	0	0	x	0	0	0	0
<i>thermophilus</i> McDunnough	0	0	0	x	x	0	0	0
<i>tricaudatus</i> Dodds	0	0	0	x	0	0	0	0
<i>unicolor</i> (Hagen)	0	x	0	0	0	0	0	0
<i>vagens</i> McDunnough	0	x	x	0	0	x	0	0

Characteristics of Nymphs Body slender, streamlined. Head rounded; eyes lateral; a narrow but distinct median notch on the apical margin of labrum; distal joint of labial palp rounded; tarsal claws with numerous fine denticles on inner margins. Gills present on segments 1-7, single on all segments; in most species gills obovate, but in some those of segments 6 and 7 may be narrow and lanceolate. In most species, 3 caudal filaments; in a few only 2 with a vestige of median. In species with 3 tails, the middle shorter and weaker than laterals. Body length: 3-7 mm. Illustration: Berner, 1950, pl. XXII.

Habitat of Nymphs Usually live in shallow, flowing water. Most commonly found under stones and rocks, among debris, or in vegetation along banks of creeks or rivers. Depending on species, nymphs are capable of living in water ranging from relatively quiet and slow-flowing to that which is virtually torrential. A few species live at lake shores where there is continuous wave action. Some species are highly tolerant to high temperatures, especially in southeast; others severely restricted to colder mountain or northern streams.

Habits of Nymphs Swim easily and readily. When nymphs stop, seize some area of attachment with their claws, raise abdomen well above support. Gills held close to and over abdomen in some species; in others, gills held out from abdomen. When stimulated to move, nymphs dart in short spurts from one spot to another by rapidly flipping caudal filaments up and down. In those species with 3 caudal filaments, hairs on filaments overlap to form effective organ for rapid swimming. Cling closely to resting places, heading upstream, abdomen swinging from side to side in current. Nymphs crawl slowly over surface of leaves or rocks searching for bits of food. Positive rheotropic orientation maintained regardless of whether nymph is on upper or underside of support. Feeding appears to be entirely herbivorous.

Life History In Florida, adults of *Baetis* emerge throughout year. Farther north season much more restricted with principal emergence occurring during summer months. Time required for nymphs to mature in various parts of North America varies with area. Undoubtedly, in warmer portions may be more than 2 generations per year; in warmer streams of colder, more northern portions of range, may be as many as 2 generations in the same season. Females have been observed ovipositing by alighting on a partially submerged stone, wrapping wings around the abdomen, and crawling into the water. Once below water surface, eggs are glued over the stone. Eggs hatch in laboratory in 28 days. Life history in more northern portion of range may take from 6 to 9 months. One species has been shown to pass through 27 instars. Emergence occurs during daylight hours; time of emergence varies with species and with season.

Subimagal life may last from 7 to 12 hours. When ready for emergence, nymph floats at surface of water and almost immediately subimago bursts free; whole process takes 5-10 seconds.

Taxonomy Leach, 1815. Brewst. Edinb. Encycl. 9: 137. Type species: *B. bioculatus* (Linnaeus); type locality: Europe.

BAETODES NEEDHAM AND MURPHY

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
species ?	o	o	x	o	o	o	o	o
Characteristics of Nymphs	Body streamlined. Head rounded; eyes lateral. Tarsal claws short and stout, bearing a series of coarse teeth. Ventrally-directed gills present on segments 1-5 only; usually with a row of median, raised projections on the middle abdominal tergites. Two caudal filaments; median filament reduced to stub; lateral tails bare of hairs, or, at most, with only a few inconspicuous setae. Body length: 7-8 mm. Illustration: Traver, 1944, fig. 11.							
Habitat of Nymphs	In very swift rapids in moderate-sized streams where they cling to rocks and vegetation.							
Life History	Unknown. No adults recorded from North America.							
Taxonomy	Needham and Murphy, 1924. Bull. Lloyd Library. 24 (Ent. ser. 4): 55. Type species: <i>B. serratus</i> Needham and Murphy; type locality: Tijuca, Rio de Janeiro, Brazil.							

BRACHYCERCUS CURTIS

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>flavus</i> Traver	o	o	x	o	o	o	o	o
<i>lacustris</i> (Needham)	o	x	x	o	o	x	o	o
<i>maculatus</i> Berner	x	o	o	o	o	o	o	o
<i>nitidus</i> (Traver)	x	o	o	o	o	o	o	o
<i>prudens</i> (McDunnough)	o	o	x	o	o	o	x	o
species ?	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body flattened, broad. Head rounded; eyes lateral; head with 3 tubercles. No hind wing pads present. Fore legs relatively short; middle and hind legs longer; claws long and slender. Dorsal surface of the abdomen depressed; lateral margins of abdominal segments produced as broad, flat, bladeliike projections. A pair of single, filamentous gills on 1st abdominal segment; gills on segment 2 operculate and semiquadrate; gills on segments 3-6 single; margins of each gill with a fringe of long

filaments. Operculate gills mostly covering the gills posterior to them. Three caudal filaments. Body length: 3-8 mm. Illustration: Berner, 1950, pl. XVIII.

Habitat of Nymphs	In flowing streams where they live close to edge on sand with a very thin overburden of silt. Most frequently occur where water is 3 or 4 inches deep; however, they have been taken from water as deep as 20 feet in sandy rivers where they apparently live partially buried in silt accumulated behind sandy ridges formed on stream bed. Nymphs have also been taken from shores of lakes.
Habits of Nymphs	When taken from water scarcely move, probably because of their long, spindly legs and attenuated claws. Nymphs flick tails over the abdomen when they walk. In the natural habitat are partially covered by silt.
Life History	Time required for nymphal development has not been determined. There is some likelihood that in the extreme southeast adults emerge throughout the year; farther north emergence restricted to warmer months of summer. Emergence in Canada has been recorded as late as early September. Emergence of subimago probably occurs after dark. The time required for subimaginal molt is unknown, but adult life is very brief, lasting only a few hours.
Taxonomy	Curtis, 1834. London Edin. Philos. Mag. s. 3,4: 122. Type species: <i>B. harrisella</i> Curtis; type locality: England.

CAENIS STEPHENS

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>amica</i> Hagen	x	x	o	o	o	o	o	o
<i>anceps</i> Traver	o	x	x	o	o	o	o	o
<i>delicata</i> Traver	o	o	x	o	o	o	o	o
<i>diminuta</i> Walker	x	o	o	o	o	x	o	o
<i>forcipata</i> McDunnough	o	x	x	o	o	x	x	o
<i>gigas</i> Burks	o	o	x	o	o	o	o	o
<i>hilaris</i> (Say)	x	x	x	o	o	o	o	o
<i>jacosa</i> McDunnough	x	x	x	o	o	x	o	o
<i>latipennis</i> Banks	o	x	o	o	x	x	x	o
<i>punctata</i> McDunnough	o	x	o	o	o	x	o	o
<i>ridens</i> McDunnough	o	o	x	o	o	x	o	o
<i>simulans</i> McDunnough	o	x	x	x	x	x	x	x
<i>tardata</i> McDunnough	o	o	o	o	o	o	x	x

Characteristics of Nymphs Body somewhat flattened, chunky. Head rounded; eyes lateral; apical margin of labrum slightly concave. No hind wing pads present. Fore legs somewhat shorter than the middle and hind

legs; tarsal claws slender, somewhat curved apically. First abdominal segment with a pair of prominent, single, filamentous gills. Gills on 2nd segment single, quadrate and operculate. Gills on segments 3-6 single, and platelike, each gill having margins deeply fissured to produce marginal fringe of long filaments; each filament is secondarily divided along tip to produce 2 or 3 smaller filaments. Postero-lateral spines on middle abdominal segments present, not upcurved. Three caudal filaments; a whorl of setae at each joint. Body length: 2-7 mm. Illustration: Berner, 1950, pl. XVII.

Habitat of Nymphs	Usually inhabitants of quiet or stagnant water, although some species develop in streams. A common pond form; nymphs develop on pond bottom in the zone of rooted vegetation. May also be found among accumulations of leaf debris and trash. In streams can be found at banks where they dwell close to bases of plants in silt which accumulates there. Some species occur among exposed, well-washed roots of terrestrial plants along the margins of streams, but even here they are very close to substrate. Species that dwell in streams can sometimes be found in riffles or on sticks, leaves, or other debris that may be anchored in flowing water. Nymphs of some species rather tolerant of considerable amounts of pollution. Even very small bodies of fresh water serve as habitats of <i>Caenis</i> ; nymphs having been found in puddles left behind by recession of flooded streams. Sometimes found at edges of lakes which are overgrown with vegetation. Probably the most tolerant of North American nymphs to stagnant water conditions.
Habits of Nymphs	Omnivorous, feeding chiefly on plant material, but sometimes feeding on dead nymphs or on other organic material that may come their way. When taken from water, nymphs crawl slowly with a wriggling motion.
Life History	In Florida, <i>C. diminuta</i> has been reared in a period of 4 months. Time required for hatching eggs of <i>C. diminuta</i> varied from 5 days to 11 days. Apparently, the difference in time required dependent on time of year in which eggs were laid. Some indication that eggs of fall and winter broods hatch much more rapidly than those of spring. Number of nymphal instars not determined. Emergence occurs in afternoon or at night. When ready to transform nymphs float at the surface in shallow water. Subimago bursts free from the nymphal skin and then takes flight. Resting on some support almost immediately molts to imago stage. Molt occurs approximately 5 to 6 minutes after emergence. The adults live 3 to 4 hours. Subimagoes and adults are strongly positively phototropic. In more northern part of range, species emerge chiefly in June and July with sporadic emergences occurring in May and September.

Taxonomy Stephens, 1835. Ill. Brit. Ent. 6: 61. Type species: *C. macura* Stephens; type locality: London, England.

CALLIBAETIS EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>americanus</i> Banks	o	x	o	x	x	x	o	o
<i>brevicostatus</i> Daggy	o	o	x	o	o	o	o	o
<i>californicus</i> Banks	o	o	o	x	o	o	o	o
<i>carolus</i> Traver	o	o	o	x	o	o	o	o
<i>coloradensis</i> Banks	o	o	o	x	o	o	o	o
<i>doddsi</i> Traver	o	o	o	x	o	o	o	o
<i>ferrugineus</i> (Walsh)	o	x	x	o	o	o	o	o
<i>floridanus</i> Banks	x	o	o	o	o	o	o	o
<i>fluctuans</i> (Walsh)	o	x	x	o	o	o	o	o
<i>fuscus</i> Dodds	o	o	o	x	x	o	o	o
<i>hageni</i> Eaton	o	x	o	x	x	x	o	o
<i>hebes</i> Upholt	o	o	o	x	o	o	o	o
<i>montanus</i> Eaton	o	o	x	x	o	o	o	o
<i>nigritus</i> Banks	o	o	o	x	x	o	o	o
<i>pacificus</i> Seemann	o	o	x	x	x	o	o	o
<i>pallidus</i> Banks	o	o	o	x	o	o	o	o
<i>pictus</i> (Eaton)	o	o	x	x	o	o	o	o
<i>pretiosus</i> Banks	x	x	o	o	o	o	o	o
<i>semicostatus</i> Banks	o	o	o	x	o	o	x	o
<i>signatus</i> Banks	o	o	o	x	o	o	o	o
<i>skokianus</i> Needham	o	x	x	o	o	x	o	o
<i>traverae</i> Upholt	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral. Tarsal claws long and slender, provided with a row of minute, ventral denticles. Seven pairs of abdominal gills; sheetlike and slightly undulated with a dense net of pinnately branched tracheae; 1st and 2nd pairs of gills double, with ventral member often bearing secondary recurved, ventral flap; gill 7 either with or without recurved flap. Three caudal filaments about equal in length and thickness; median filament fringed on both sides with long setae; lateral filaments fringed on medial side only. Body length: 6-10 mm. Illustration: Berner, 1950, pl. XIX.

Habitat of Nymphs In still water such as permanent ponds, roadside ditches, margins of lakes, or in transient pools in which water has remained for several weeks where nymphs climb amid vegetation. Show very wide limits of toleration. In some places where they occur in great abundance, water may be choked with vegetation; in others, vegetation may be very sparse. Temperature of water in which nymphs occur may sometimes rise to 90 degrees in

southern portion of Florida, while in northern part of its range temperature may be far below this. Nymphs appear to be very tolerant of acidity and alkalinity of water and one species has been reported from brackish water. Occasionally, nymphs are found on vegetation in backwaters of streams or along the margins where there is virtually no flow.

Habits of Nymphs	Among most graceful of all mayfly immatures. With body arched, insects hang from plant stem and blend almost perfectly with background. When disturbed, dart rapidly away by rapid flicks of caudal filaments. When collected and placed against a white background, nymphs hop about much like small minnows when attempts are made to lift them. Herbivorous, feeding on algae and diatoms.
Life History	Certain species require 6 weeks for development. Eggs are retained and develop within body of mother for a period of 5 to 6 days. Usually 450-500 eggs in each female. When ready to deposit young, female drops onto surface of water and releases all of them. Eggs hatch immediately upon being released; young search for vegetation to which to become attached. Number of molts has not been determined. Emergence of adults usually occurs in afternoon. Subimaginal molt takes place 7-9 hours after emergence. Females have been kept alive as long as 13 days in the laboratory. Male adults were seen mating with subimaginal females on one occasion.
Taxonomy	Eaton, 1881. Ent. Mo. Mag. 17: 196. Type species: <i>C. pictus</i> (Eaton); type locality: Texas.

CAMPSURUS EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>decoloratus</i> (Hagen)	o	o	x	o	o	o	o	o

Characteristics of Nymphs	Mandible with an external tusk projecting forward and visible from above head. Front of head rounded, lacking frontal process. Row of spines on outer edge of mandibular tusks and about 8 or 9 saw-like teeth on inner edge with proximal tooth being the largest. Legs fossorial; fore tibia broadened and flattened for digging. Seven pairs of abdominal gills; 1st gill bilobed, small, rudimentary, one lobe much smaller than the other. Remaining 6 pairs of gills larger, normal, bilobed, and fringed with long filaments. Three caudal filaments, median about 1½ times as long as laterals. Illustration: Needham and Murphy, 1924, pl. IV.
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Habitat of Nymphs	Unknown. Probably develops in larger rivers.
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Life History	Unknown.
Taxonomy	Eaton, 1868. Ent. Mo. Mag. 5: 83. Type species: <i>C. latipennis</i> (Walker); type locality: Para, Brazil.

CENTROPTILUM EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>album</i> McDunnough	o	o	o	o	o	x	o	o
<i>asperatum</i> Traver	o	o	o	x	o	o	o	o
<i>bellum</i> McDunnough	o	o	o	o	o	x	o	o
<i>bifurcatum</i> McDunnough	o	o	o	o	x	o	o	x
<i>calinosum</i> McDunnough	o	o	o	o	o	x	o	o
<i>conturbatum</i> McDunnough	o	o	o	x	x	o	o	x
<i>convexum</i> Ide	o	o	o	x	o	x	o	o
<i>elsa</i> Traver	o	o	o	o	x	o	o	o
<i>fragile</i> McDunnough	o	x	o	o	o	x	o	o
<i>hobbsi</i> Berner	x	o	o	o	o	o	o	o
<i>infrequens</i> McDunnough	o	o	o	o	o	o	x	o
<i>intermediale</i> McDunnough	o	o	o	o	o	x	o	o
<i>oreophilum</i> Edmunds	o	o	o	x	o	o	o	o
<i>ozburni</i> McDunnough	o	x	o	o	o	x	o	o
<i>quaesitum</i> McDunnough	o	o	x	o	o	o	o	x
<i>rivulare</i> Traver	o	o	x	o	o	o	o	o
<i>rufostrigatum</i> McDunnough	o	o	x	o	o	x	x	o
<i>selanderoum</i> Edmunds	o	o	o	x	o	o	o	o
<i>semirufum</i> McDunnough	o	o	o	o	o	x	o	o
<i>simile</i> McDunnough	o	x	o	o	o	x	o	o
<i>venosum</i> Traver	o	o	o	x	o	o	o	o
<i>victoriae</i> McDunnough	o	o	o	o	o	x	o	o
<i>viridocularis</i> Berner	x	o	o	o	o	o	o	o
<i>walshi</i> McDunnough	o	o	x	o	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral; labial palp 3 segmented, distal segment dilated and truncate apically. Tarsal claws long and slender, usually not denticulate. Abdominal gills platelike and usually single on all segments; in some species, gills of basal segments may have a recurved, dorsal flap. Three caudal filaments; median as long as laterals; median filament with long hairs on both sides; laterals with long hairs on medial side. Body length: 4-8 mm. Illustration: Berner, 1950, pl. XXIII.

Habitat of Nymphs Some species live among lily pads and pond weeds in quiet portions of streams; other species occur in moderately swift water on upper surfaces of stones or on vegetation. Although nymphs are tolerant of very slow flowing water, they do not inhabit

ponds, but may be found along edges of lakes where there is wave action. One species from Florida is confined to streams which are alkaline with pH between 7.3 and 8.0.

Habits of Nymphs	When live nymphs are placed in water, tails are depressed slightly at tips. Swim easily by rapidly flicking abdomen and holding tails stiffly out from body. Nymphs are very active. When taken out of water, hop about, flipping abdomen like a small minnow. Food is made up of plant material.
Life History	Length of nymphal life not determined, but probably requires 6 to 9 months. Emergence takes place generally in late afternoon. Subimagal molt within 10 to 12 hours after emergence. Some evidence indicates that time interval of later instars is between 3 and 5 days.
Taxonomy	Eaton, 1869. Ent. Mo. Mag. 6: 132. Type species <i>C. luteolum</i> (Müller); type locality: Europe.

CHOROTERPES EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>albiannulata</i> McDunnough	o	o	o	o	o	o	o	x
<i>basalis</i> (Banks)	o	x	x	o	o	x	o	o
<i>ferruginea</i> Traver	o	x	o	o	o	o	o	o
<i>fusca</i> Spieth	o	x	o	o	o	x	o	o
<i>hubbelli</i> Berner	x	o	o	o	o	o	o	o
<i>inornata</i> Eaton	o	o	o	x	o	o	o	o
<i>nanita</i> Traver	o	o	x	o	o	o	o	o
<i>oklahoma</i> Traver	o	o	x	o	o	o	o	o
<i>terratoma</i> Seemann	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body somewhat depressed. Head depressed; eyes dorsal; labrum widened and deeply emarginate. Tarsal claws with row of minute blunt denticles. Gills on segment 1 single and unbranched, linear-lanceolate; remaining gills double, lamelliform, each lamella having a spatulate terminal extension. Three caudal filaments; median filament longer than laterals; hairs present on both sides of filaments, but relatively short and inconspicuous. Body length: 5-8 mm. Illustration: Berner, 1950, pl. X.

Habitat of Nymphs In crevices on underside of rocks, logs, or sticks anchored in streams; may also be found in more slowly-flowing portions of streams where they live among accumulations of leaves intermixed with silt. Nymphs also known from margins of lakes where there is some wave action; here nymphs also occupy crevices on underside of firmly anchored objects.

Habits of Nymphs Negatively phototropic and strongly thigmotactic. Gills held above and close to abdomen, where they are frequently vibrated. The nymphs appear to be herbivorous.

Life History Time required for nymphal development unknown; may take from 6 months to 1 year, depending on part of country in which species occurs. Transformation from nymphal to adult stage occurs after dark. Nymph, when ready to emerge, swims vigorously to surface, subimago bursts free, floats for a moment on exuviae, then flies to nearby support. Subimaginal life lasts from 8-10 hours. In Florida emergence occurs throughout year, reaching peak during spring and early summer. Farther north, emergence occurs from July to early September. *C. oklahoma* adults were collected on March 20.

Taxonomy Eaton, 1881. Ent. Mo. Mag. 17: 194. Type species: *C. picteti* Eaton; type locality: Geneva, Switzerland.

CINYGMA EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>dimicki</i> McDunnough	o	o	o	o	x	o	o	o
<i>integrum</i> Eaton	o	o	o	o	x	o	o	x
<i>lyriformis</i> McDunnough	o	o	o	o	o	o	o	x
species ?	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body flattened. Head flattened; eyes dorsal. Femora flattened; tarsal claws relatively short and stout at base, each claw with 2 or 3 teeth near tip. Seven pairs of gills, each gill composed of broad, platelike, dorsal element and small ventral tuft of filaments; gills do not extend over abdominal sternites; 1st gill decidedly smaller than other 6 pairs. Three tails of approximately equal length. Body length: 12 mm. Illustration: not illustrated in full; parts in McDunnough, 1933, pl. 2.

Habitat of Nymphs In Sierra Nevada Mountains occur at altitude of 3,000 to 7,000 feet in moderately fast water; nearly always clinging to wood and bark of dark color.

Life History Unknown. Adults have been recorded from early May to late July.

Taxonomy Eaton, 1885. Trans. Linn. Soc. London: 2nd Ser. 3: 247. Type species: *C. integrum* Eaton; type locality: Washington Territory and Mount Hood, Oregon.

CINYGMULA McDUNNOUGH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>confusa</i> McDunnough	o	o	o	o	o	o	o	x
<i>gartrelli</i> McDunnough	o	o	o	o	o	o	o	x
<i>kootenai</i> McDunnough	o	o	o	x	o	o	o	x
<i>mimus</i> (Eaton)	o	o	o	x	x	o	o	x
<i>par</i> (Eaton)	o	o	o	x	o	o	o	x
<i>ramaleyi</i> (Dodds)	o	o	o	x	o	o	o	x
<i>reticulata</i> McDunnough	o	o	o	o	x	o	o	o
<i>subaequalis</i> (Banks)	x	x	o	o	o	x	o	o
<i>tarda</i> McDunnough	o	o	o	x	x	o	o	x
<i>tioga</i> Mayo	o	o	o	x	o	o	o	o
<i>uniformis</i> McDunnough	o	o	o	x	o	o	o	x

Characteristics of Nymphs Body depressed. Head flattened; eyes dorsal. Femora somewhat depressed; tarsal claws short, stout, and with 3 to 5 minute, ventral teeth. Pair of gills on each of first 7 abdominal segments; gills similar on all segments, each being platelike with fibrillar portion reduced to 2 or 3 filaments; gills do not extend beneath venter. Three caudal filaments; median slightly longer than laterals. Body length: 7-11 mm. Illustration: not illustrated in full; parts in McDunnough, 1933, pl. 3.

Habitat of Nymphs Often one of commonest nymphs; live under stones in all parts of stream. In Colorado, have been found in some of higher streams and lakes (8,000-11,000 feet) which have clean, rocky bottoms. Wide distribution in both streams and lakes may be due to constant conditions existing under stones in both streams and lakes. Little or no current beneath rocks, and oxygen content about the same in the two environments. In streams of California, nymphs have been found in water only 1 or 2 inches deep at foot of water falls; live in crevices, and on lower surfaces of small stones in streams of redwood belt of Coast Range and Sierra Nevadas.

Life History Unknown. Adults have been taken as early as April in Southeast and as late as mid-August in Northwest and in Canada.

Taxonomy McDunnough, 1933. Can. Ent. 65: 75. Type species: *C. ramaleyi* (Dodds); type locality: Tolland, Colorado.

CLOEON, LEACH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>implicatum</i> McDunnough	o	o	o	o	o	o	o	x
<i>inanum</i> McDunnough	o	o	o	o	o	o	o	x
<i>ingens</i> McDunnough	o	x	o	x	o	x	o	x
<i>insignificans</i> McDunnough	o	o	o	o	o	x	o	o
<i>mendax</i> Walsh	o	x	x	o	o	x	o	o
<i>minor</i> McDunnough	o	o	o	o	o	x	o	o
<i>rubropictum</i> McDunnough	x	x	x	o	o	x	o	o
<i>simplex</i> McDunnough	o	o	o	o	o	x	o	o
<i>triangulifer</i> McDunnough	o	o	o	o	o	x	o	o
<i>vicinum</i> Hagen	o	x	o	o	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral; labial palp three segmented; apical segment somewhat conical, the outer margin extending out farther than the inner one. Tarsal claws with very slender tips, somewhat widened at the base; finely denticulate on the inner margin. No hind wing pad present. Seven pairs of gills; sheetlike, undulated, and usually double; tracheae usually branched palmately. In some species gills may be double only on 1st segment, and in others may be single on all abdominal segments. Three caudal filaments, approximately equal in length and thickness; hairs present on both sides of median filament and on medial side of laterals. Body length: 4-9 mm. Illustration: Eaton, 1883-88, pl. 47.

Habitat of Nymphs In slow-flowing streams, or in backwaters or quiet areas along the margins of more rapidly-flowing ones. Live among vegetation, sometimes occurring in large numbers. Have also been taken at edge of some larger lakes and, in northern part of range, have been found in weedy areas at edge of ponds.

Habits of Nymphs Climb about on vegetation. They are apparently herbivorous.

Life History In Florida no definite seasonal period for emergence; however, farther north, in colder water, emergence restricted to warmer months. When ready to emerge, nymph rises to surface and almost immediately subimago escapes from nymphal skin. Observations have indicated that females are immediately seized by males upon emergence, so that a rather unusual situation develops in which female subimagos mate with adult males.

Taxonomy Leach, 1815. Brewst. Edin. Encycl. 9: 137. Type species: *C. dipterum* (Linnaeus); type locality: Europe.

DOLANIA EDMUNDS AND TRAVER

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>americana</i> Edmunds and Traver	x	o	o	o	o	o	o	o
Characteristics of Nymphs	<p>Body rounded. Head flattened; antennae inserted ventrally; anterior margin with a pair of patches of spines and setae; three ocelli; labrum emarginate medially; mandibles small, without a mandibular tusk. Antero-lateral corners of pronotum produced and crowned with spines, postero-lateral corners produced; prothoracic legs palp-like; mesothoracic legs highly modified, tibia and tarsus forming a spinous pad; metathoracic legs highly modified; all legs without claws. Abdominal tergites with dense, laterally extended setae and a row of setae on the posterior margin of each segment; sternites with setae. Gills on segments 1-7; carried in ventral position; all gills with fringed margins; first gill single, others two-branched. Three caudal filaments variable in length; median filament as long as or nearly as long as laterals. Body length: 13 mm. Illustration: Edmunds and Traver, 1959, figs. 1-11.</p>							
Habitat of Nymphs	<p>Large rivers or tributaries with sandy bottoms. Nymphs apparently adapted for burrowing in sand. One nymph collected in silt in stream margin, but normal habitat probably in moderately clean sand in fairly swift current.</p>							
Habits of Nymphs	<p>When placed in water, nymphs swim downward quickly and burrow into sand disappearing almost immediately. Forward motion in sand seems to be effected by burrowing action of forelegs and elongated labial and maxillary palpi. Head seems to act much like bulldozer blade, and in part to protect mouthparts and eyes. Thoracic prolongations and drawn-up, cheliped-like middle legs box-in ventral, anterior, bulky half of animal thus increasing its efficiency as a burrower. Trailing hind tibia and tarsi lie just below ventral rows of gills, maintaining space free of sand at all times.</p>							
Life History	Unknown.							
Taxonomy	<p>Edmunds and Traver, 1959. Ent. Soc. Amer., Ann. 52(1): 46. Type species: <i>D. americana</i> Edmunds and Traver; type locality: 25 miles south of Aiken, Upper Three Runs, South Carolina.</p>							

EDMUNDSIUS DAY

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>agilis</i> Day	o	o	o	x	o	o	o	o

Characteristics of Nymphs	Streamlined body form. Head rounded; eyes lateral; frontal margin of labrum broadly and deeply excavated. Meso- and metathoracic tarsal claws almost twice the length of the prothoracic tarsal claws. Postero-lateral angles of the apical abdominal segments prolonged into thin, flat, lateral spines; gills double on 1st and 2nd abdominal segments with ventral lamella about $\frac{2}{3}$ as large as dorsal lamella, other gills large, regularly oval, single. Three caudal filaments of equal length. Middle tail heavily fringed with long hairs on both sides; lateral filaments heavily fringed on inner side. Body length: 15 to 17 mm. Illustration: not illustrated in full; parts in Day, 1956, figs. 3: 27, m, q.
Habitat of Nymphs	Live in quiet, shallow, well-aerated streams. Rest close to shady edges of pools on sand or fine gravel bottoms. Found in streams at elevations of 5,000-8,000 feet.
Life History	Emerge between sunset and sunrise. Maturity reached during July and early August. Duration of nymphal life unknown.
Taxonomy	Day, 1953. Pañ-Pacif. Ent. 29(1): 19. Type species: <i>E. agilis</i> Day; type locality: Willow Creek, Madera County, California.

EPHEMERA LINNAEUS

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>blanda</i> Traver	x	o	o	o	o	o	o	o
<i>compar</i> Hagen	o	o	o	x	o	o	o	o
<i>guttulata</i> Pictet	x	x	o	o	o	x	o	o
<i>simulans</i> Walker	x	x	x	x	x	x	x	x
<i>traverae</i> Spieth	o	o	x	o	o	o	o	o
<i>triplex</i> Traver	o	x	o	o	o	o	o	o
<i>varia</i> Eaton	x	x	x	o	o	x	o	o

Characteristics of Nymphs	Mandibles with external tusks projecting forward and visible from above. Frontal process on head bifid; mandibular tusks slender, upcurved apically in lateral view, margins smooth. Legs fossorial; foreleg flattened and broadened for digging; legs moderately stout and somewhat flattened and twisted, clothed with long, yellowish hairs on all exposed sides; fore tibia moderately flattened, widened from the base outward only to midway its length; tarsus more than twice as long as wide, and more than half as long as tibia. Abdominal gills present on segments 1-7; gills narrow, margined on each side by a fringe of hairs at least twice as long as the width of gill. Body length: 12-20 mm. Illustration: Eaton, 1883-88, pl. 30.
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Habitat of Nymphs	In streams and lakes where they burrow in sand with a small admixture of silt. In streams nymphs tend to be in the quieter areas where current reduced. Streams where nymphs occur vary from very small creeks to very large rivers, depending on the species. <i>E. simulans</i> very common in Lake Winnepeg, Canada, where nymphs live in shallow, sandy bays. In lakes, nymphs live in water not more than a few meters deep.
Habits of Nymphs	When taken from their burrows and placed on sand, nymphs immediately begin burrowing. Show a very pronounced negative phototropism. When kept in water free of sand, gills are moved in undulating fashion, movement beginning at the anterior end of body and moving progressively posteriorly. Nymphs are poor swimmers, progression being accomplished by undulating movements of entire abdomen.
Life History	Life history of <i>E. simulans</i> only has been determined. At Lake Wawasee, Indiana, main emergence occurred during last of May and first few days of June. Eggs hatched within 14 days in the laboratory. Estimated that under natural conditions from 20 to 30 days required for development. On hatching young nymphs are negatively phototropic, positively thigmotropic, and begin burrowing immediately. Growth of specimens during summer months is rapid, nymphs increasing approximately 7 mm. in 39 days. The growth, however, is variable. This rate of development does not continue through winter but is a function of temperature. Assumed that growth slows as water cools, but nymphs are probably almost of mature length before winter arrives. On basis of evidence gathered at Lake Wawasee, appears that life cycle requires one year. Emergence in other areas occurs from May to August.
Taxonomy	Linnaeus, 1758. Syst. Nat. ed. 10: 546. Type species: <i>E. vulgata</i> Linnaeus; type locality: Europe.

EPHEMERELLA WALSH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>aestiva</i> McDunnough	x	x	o	o	o	x	o	o
<i>alleganiensis</i> Traver	o	x	o	o	o	o	o	o
<i>argo</i> Burks	o	o	x	o	o	o	o	o
<i>attenuata</i> McDunnough	o	x	o	o	o	x	o	o
<i>aurivillii</i> Bengtsson	o	x	o	o	x	x	o	x
<i>autumnalis</i> McDunnough	o	o	o	o	o	o	o	x
<i>berneri</i> Allen and Edmunds	x	o	o	o	o	o	o	o
<i>bicolor</i> Clemens	x	x	o	o	o	x	o	o
<i>bicoloroides</i> McDunnough	o	o	o	o	o	x	o	o

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>catawba</i> Traver	x	o	o	o	o	o	o	o
<i>cherokee</i> Traver	x	o	o	o	o	o	o	o
<i>choctawhatchee</i> Berner	x	o	o	o	o	o	o	o
<i>cognata</i> Traver	o	o	o	x	o	o	o	o
<i>coloradensis</i> Dodds	o	o	o	x	x	o	o	x
<i>columbiella</i> McDunnough	o	o	o	o	o	o	o	x
<i>conestee</i> Traver	x	o	o	o	o	o	o	o
<i>cornuta</i> Morgan	x	x	o	o	o	x	o	o
<i>cornutella</i> Morgan	x	x	o	o	o	x	o	o
<i>coxalis</i> McDunnough	x	o	o	o	o	x	o	o
<i>deficiens</i> Morgan	x	x	o	o	o	x	o	o
<i>delantala</i> Mayo	o	o	o	x	o	o	o	o
<i>depressa</i> Ide	o	o	o	o	o	x	o	o
<i>doddsi</i> Needham	o	o	o	x	x	o	o	x
<i>doris</i> Traver	x	o	o	o	o	o	o	o
<i>dorothea</i> Needham	x	x	o	o	o	x	o	o
<i>euterpe</i> Traver	o	o	o	x	o	o	o	o
<i>excrucians</i> Walsh	o	o	x	o	o	x	o	o
<i>flavilinea</i> McDunnough	o	o	o	x	x	o	o	x
<i>flavincta</i> McDunnough	o	o	o	o	x	o	o	o
<i>fratercula</i> McDunnough	x	o	o	o	o	x	o	o
<i>frisoni</i> McDunnough	o	o	x	o	o	o	o	o
<i>funeralis</i> McDunnough	x	x	x	o	o	x	o	o
<i>glacialis carsona</i> Day	o	o	o	x	o	o	o	o
<i>glacialis glacialis</i> Traver	o	o	o	o	x	o	o	o
<i>grandis</i> Eaton	o	o	o	x	x	o	o	o
<i>hecuba</i> Eaton	o	o	o	x	x	o	o	o
<i>heterocaudata</i> McDunnough	o	o	o	x	x	o	o	o
<i>hirsuta</i> Berner	x	o	o	o	o	o	o	o
<i>hysterix</i> Traver	o	o	o	x	x	o	o	o
<i>inermis</i> Eaton	o	o	o	x	x	o	o	o
<i>infrequens</i> McDunnough	o	o	o	x	x	o	o	x
<i>ingens</i> McDunnough	o	o	o	o	o	o	o	x
<i>invaria</i> (Walker)	o	o	x	o	o	x	o	o
<i>jacobi</i> McDunnough	o	o	o	o	o	o	o	x
<i>lapidula</i> McDunnough	o	o	o	o	x	o	o	o
<i>lata</i> Morgan	x	x	o	o	o	x	o	o
<i>levis</i> Day	o	o	o	x	o	o	o	o
<i>lita</i> Burks	o	o	x	o	o	o	o	o
<i>lodi</i> Mayo	o	o	o	x	o	o	o	o
<i>longicornis</i> Traver	x	o	o	o	o	o	o	o
<i>lutulenta</i> Clemens	x	o	x	o	o	x	o	o
<i>maculata</i> Traver	o	o	o	x	o	o	o	o
<i>margarita</i> Needham	o	x	o	x	x	o	o	x
<i>micheneri</i> Traver	o	o	o	x	o	o	o	o

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>minimella</i> McDunnough	x	o	o	o	o	x	o	o
<i>molita</i> McDunnough	o	o	o	o	o	x	o	o
<i>mollitia</i> Seemann	o	o	o	x	o	o	o	o
<i>needhami</i> McDunnough	o	x	x	o	o	x	o	o
<i>ora</i> Burks	o	o	x	o	o	o	o	o
<i>pelosa</i> Mayo	o	o	o	x	o	o	o	o
<i>proserpina</i> Traver	o	o	o	x	o	o	o	o
<i>prudentialis</i> McDunnough	o	o	o	o	o	x	o	o
<i>rotunda</i> Morgan	x	x	x	o	o	x	o	o
<i>septentrionalis</i> McDunnough	x	x	o	o	o	x	o	o
<i>serrata</i> Morgan	x	x	o	o	o	x	o	o
<i>serratoides</i> McDunnough	x	x	o	o	o	x	o	o
<i>sierra</i> Mayo	o	o	o	x	o	o	o	o
<i>simplex</i> McDunnough	x	x	x	o	o	x	o	o
<i>soquele</i> Day	o	o	o	x	o	o	o	o
<i>sordida</i> McDunnough	o	o	o	o	o	x	o	o
<i>spinifera</i> Needham	o	o	o	x	x	o	o	o
<i>subvaria</i> McDunnough	o	x	x	o	o	x	o	o
<i>temporalis</i> McDunnough	x	x	x	o	o	x	o	o
<i>teresa</i> Traver	o	o	o	x	o	o	o	o
<i>tibialis</i> McDunnough	o	o	o	x	x	o	o	x
<i>trilineata</i> Berner	x	o	o	o	o	o	o	o
<i>tuberculata</i> Morgan	x	x	o	o	o	x	o	o
<i>vernalis</i> Banks	x	o	o	o	o	o	o	o
<i>versimilis</i> McDunnough	o	x	o	o	o	x	o	o
<i>walkeri</i> Eaton	x	o	x	o	o	x	o	o
<i>wayah</i> Traver	x	o	o	o	o	o	o	o
<i>wilsoni</i> Mayo	o	o	o	x	o	o	o	o

Characteristics
of Nymphs

Very variable in body form; some slender, streamlined forms; others flattened ventrally with dorsum arched, and with broad, flattened femora. Many have prominent dorsal tubercles or spines on head, thorax, legs and abdomen. Some species smooth, others densely covered with hairs. All characterized by having gills absent from one or more of abdominal segments 1-7. Gills may be present on segments 3-7 or 4-7, and there may be a rudimentary gill present on segment one. If present only on segments 4-7, those on 4 are operculate or semi-operculate covering all or parts of the preceding pairs of gills. In all species the gills wholly dorsal in position. Maxillary palp may be rudimentary or wanting in some species, in others may be normal. Tarsal claws of most species bear several denticles. Lateral extensions usually present on the abdominal segments, bearing postero-lateral spines of greater or less development. Three caudal filaments with spines or hairs or both. Some of the nymphs are highly variable in color. Body length: 5-20 mm.

Illustrations: Berner, 1950, pls. XIII, XIV; Day, 1956, figs. 3: 22.

Habitat of Nymphs	Occur in a wide variety of habitats—in lakes where there is wave action along shore, in slowly flowing to virtually stagnant streams, and in swiftly flowing streams with rapids. Wherever they occur nymphs usually seek protection in crevices of rocks or in vegetation where flow is reduced. In some western forms, nymphs are adapted to live in torrential conditions, the abdomen being modified to form a sucker-disk permitting nymphs to cling to rocks in swiftest water. Forms occurring in quiet water are very often to be found at stream banks where they bury themselves close to the bases of plants and among roots in shallow water. Some nymphs live on top of rocks deep within moss which may be growing on them in swift-flowing water. By scraping deeply within the moss nymphs can be found, or by taking rock from water, letting water drain away from moss, the nymphs slowly begin to climb out toward the tops of the plants.
Habits of Nymphs	Most nymphs cling very tightly to objects to which they are attached when they are in water. When removed from water they remain quiescent; as they dry out some slow, deliberate movements can be seen. In some forms nymphs flick tails forward over abdomen, then straighten them out, repeating act continually. In others there is no movement at all, and it is only by careful examination that nymphs can be seen against background. Especially true of those nymphs taken from very swift water. Nymphs are awkward swimmers, using undulatory movements of the abdomen for locomotion. Almost immediately head for some attached object to which they can cling, and once attached blend in perfectly with their backgrounds. Those nymphs with operculate gill covers circulate water under gills by raising one or both covers and vibrating the other pairs of gills. Nymphs are omnivorous.
Life History	Time required for development has not been determined, but it is likely that most species require approximately one year. In Florida emergence takes place in late winter, spring, and early summer. Some species emerge by simply floating at the surface of water, and almost immediately subimago emerges and flies away. In others, nymphs may crawl partially out of water onto some attached object and transform. Emergence normally takes place in late afternoon, sometimes occurring after dark. Subimagal stage may take from 22 to 30 hours for completion.
Taxonomy	Walsh, 1862. Proc. Acad. Nat. Sci. Philad. p. 377. Type species: <i>E. excrucians</i> Walsh; type locality: Rock Island, Illinois.

EPEORUS EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>albertae</i> (McDunnough)	o	o	o	x	x	o	o	x
<i>arctus</i> (Traver)	o	o	o	o	x	o	o	o
<i>californicus</i> (Banks)	o	o	o	x	o	o	o	o
<i>deceptivus</i> (McDunnough)	o	o	o	x	o	o	o	x
<i>dispar</i> (Traver)	x	o	o	o	o	o	o	o
<i>dulciana</i> (McDunnough)	o	o	o	x	o	o	o	x
<i>flavipennis</i> (Traver)	o	o	o	o	o	o	o	x
<i>fragilis</i> (Morgan)	o	x	o	o	o	x	o	o
<i>frisoni</i> (Burks)	o	x	o	o	o	o	o	o
<i>geminatus</i> (Eaton)	o	o	o	x	x	o	o	o
<i>grandis</i> (McDunnough)	o	o	o	x	x	o	o	x
<i>hesperus</i> (Banks)	o	o	o	x	x	o	o	o
<i>lagunitas</i> (Traver)	o	o	o	x	o	o	o	o
<i>lepidus</i> (Traver)	o	o	o	x	o	o	o	o
<i>longimanus</i> (Eaton)	o	o	o	x	x	o	o	o
<i>namatus</i> (Burks)	o	o	x	o	o	o	o	o
<i>nitidus</i> (Eaton)	o	o	o	x	x	o	o	o
<i>permagnus</i> (Traver)	o	o	o	o	x	o	o	o
<i>pleuralis</i> (Banks)	x	x	o	o	o	x	o	o
<i>punctatus</i> (McDunnough)	o	x	o	o	o	x	o	o
<i>rubidus</i> (Traver)	x	o	o	o	o	o	o	o
<i>subpallidus</i> (Traver)	x	o	o	o	o	o	o	o
<i>suffusus</i> (McDunnough)	o	o	o	o	o	x	o	o
<i>vitrea</i> (Walker)	o	x	o	o	o	x	o	o

Characteristics of Nymphs Body flattened and slightly convex dorsally. Head flattened; eyes dorsal; frontal and lateral margins of head expanded, covering mouthparts completely. Legs fringed with hairs; tarsal claws short, each with 2 to 6 minute teeth near tip. Gills present on segments 1-7; each gill composed of ventral plate-like element and a much reduced tuft of filaments; anterior lobe of lamellate portion of first better developed than others. In some species anterior lobes almost, or completely meet beneath the body; in other species a long space intervenes between. Posterior pair of gills may or may not project beneath abdominal venter to form, along with intermediate gills, a partial or complete adhesive disk. Two caudal filaments. Body length: 7-14 mm. Illustration: Burks, 1953, fig. 386.

Habitat of Nymphs Live in shallow, cool or cold, rapidly flowing water, where they are attached to rocks, sticks, or other firmly anchored material.

Habits of Nymphs Because of holdfast provided by gills, nymphs hold on to rocks tenaciously when attempts are made to remove them.

Life History	Length of time required for development unknown, but probably one year. Adults have been observed emerging in afternoon. Nymphs rise to surface, and subimago immediately escapes from turbulent water. Have been observed crawling to within an inch of surface and emerging there from nymphal skin, breaking through surface film with wings fully expanded. Adults have been found from late May to early August. Variation in emergence time probably correlated with temperature conditions under which nymph develops.
Taxonomy	Eaton, 1881. Ent. Mo. Mag. 18: 26. Type species: <i>E. torrentium</i> Eaton; type locality: Tarascon, France.

EPHORON WILLIAMSON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>album</i> (Say)	o	o	x	x	x	o	x	o
<i>leukon</i> Williamson	x	x	x	o	o	x	o	o

Characteristics of Nymphs	Mandible with an external tusk, projecting forward, visible from above head; tusks downcurved, convergent apically; irregularly toothed on the outer margin, bearing short spines on the dorsal and lateral surfaces, long hairs on inner margin, a fringe of hairs of graduated length basally on outer margin, longer apically. Head with rounded, median, frontal prominence. Fore legs short and stout, fossorial; tibiae and tarsi of hind legs slender, femora moderately stout. Seven pairs of gills, all dorsal in position, single on 1st segment, double on segments 2-7, each member of a pair fringed on each side with short hairs; lateral tracheae numerous, distinct. Three short caudal filaments. Body length: 12-16 mm. Illustration: Eaton, 1883-88, pl. 28 (as <i>Polymitarcys</i>).
Habitat of Nymphs	In swift streams in tubular burrows beneath stones partially imbedded in substrate. May be under either large or small stones, often found more commonly under large, flat stones. During daylight hours, nymphs go fairly deep in burrows; later in evening, as darkness falls, come closer to surface.
Habits of Nymphs	Probably filter food that passes through burrow. Current of water drawn through burrow by movement of gills. Food is filtered out on long hairs that border fore legs.
Life History	Time required for development has not been determined, but estimated that full year needed for nymphal development. Adults have been taken from May to September. Adult life is extremely brief. One observation indicates that adults live for about one hour. Emergence occurs about sundown or shortly thereafter, with subimagal period lasting but a few minutes.

Taxonomy Williamson, 1802. Trans. Amer. Soc. Phil. 5: 71. Type species: *E. virgo* (Olivier); type locality: Europe.

HABROPHLEBIA EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>vibrans</i> Needham.	x	x	o	o	o	o	o	o

Characteristics of Nymphs Body slender and only slightly flattened. Head somewhat rounded; eyes lateral. Tarsal claws relatively short with a single ventral row of denticles. Seven pairs of gills, all double and narrowly lamelliform at base, but quickly breaking up into a number of linear filaments outspread at sides of abdomen. Three caudal filaments; median filament longer than laterals. Body length: 4-5 mm. Illustration: Eaton, 1883-88, pl. 36.

Habitat of Nymphs In small streams, near the edges among vegetation or in leaf debris where there is some accumulation of silt.

Life History Not determined. Probably requires from eight to twelve months to complete development depending on the part of the country in which species occur. Adults have been collected from April to August.

Taxonomy Eaton; 1881. Ent. Mo. Mag. 17: 195. Type species: *H. fusca* (Curtis); type locality: Europe.

HABROPHLEBIODES ULMER

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>americana</i> Banks	x	x	x	o	o	x	o	o
<i>annulata</i> Traver	o	o	x	o	o	o	o	o
<i>brunneipennis</i> Berner	x	o	o	o	o	o	o	o

Characteristics of Nymphs Body slender, somewhat depressed. Head tends to be flattened; eyes lateral; anterior margin of labrum rather deeply cleft. Tarsal claws long and slender; each bearing a single ventral row of denticles. Seven pairs of abdominal gills, all similar; each gill basally has a slender stem which subdivides into 2 long, slender, lanceolate filaments; a single, main, multibranching trachea. Three caudal filaments; median filament slightly longer than the laterals; all filaments sparsely covered with short hairs. Body length: 4½-6 mm. Illustration: Berner, 1950, pl. IX.

Habitat of Nymphs In slowly to moderately swift-flowing streams where they may occur in leaf debris. They can sometimes be found in riffles, but are most common among exposed roots of terrestrial plants or in

submerged vegetation along the banks of streams. Nymphs are also found in crevices of logs which have become water-soaked and are partially rotted. Early instars may often be found among pebbles in riffles, but as maturity is reached, nymphs migrate into quieter water. Streams inhabited by these nymphs usually drain heavily wooded areas or bogs and are somewhat acid and tinged with brown.

Habits of Nymphs	Gills are kept in constant motion. When the nymphs are at rest gills held stiffly out from the body at about 45 degree angle and slowly waved forward and backward. While swimming nymphs press gills against abdomen. Awkward swimmers; usually move most efficiently by crawling. Swim by undulatory movements, wave beginning at head and travelling to caudal filaments which are depressed or raised as unit. Caudal filaments help very little in propelling the insect. Strongly negatively phototropic and positively rheotropic.
Life History	Time required for nymphal development not determined; probably takes from 6 to 12 months, depending on part of country in which species lives. Emergence usually occurs in morning or early afternoon. When ready to transform, nymph crawls out of water, sometimes as far as an inch above surface. After a few moments, subimago appears, rests a moment, then flies to a nearby support. Subimago stage lasts 12 to 14 hours. In Florida emergence occurs throughout year; farther north emergence is restricted to late spring and summer months.
Taxonomy	Ulmer, 1919. Arch. Naturg. 85: Abt. A. 11: 39. Type species: <i>H. americana</i> (Banks); type locality: Passaic, New Jersey.

HEPTAGENIA WALSH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>adequata</i> McDunnough	0	0	0	0	0	0	0	x
<i>aphrodite</i> McDunnough	x	x	0	0	0	x	0	0
<i>criddlei</i> McDunnough	0	0	0	x	x	0	0	x
<i>cruentata</i> Walsh	0	0	x	0	0	0	x	0
<i>diabasia</i> Burks	0	0	x	0	0	0	0	0
<i>dolosa</i> Traver	x	0	0	0	0	0	0	0
<i>elegantula</i> (Eaton)	0	0	x	x	0	0	x	0
<i>flavescens</i> (Walsh)	x	0	x	0	0	0	x	0
<i>hebe</i> McDunnough	0	x	x	0	0	x	0	0
<i>horrida</i> McDunnough	0	0	0	0	0	x	0	0
<i>inconspicua</i> McDunnough	0	0	0	0	0	0	x	0
<i>julia</i> Traver	x	0	0	0	0	0	0	0
<i>juno</i> McDunnough	x	x	0	0	0	x	0	0
<i>kennedyi</i> McDunnough	0	0	0	x	0	0	0	0

Species.	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>lucidipennis</i> (Clemens)	o	x	x	o	o	x	o	o
<i>maculipennis</i> (Walsh)	x	o	x	o	o	o	x	o
<i>manifesta</i> (Eaton)	o	o	x	o	o	o	o	o
<i>marginalis</i> Banks	x	x	x	o	o	o	o	o
<i>minerva</i> McDunnough	x	x	o	o	o	x	o	o
<i>otiosa</i> McDunnough	o	o	o	o	x	o	o	o
<i>patoka</i> Burks	o	o	x	o	o	o	o	o
<i>perfida</i> McDunnough	o	o	o	o	o	x	o	o
<i>persimplex</i> McDunnough	o	o	x	o	o	o	o	o
<i>pulla</i> McDunnough	o	x	x	o	o	x	o	o
<i>rodocki</i> Traver	o	o	o	o	x	o	o	o
<i>rosea</i> Traver	o	o	o	x	x	o	o	o
<i>rusticalis</i> McDunnough	o	x	x	o	o	x	o	o
<i>simplicoides</i> McDunnough	o	o	o	x	x	o	o	x
<i>solitaria</i> McDunnough	o	o	o	x	o	o	o	x
<i>spinosa</i> Traver	x	o	o	o	o	o	o	o
<i>thetis</i> Traver	x	o	o	o	o	o	o	o
<i>townesi</i> Traver	x	o	o	o	o	o	o	o
<i>umbricata</i> McDunnough	o	o	o	o	o	x	o	o
<i>walshi</i> McDunnough	o	o	o	o	o	x	o	o

Characteristics of Nymphs Body flattened. Head flattened; eyes dorsal. Femora moderately flattened; posterior margin of each bears a dense row of hairs and a sparse row of short, stout spines. Gills present on abdominal segments 1-7; all gills of same form, but not same size. Each gill composed of dorsal platelike element and ventral filamentous tuft; in some species tuft greatly reduced or lacking on 7th pair of gills. No gills extended beneath abdominal venter. Three caudal filaments, approximately of equal length. Body length: 6-12 mm. Illustration: Burks, 1953, fig. 383.

Habitat of Nymphs Generally occur under stones and among debris in shallow, rapidly flowing water near banks of small streams and rivers. Sometimes found under stones at edge of quiet pools between rapids. Also occur at margins of lakes where there is wave action and shore is rocky, or has debris to which insects may attach themselves.

Habits of Nymphs Very active; when a stone is lifted from water, often scurry to underside. Agile and frequently can elude attempts to lift them from surface to which they are attached; cling closely and with considerable strength. When placed in pan of water, nymphs, provided no attaching surface available, tend to form into balls clinging to one another and tumbling about in water.

Life History	Eggs deposited by female as she dips abdomen into water. Hatching in the laboratory takes from 12 to 40 days. Length of nymphal life probably one year, although not determined accurately. When ready to emerge, nymph comes close to surface and subimago bursts free. Life as adult lasts from 2 to 4 days. Adults taken from May to October. Principal emergence in June and July.
Taxonomy	Walsh, 1863. Proc. Ent. Soc. Phila. 2: 197. Type species: <i>H. flavescens</i> (Walsh); type locality: Rock Island, Illinois.

HEXAGENIA WALSH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>atrocaudata</i> McDunnough	x	x	x	o	o	x	o	o
<i>bilineata</i> (Say)	x	o	x	o	o	o	o	o
<i>limbata californica</i> Upholt	o	o	o	x	o	o	o	o
<i>limbata limbata</i> (Serville)	o	o	x	x	x	o	o	x
<i>limbata occulta</i> Walker	x	x	x	o	o	x	x	o
<i>limbata venusta</i> Eaton	x	o	x	o	o	o	o	o
<i>limbata viridescens</i> (Walker)	o	o	x	o	o	x	x	o
<i>munda affiliata</i> McDunnough	o	x	x	o	o	x	o	o
<i>munda elegans</i> Traver	x	o	x	o	o	o	o	o
<i>munda marilandica</i> Traver	x	x	o	o	o	o	o	o
<i>munda munda</i> Eaton	o	o	x	o	o	o	o	o
<i>munda orlando</i> Traver	x	o	o	o	o	o	o	o
<i>recurvata</i> Morgan	x	x	x	o	o	x	o	o
<i>rigida</i> McDunnough	o	x	x	o	o	x	x	o

Characteristics of Nymphs Mandible with an external tusk projecting forward and visible from above head. Mandibular tusks long, slender, smooth, up-curved, tips divergent. Frontal process on the head entire, apical margin may be truncate, conical or rounded. Fore tibiae flattened and widened; fossorial. Seven pairs of abdominal gills, narrow, tapering, and with no distinct lateral tracheal branches; margined on each side by fringe of hairs at least twice as long as width of gills. Gills on 1st abdominal segment rudimentary and bifurcate; without conspicuous hairs. Three relatively short caudal filaments. Body length: 12-32 mm. Illustration: Berner, 1950, pl. IV.

Habitat of Nymphs In both streams and lakes where nymphs burrow in soft bottom. In streams, they inhabit quieter backwaters where there is an accumulation of silt. Burrows may occur in large numbers, openings of which can be easily seen if water is clear. In lakes, nymphs occur in bottom muds at considerable depths. Depth in itself does not appear to have a great influence over distribution, nymphs being found from very shallow water down to 17½

meters; however, nymphs much scarcer in deeper waters than in more shallow areas, with maximum depth probably about 18 meters. Character of bottom of great importance in determining local distribution in lakes. Usually found in large numbers only in bottoms composed of soft mud or clay and largely restricted to a substratum which is soft, yet firm enough to permit maintenance of a burrow. Nymphs do not ordinarily inhabit sand, gravel, rubble, peat, or bottoms which are flocculent. Burrow U-shaped, both ends open to mud surface. Nymphs maintain flow of water through tunnel by rhythmically waving gills. Insects known to burrow to depth of 5 inches, but probably do not penetrate to depth greater than 6 inches. Appear to be unable to withstand stagnation in which dissolved oxygen content of water falls below 1.0 ppm. Average numbers of *H. limbata* nymphs per square foot in Michigan lake ranged from 6 to 30. In Lake Winnepeg estimates of 62,000,000 to 93,700,000 per square kilometer were given for two species. Estimates were made at time of maximal population density. In Michigan lakes which were studied, nymphs comprised as much as 59 percent of entire volume of macroscopic bottom fauna in suitable bottom areas.

Habits of
Nymphs

Swimming accomplished by dorso-ventral undulations of body, chiefly of abdomen. Caudal filaments directed backward and overlap one another. Fore and middle legs directed anteriorly, hind legs posteriorly, all legs being held close to body. Gills extended up and laterally, waved continuously as swimming proceeds. When released at water surface, nymphs usually swim vigorously downward in attempt to reach bottom quickly. Immediately on contact with bottom attempt to burrow. Burrowing accomplished in seconds. Entrance into mud gained by digging of fore legs, pushing with hind legs, and an occasional strong, undulating movement of abdominal gills. Once head and legs under mud, remainder of body quickly disappears. Size and depth of burrows depends on size of nymphs. Nymphs seem to be mud-eaters.

Life History

In Michigan, *H. limbata* probably requires one year, with rate of growth being a function of water temperature. Under laboratory conditions of high temperature, adults reared from egg to maturity in less than six months; in natural waters, with low temperature two years required. Number of eggs produced per female varies between 2,200 and 8,000, average female producing about 4,000. Time required for hatching variable, depending on temperature. In laboratory, hatching obtained in 11 to 26 days. Estimated that in lakes under natural conditions eggs hatch about two weeks after laying. In northern part of range adults emerge in period of 3-6 weeks, with stragglers continuing to appear much later. Emergence occurs in late afternoon just about dusk. At time of emergence, nymph, ordi-

narly, negatively phototropic and positively geotropic, reverses tropisms and swims from lake bottom or stream bottom to surface and breaks through surface film; adult immediately bursts free. Subimagal period lasts from 24-48 hours. In Florida *H. munda orlando* emerges principally during summer; stragglers can be taken in nearly every month of year, except in midwinter.

Taxonomy Walsh, 1863. Proc. Ent. Soc. Philad. 2: 197. Type species: *H. bilineata* (Say); type locality: North America.

HOMOEONEURIA EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>ammophila</i> Spieth	o	o	x	o	o	o	o	o
<i>dolani</i> Edmunds, Berner, Traver	x	o	o	o	o	o	o	o
species ?	x	o	x	o	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded, eyes lateral; gills attached to base of maxilla. Fore femur and tibia with dense fringe of long hairs on inner side; fore tarsus reduced to small protuberance; other legs hairy with thin tarsal claws. First pair of gills ventral, large, and multibranched; other 6 pairs of gills dorsal, small, flat, and slender. Caudal filaments approximately equal in length; heavy fringe of hairs on both sides of median filament, lateral filaments with fringe of hairs on medial side. Body length: 9-12 mm. Illustration: Edmunds, Berner, Traver, 1958, figs. 15-29.

Habitat of Nymphs Found in large, moderately to rapidly flowing streams with shifting sand bottoms in which nymphs burrow.

Habits of Nymphs Burrow rapidly in sand and occur 1-2 inches below sand surface. Awkward swimmers; when brought above level of sand, often rest on their sides. Filter food from water with long hairs on fore legs and graze on materials so collected.

Life History Length of nymphal life unknown; probably takes one year to develop from egg to adult. Emergence has not been noted. Female, with vestigial legs, probably molts on the wing; male may possibly alight to molt, as it still has some functional legs remaining. Emerge June to October.

Taxonomy Eaton, 1881. Ent. Mo. Mag., p. 192. Type species: *H. salvinae* Eaton; type locality: Dueñas, Guatemala.

ISONYCHIA EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>annulata</i> Traver	x	o	o	o	o	o	o	o
<i>arida</i> (Say)	o	o	x	o	o	o	o	o
<i>aurea</i> Traver	x	o	o	o	o	o	o	o
<i>bicolor</i> (Walker)	x	x	x	o	o	x	o	o
<i>campestris</i> McDunnough	o	o	o	x	o	o	o	x
<i>christina</i> Traver	o	x	o	o	o	x	o	o
<i>circe</i> Traver	x	o	o	o	o	o	o	o
<i>diversa</i> Traver	x	o	o	o	o	o	o	o
<i>fattigi</i> Traver	x	o	o	o	o	o	o	o
<i>georgiae</i> McDunnough	x	o	o	o	o	o	o	o
<i>harperi</i> Traver	o	x	x	o	o	o	o	o
<i>intermedia</i> Eaton	o	o	o	x	o	o	o	o
<i>manca</i> Eaton	o	o	x	o	x	o	o	o
<i>matilda</i> Traver	o	x	o	o	o	o	o	o
<i>notata</i> Traver	x	o	o	o	o	o	o	o
<i>obscura</i> Traver	x	o	o	o	o	o	o	o
<i>pacoleta</i> Traver	x	o	o	o	o	o	o	o
<i>pictipes</i> Traver	x	o	o	o	o	o	o	o
<i>rufa</i> McDunnough	x	x	x	o	o	o	o	o
<i>sadleri</i> Traver	x	x	o	o	o	o	o	o
<i>sayi</i> Burks	o	o	x	o	o	o	o	o
<i>serrata</i> Traver	x	o	o	o	o	o	o	o
<i>sicca</i> (Walsh)	o	o	x	o	o	x	o	o
<i>similis</i> Traver	x	o	o	o	o	o	o	o
<i>thalia</i> Traver	x	o	o	o	o	o	o	o
<i>tusculanensis</i> Berner	x	o	o	o	o	o	o	o
<i>velma</i> Needham	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral; head with a median frontal ridge below middle ocellus; mouthparts very hairy. Gill tufts present at the bases of maxillae. Fore tibia with a conspicuous apical spine; fore leg with fringes of long spinelike hairs on femur, tibia, and tarsus. Gill tufts present at base of fore coxa; claws stout and denticulate on inner margin. Gills present on first 7 segments; each gill consisting of a basal filamentous portion, covered by a dorsal platelike portion. Three caudal filaments; median filament with heavy fringe of hairs on both sides; lateral filaments with hairs on the medial side. Body length; 9-17 mm. Illustration: Berner, 1950, pl. VI.

Habitat of Nymphs Vigorous swimming forms found in rapidly flowing water of creeks and rivers. Nymphs occur in tangles of vegetation and debris anchored in stream, especially on branches and collections of leaves caught in swift flow. May be found concentrated in large numbers where branches trail in flowing water. Nymphs

on rocks or on flat rock ledges where there is considerable disturbance of the water as it pours across surface. Negatively phototropic.

Habits of Nymphs	Very strong swimmers; face current with fore legs held in front of mouth, long hairs overlapping, and filtering food from flowing water. From time to time they graze on materials caught on hairs.
Life History	In warmer parts of coastal plain of southeast, emergence may occur throughout year; in colder areas emergence limited to warmer months. Length of time required for nymphal development not determined, but probably requires approximately one year. To emerge, nymph leaves water by crawling a few inches above water surface onto rocks, sticks or any other protruding object. Length of time as subimago varies between 22 and 31 hours. Emergence occurs in late afternoon or shortly after dark, with an occasional subimago appearing in early morning.
Taxonomy	Eaton, 1871. Trans. Ent. Soc. London, p. 134. Type species: <i>I. ignota</i> (Walker); type locality: unknown, probably Europe.

LACHLANIA HAGEN

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>powelli</i> Edmunds	o	o	o	x	o	o	o	o
<i>saskatchewanensis</i> Ide	o	o	o	o	o	o	x	o

Characteristics of Nymphs	Body somewhat depressed. Head more or less flattened; eyes dorsal; maxilla with tuft of gills at base. Fore tibia and femur bearing long fringe of hairs on inner sides; short, stout tarsal claws. Abdomen somewhat flattened with lateral margins prolonged into rather coarse postero-lateral spines. First pair of gills ventral, small; remaining 6 pairs dorsal, platelike, small. Two caudal filaments with rather sparse fringe of hairs on inner margin. Body length: 8-10 mm. Illustration: Edmunds, 1951, fig. 8.
Habitat of Nymphs	Mainly found clinging to small sticks lodged in interstices of rocks in rapids or on undersides of rocks.
Habits of Nymphs	When disturbed, nymphs tip tails up over back. Slow moving; cling to sticks and rocks with great tenacity.
Life History	Unknown. Mating flights have been observed as early as 7:45 a.m. Subimaginal skin shed from all parts of body except wings while insects are in flight. Length of adult life extremely short, perhaps not more than 4 or 5 hours. Swarming observed in Utah in early September.

Taxonomy Hagen, 1868. Proc. Soc. Nat. Hist. Boston. p. 373. Type species: *L. abnormis* Hagen; type locality: Cuba.

LEPTOHYPHES EATON

Species.	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
species ?	o	o	x	o	o	o	o	o

Characteristics of Nymphs Body flattened. Head rounded; eyes lateral. Short, thickset legs with edentate tarsal claws. Hind wing pads present. Abdominal gills at lateral margins of segments 2-6; 1st pair elongate, oval, and elytriod covering following pairs. Lateral margins of abdominal segments produced as broad, shelf-like projections with postero-lateral angles acute. Three caudal filaments. Body length: 3-5 mm. Illustration: Needham and Murphy, 1924, pl. VII, figs. 79-88, 91-95.

Habitat of Nymphs In larger rivers where they occur on sticks, logs, and branches which have fallen into the water.

Life History Unknown.

Taxonomy Eaton, 1882. Ent. Mo. Mag. 18: 208. Type species: *L. eximius* Eaton; type locality: Cordova, Argentina.

LEPTOPHLEBIA WESTWOOD

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>austrina</i> (Traver)	x	o	o	o	o	o	o	o
<i>collina</i> (Traver)	x	o	o	o	o	o	o	o
<i>cupida</i> (Say)	x	x	x	o	o	x	x	o
<i>grandis</i> (Traver)	x	o	o	o	o	o	o	o
<i>gravestella</i> (Eaton)	o	o	o	x	x	o	o	o
<i>intermedia</i> (Traver)	x	o	o	o	o	o	o	o
<i>johnsoni</i> McDunnough	x	x	o	o	o	x	o	o
<i>nebulosa</i> (Walker)	o	x	x	x	x	x	o	o
<i>pacifica</i> (McDunnough)	o	o	o	o	x	o	o	o

Characteristics of Nymphs Stout-bodied. Rounded head; eyes lateral. Thorax and abdomen slightly flattened on dorsum. Tarsal claws with rows of ventral denticles. Seven pairs of abdominal gills; double and lamelliform on all 7 segments, narrowly so on segment one. On segments 2 through 7 gills double and quite broad; each lamella has a terminal filamentous extension. Three caudal filaments; approximately equal in length. Body length: 7-15 mm. Illustration: Berner, 1950, pl. VII (as *Blasturus*).

Habitat of Nymphs	In parts of range develop in ponds or in quiet eddies along banks of streams. In southeast nymphs found only in flowing water or in backwaters of streams. Poorly adapted for swift water and rarely found other than in quieter portions of streams or in pools recently cut off from streams. Associated with quiet area near the banks, in pools where dead leaves may accumulate, or at submerged mossy banks where nymphs crawl amid the bases of the plants. During time of emergence, nymphs migrate into quiet backwaters where they become highly concentrated in favorable situations lacking water movement and water is relatively shallow. Usually concentrate among layers of leaf debris. Large gill expanse probably correlated with low oxygen content of almost stagnant water in which nymphs live.
Habits of Nymphs	Omnivorous, feeding on detritus, diatoms, algae, and cast skins of nymphs of their own or other species. Nymphs negatively phototropic, seeking dark underside of any materials that are available. When kept in the laboratory, and room is darkened, nymphs move to upper surface of the substrate. However, when light is switched on nymphs scurry away into some dark crevice. Nymphs about to emerge undergo a phototactic reversal. Crawl to upper side of leaves or onto sticks, logs or any other available support near surface of water. <i>L. cupida</i> has been shown, in Manitoba, to migrate up temporary streams formed by melting snow, some nymphs even leaving the water and crawling along banks in moving upstream; may migrate as much as 300 to 400 yards a day.
Life History	Time required for nymphal development unknown, but probably one year. Estimate based on concentration of mature nymphs in backwaters during one definite period. Mature nymph moves to surface and subimago emerges. Some nymphs crawl out of the water, but, generally, emergence is at the surface. Emergence may occur at any time of day with height of transformation in early afternoon. Subimagonal stage lasts from 18 to 29 hours. In Florida, emergence was reported as early as late January with the peak of emergence in February to early March. Farther north emergence occurs as early as February, then continues on into May. In southern Canada species emerge in late May and continue emergence into late June.
Taxonomy	Westwood, 1840. <i>Introd. Mod. Classif. Ins.</i> 2: 31. Type species: <i>L. vespertina</i> (Linnaeus); type locality: Europe.

METRETOPUS EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>borealis</i> Eaton	o	o	o	o	o	x	x	x
Characteristics of Nymphs	Body streamlined. Head rounded; eyes lateral. Terminal segment of labial palp expanded and truncate apically. Legs fairly long; tarsi longer than tibiae; femora almost as long as the tibiae and tarsi together. Tarsal claws of prothoracic leg differ from those of the other legs in being bifid. Gills on segments 1-7 similar in form and single. Three tails; middle one fringed with long hairs on both sides, the lateral caudal filaments fringed on medial side only. Not illustrated.							
Habitat of Nymphs	Nymphs probably occur in slow-flowing streams on vegetation or on the bottom near the shore.							
Life History	Adults have been taken in late July and mid-August in Canada.							
Taxonomy	Eaton, 1901. Ent. Mo. Mag. 2nd. ser. 12: 253. Type species: <i>M. norvegicus</i> Eaton; type locality: Aal, Norway.							

NEOCLOEON TRAVER

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>alamance</i> Traver	x	o	x	o	o	o	o	o
Characteristics of Nymphs	Body streamlined. Head rounded; eyes lateral; labial palp three segmented, distal segment widely dilated apically, especially on inner margin. Tarsal claws very long and slender, not denticulate, almost $\frac{3}{4}$ as long as their respective tarsi. Seven pairs of abdominal gills, single on all segments; middle gills irregularly rounded, others more or less straight on outer margins; tracheae pinnate. Three caudal filaments of approximately equal length; median filament with long hairs on both sides; laterals with hairs on medial side. Body length: 5-6 mm. Illustration: Needham, Traver and Hsu, 1935, pl. XL.							
Habitat of Nymphs	Collected from small, spring-fed streams; probably occur among vegetation in more slowly-flowing portion of stream. Nymphs were also found in masses of plants in slow-flowing current of spring-fed tributaries.							
Life History	Length of nymphal life unknown; probably requires six to nine months for development. Earliest recorded emergence February 7; the latest mid-April. Emergence occurs in the morning. Subimaginal period apparently lasts 6 to 7 hours.							

Taxonomy Traver, 1932. Jour. N. Y. Ent. Soc. 40: 365. Type species: *N. alamanca* Traver; type locality: Big Alamance Creek, North Carolina.

NEOPHEMERA McDUNNOUGH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>bicolor</i> McDunnough	o	o	x	o	o	x	o	o
<i>compressa</i> Berner	x	o	o	o	o	o	o	o
<i>purpurea</i> (Traver)	x	o	o	o	o	o	o	o
<i>youngi</i> Berner	x	o	o	o	o	o	o	o

Characteristics of Nymphs Body elongate. Head rounded; eyes lateral; head almost twice as wide as long. Prothorax longer at margins than at midline. Legs long and spiderlike; tarsal claws simple, curved. First abdominal segment with a pair of vestigial filamentous gills; gills on segment 2 fused to form elytroid plates covering following 4 pairs. Prominent median spine on tergites 1 and 2. Lateral margins of segments 3-9 prolonged posteriorly into flattened processes that may be decurved; exceptionally well developed on segments 6-9. Three caudal filaments with rings of stiff hairs at joints. Body length: 8-17 mm. Illustration: Berner, 1956, figs. 1-14.

Habitat of Nymphs In streams of slow to moderately swift flow. Nymphs of most species occur in debris which is anchored in flowing water. May also occur in large numbers among exposed, well-washed roots of terrestrial plants; frequently found among tangles of branches washed into stream. Some species have been taken living deep within moss which is also exposed to current. *N. purpurea* sometimes occurs under large, flat rocks in midstream where flow of water is swift; however, nymphs occur in protected places, well away from the current.

Habits of Nymphs Slowly moving insects. When dislodged, swim with great difficulty with legs outspread; almost immediately settle to bottom and become attached to some object to which they cling tenaciously. They swim but little, and their motions are extremely awkward when they do. Tails are bent over abdomen and suddenly lashed so that movement of abdomen, assisted by the beating of almost bare caudal filaments, propels the insect. Attitude of nymphs when taken from water is characterized by a slow, deliberate movement with occasional flicking motion of the caudal filaments as insect brings them completely back over its dorsum until they point anteriorly, then lashes out with them. Nymphs walk slowly and laboriously.

Life History Time required for development has not been determined, but circumstantial evidence indicates that it is one year. When

ready to emerge, nymph comes to surface and adult escapes. Occasionally nymph crawls out of water for emergence. In Florida, emergence begins in March and extends into early May. Farther north, emergence is somewhat later with *N. purpurea* emerging in late June. In Canada, *N. bicolor* has been recorded in July. The time of emergence is variable, some subimagos rising in morning, others in late afternoon or early evening.

Taxonomy McDunnough, 1925. Can. Ent. 57: 168. Type species: *N. bicolor* McDunnough; type locality: Laprairie, Quebec.

PARACLOEODES DAY

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>abditus</i> Day	o	o	o	x	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral; anterolateral portion of head deeply cut away exposing mouthparts; labial palp 2-segmented, outer apical margin of distal segment terminating in a sharp point, and inner apical margin forming a large, smoothly rounded lobe. Tarsal claws slightly curved and hooked at ends, over half as long as respective tarsi, 18-20 fine, straight denticles on inner margin of basal portion. No hind wing pad. Anterior margin of 1st tergite with a wide, deep median slot into which mesonotal scutellum fits. Seven pairs of gills, all single and ovate. Three caudal filaments; median filament almost as long as laterals and about equally stout; short hairs on each side of middle filament and on inner side of laterals. Body length: 4 mm. Illustration: not illustrated in full; parts in Day, 1955, figs. 7-12.

Habitat of Nymphs In larger rivers, where it is suspected that they live in the deeper, cooler portion until reaching maturity, when they migrate into depths of 4-6 inches near stream margins. Nymphs seem to prefer strong current where they rest on fine sand. They are warm-water species, showing remarkable ability to survive under highly marginal conditions. Type locality from which *abditus* described has been dredged, diverted, and dammed, and has suffered pollution from irrigation runoff, crop dusting, sewage, and industry. Have been taken where water temperature ranges from 75-82 degrees F.

Life History Length of nymphal life unknown. In laboratory emergence of subimago occurred between 8:00 and 9:00 p.m. Sometime during night subimagal molt occurred. Adults reared in August.

Taxonomy Day, 1955. Pan-Pacific Ent. 31(3): 121. Type species: *P. abditus* Day; type locality: Tuolumne River, Stanislaus County, California.

PARALEPTOPHLEBIA LESTAGE

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>adoptiva</i> McDunnough	x	x	o	o	o	x	o	o
<i>assimilis</i> Banks	x	o	o	o	o	o	o	o
<i>associata</i> McDunnough	o	o	o	x	o	o	o	o
<i>bicornuta</i> McDunnough	o	o	o	o	x	o	o	x
<i>bradleyi</i> Needham	x	o	o	o	o	o	o	o
<i>brunneipennis</i> McDunnough	o	o	o	o	x	o	o	o
<i>cachea</i> Day	o	o	o	x	o	o	o	o
<i>californica</i> Traver	o	o	o	x	o	o	o	o
<i>clara</i> McDunnough	o	o	o	x	o	o	o	o
<i>debilis</i> (Walker)	o	x	x	x	x	x	o	x
<i>falcula</i> Traver	o	o	o	o	x	o	o	o
<i>georgiana</i> Traver	x	o	o	o	o	o	o	o
<i>gregalis</i> (Eaton)	o	o	o	x	x	o	o	x
<i>guttata</i> McDunnough	x	x	o	o	o	x	o	o
<i>helena</i> Day	o	o	o	x	o	o	o	o
<i>heteronea</i> McDunnough	o	o	o	x	o	o	o	x
<i>jeanae</i> Berner	x	o	o	o	o	o	o	o
<i>moerens</i> McDunnough	x	x	x	o	o	x	o	o
<i>mollis</i> (Eaton)	x	x	o	o	o	x	o	o
<i>ontario</i> McDunnough	o	x	x	o	o	x	o	o
<i>packii</i> Needham	o	o	o	x	o	o	o	o
<i>pallipes</i> (Hägen)	o	o	o	x	x	o	o	x
<i>placeri</i> Mayo	o	o	o	x	o	o	o	o
<i>praepedita</i> (Eaton)	o	x	x	o	o	x	o	o
<i>quisquilia</i> Day	o	o	o	x	o	o	o	o
<i>rufivenosa</i> (Eaton)	o	o	o	o	x	o	o	x
<i>sculleni</i> Traver	o	o	o	o	x	o	o	o
<i>sticta</i> Burks	o	o	x	o	o	o	o	o
<i>strigula</i> McDunnough	o	x	o	o	o	x	o	o
<i>swannanoa</i> Traver	x	o	o	o	o	o	o	o
<i>temporalis</i> McDunnough	o	o	o	o	x	o	o	x
<i>vaciva</i> Eaton	o	o	o	o	x	o	o	o
<i>volitans</i> McDunnough	x	x	o	o	o	x	o	o
<i>zayante</i> Day	o	o	o	x	o	o	o	o

Characteristics of Nymphs Slender, body usually compressed dorso-ventrally. Head somewhat depressed; eyes lateral. In a few western species, mandible greatly elongated and tusklike, projecting anteriorly far past labrum. Tarsal claws slender, pectinate. Spinules present on apical margins of tergites 1-10. Seven pairs of narrowly lanceolate, bifid, filamentous gills. Three caudal filaments, approximately of equal length. Body length: 6½-10 mm. Illustration: Eaton, 1883-88, pl. 32 (as *Leptophlebia*); parts in Needham, Traver and Hsu, 1935, pl. XXXVII.

Habitat of Nymphs	Chiefly in shallow, fairly rapid streams of small to moderate size. Often streams have bottoms of coarse gravel. Some species live among leaf debris where current is slow to moderately swift. Though mainly found here, they also occur in riffles or on large logs, sticks, and vegetation. Other species occur in rapid portions of swiftly flowing streams in crevices on underside of rocks. In larger shallow streams, nymphs can sometimes be found near banks on exposed roots of terrestrial plants which project into water.
Habits of Nymphs	Awkward swimmers, moving by undulatory movements, the wave beginning cephalically and travelling to the tails which are depressed or raised as unit. When taken out of water, nymphs move in a snake-like fashion, wriggling from side to side. Appear to be herbivores, feeding on detritus and algae. Nymphs are negatively phototropic.
Life History	Time required for nymphal development varies; in northern part of range species require a full year for development. In the extreme southern portion of range less time required. As far south as Florida nymphs may mature in 6 to 8 months. When ready to transform mature nymph crawls a short distance above water surface and after a few moments subimago appears. Subimaginal stage may last from 12 hours in the southern forms to as much as 48 hours in northern species. In the extreme southern portion of range emergence occurs throughout year; however, in northern portion, emergence restricted to summer months beginning as early as May and continuing into August.
Taxonomy	Lestage, 1917. Ann. Biol. Lacust. 8: 340. Type species: <i>P. cincta</i> (Retzius); type locality: Central Europe.

PARAMELETUS BENGTSSON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>chelifer</i> Bengtsson	o	o	o	o	o	o	x	o
<i>columbiae</i> McDunnough	o	o	o	x	o	o	o	x
<i>croesus</i> McDunnough	o	o	o	o	o	x	o	o
<i>midas</i> McDunnough	o	o	o	o	o	x	o	o

Characteristics of Nymphs	Body streamlined. Head rounded; eyes lateral. A pincerlike process near the tip of the labial palp. Tarsal claws long and slender. Gill lamellae broad, single on all segments. Three caudal filaments; middle filament heavily fringed on both sides, laterals fringed on inner side. Body length: 10-13 mm. Illustration: not illustrated in full; parts in Burks, 1953, fig. 230.
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Habitat of Nymphs	Live in swamps and forest pools. Water temperature of pools may exceed air temperature in middle of day.
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Life History	In Utah, eggs deposited in mid-June and remain dormant during summer and winter, hatching next May within one day after snow melts. Six days after hatching nymphs are 4-5 mm. in length and after 8 days 5-6 mm. Nymphal life completed within 16-22 days. Nymphs crawl 1 to 2 inches out of water to emerge.
Taxonomy	Bengtsson, 1908. Vet. Akad. Arsbok. 6: 242. Type species: <i>P. chelifera</i> Bengtsson; type locality: Bjorkfors, Sweden.

PENTAGENIA WALSH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>robusta</i> McDunnough	o	o	x	o	o	o	o	o
<i>vittigera</i> (Walsh)	x	o	x	o	o	o	x	o
Characteristics of Nymphs	Mandible with an external tusk projecting forward and visible from above head; tusks upcurved apically in lateral view and crenate on upper margin. Frontal process on the head bifid. Fore femora flattened; tibiae dilated apically. Legs are fossorial. Seven pairs of abdominal gills, all bifid. First pair of gills rudimentary, without fringes of hairs; other 6 pairs fringed laterally with long hairs that are almost as long as gills are wide. Three relatively short caudal filaments. Body length: 24 mm. Illustration: Needham, 1917-18, pl. LXXIV, figs. 19-26.							
Habitat of Nymphs	Burrow in mud in quieter parts of larger rivers.							
Life History	Unknown. Nymph probably takes from 1 to 2 years to complete development. Adults have been taken from May to late September.							
Taxonomy	Walsh, 1863. Proc. Ent. Soc. Philad. 2: 196. Type species: <i>P. vittigera</i> (Walsh); type locality: Rock Island, Illinois.							

POTAMANTHUS PICTET

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>diaphanus</i> Needham	o	x	o	o	o	o	o	o
<i>distinctus</i> Traver	x	x	x	o	o	o	o	o
<i>inequalis</i> Needham	o	x	o	o	o	o	o	o
<i>myops</i> (Walsh)	o	o	x	o	o	o	o	o
<i>neglectus</i> Traver	o	x	o	o	o	o	o	o
<i>rufous</i> Argo	o	x	o	o	o	o	o	o
<i>verticis</i> (Say)	x	x	x	o	o	o	o	o
<i>walkeri</i> Ide	o	x	o	o	o	x	o	o

Characteristics of Nymphs	Mandibles with external tusks projecting forward and visible from above the head. Body of sprawling type. Frontal margin of head somewhat rounded. Mandibular tusks with short spines on dorsal surface and a few on lateral margin. Femora flattened; tibiae and tarsi slender; long, curved spine at tip of fore tibia. Seven pairs of gills; lateral in position. Gills on 1st segment rudimentary; on segments 2-7 paired, each division slender and pointed, margins fringed with long hairs. Three caudal filaments; bare at extreme base and at tip, margined with hairs elsewhere. Body length: 8-15 mm. Illustration: Burks, 1953, fig. 55.
Habitat of Nymphs	Live on bottom amid silt and sand in rather swiftly-flowing streams where they may be found beneath large stones in mid-stream in shallow water. May also occur in gravel in shallow water where they sprawl on bottom. Occasionally nymphs can be found clinging to sides of rocks.
Life History	Time required for development probably one year, although not determined definitely. Eggs have been hatched in the laboratory in 14 days. Adults have been collected from May to mid-August.
Taxonomy	Pictet, 1843. Hist. Nat. 2, Ephem. Neurop. p. 208. Type species: <i>P. luteus</i> (Linnaeus); type locality: Europe.

PSEUDIRON McDUNNOUGH

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>centralis</i> McDunnough	o	o	x	o	o	o	x	o
<i>meridionalis</i> Traver	x	o	o	o	o	o	o	o
species ?	o	o	o	x	o	o	o	o

Characteristics of Nymphs Nymph not known with certainty.

Life History Adults have been collected in June and July.

Taxonomy McDunnough, 1931. Can. Ent. 63: 91. Type species: *P. centralis* McDunnough; type locality: Lawrence, Kansas.

PSEUDOCLOEON KLAPALEK

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>alachua</i> Berner	x	o	o	o	o	o	o	o
<i>anoka</i> Daggey	o	o	x	o	o	o	o	o
<i>bimaculatum</i> Berner	x	o	o	o	o	o	o	o

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>carolina</i> Banks	x	x	o	o	o	x	o	o
<i>chlorops</i> McDunnough	o	o	o	o	o	x	o	o
<i>cingulatum</i> McDunnough	o	o	o	o	o	x	o	o
<i>dubium</i> (Walsh)	x	x	x	o	o	x	o	o
<i>elliotti</i> Daggy	o	o	x	o	o	o	o	o
<i>etowah</i> Traver	x	o	o	o	o	o	o	o
<i>futile</i> McDunnough	o	o	o	o	o	o	o	x
<i>ida</i> Daggy	o	o	x	o	o	o	o	o
<i>minutum</i> Daggy	o	o	x	o	o	o	o	o
<i>myrsum</i> Burks	o	o	x	o	o	o	o	o
<i>parvulum</i> McDunnough	x	o	o	o	o	x	o	x
<i>punctiventris</i> McDunnough	x	o	o	o	o	x	o	o
<i>rubrolaterale</i> McDunnough	o	o	o	o	o	o	o	x
<i>turbidum</i> McDunnough	o	o	o	x	o	o	o	x
<i>veteris</i> McDunnough	o	o	x	o	o	o	o	o
<i>virile</i> McDunnough	o	o	o	o	o	x	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral; labial palp three segmented, distal joint rounded apically. Tarsal claws widest at base, tapering to slender tips; inner margin denticulate; each claw about $\frac{1}{3}$ as long as its respective tarsus. No hind wing pads. Seven pairs of gills, single and platelike. Two well-developed caudal filaments; median filament represented by a minute rudiment. Body length: 3-6 mm. Illustration: Berner, 1950, pl. XXIV.

Habitat of Nymphs Typically live in shallow, fairly rapidly-flowing water in all size streams from extremely small trickles to large rivers. Nymphs have also been taken along margins of lakes where there is some wave action. Preferred habitats in smaller streams appear to be upper side of rocks or other solid structures in swiftest current. Sometimes move into crevices, but mostly they are exposed. In swift water, where there is vegetation, the nymphs cling to tips of leaves where they are fully exposed to current. Often they can be found in numbers in small, pebbly riffles.

Habits of Nymphs Positively rheotropic; awkward swimmers. When forced to move they swim rapidly by vigorous abdominal undulations and strong lashing of caudal filaments, which are not effective propelling organs. Distance moved is extremely short. As soon as swimming ceases, insect spreads the legs, raises the tails, arches the back, and settles to the bottom of container. Highly adapted to living in swiftest waters. There has been a great increase in the relative size of the thorax and legs and a corresponding reduction of the abdomen including an almost entire disappearance of the hairs on caudal filaments, and reduction of middle filament to a mere rudiment. Nymphs are herbivorous.

Life History	Probably takes from 6 to 9 months to complete life cycle. Emergence of subimago occurs in afternoon. Nymph comes to surface, skin splits along dorsum, and subimago immediately rises. Subimagal stage lasts from 8 to 10 hours. In Florida adults have been taken throughout year; in other parts of its range <i>Pseudocloeon</i> has more limited emergence, adults appearing during spring and summer months on into September.
Taxonomy	Klapalek, 1905. Mitt. Naturh. Mus. Hamburg 22: 105. Type species: <i>P. kraepelini</i> Klapalek; type locality: Buitenzorg, Java.

RHITHROGENA EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>amica</i> Traver	x	x	o	o	o	o	o	o
<i>anomala</i> McDunnough	o	x	o	o	o	x	o	o
<i>brunnea</i> (Hagen)	o	o	o	x	o	o	o	o
<i>brunneotincta</i> McDunnough	o	o	o	o	o	x	o	o
<i>decocta</i> Day	o	o	o	x	o	o	o	o
<i>doddsi</i> McDunnough	o	o	o	x	o	o	o	x
<i>exilis</i> Traver	x	o	o	o	o	o	o	o
<i>fasciata</i> Traver	x	o	o	o	o	o	o	o
<i>flavianula</i> (McDunnough)	o	o	o	x	o	o	o	o
<i>fuscifrons</i> Traver	x	o	o	o	o	o	o	o
<i>futilis</i> McDunnough	o	o	o	x	x	o	o	x
<i>gaspeensis</i> McDunnough	o	o	o	o	o	x	o	o
<i>impersonata</i> (McDunnough)	o	o	o	o	o	x	o	o
<i>jejuna</i> Eaton	o	o	o	o	o	o	x	o
<i>morrisoni</i> (Banks)	o	o	o	x	o	o	o	x
<i>pellucida</i> Daggy	o	o	x	o	o	o	o	o
<i>robusta</i> Dodds	o	o	o	x	o	o	o	x
<i>rubicunda</i> Traver	x	o	o	o	o	o	o	o
<i>sanguinea</i> Ide	o	o	o	o	o	x	o	o
<i>uhari</i> Traver	x	o	o	o	o	o	o	o
<i>undulata</i> Banks	o	o	o	x	x	o	o	o
<i>virilis</i> McDunnough	o	o	o	o	o	o	o	x

Characteristics of Nymphs Body flattened. Head flattened; eyes dorsal. Femora flattened, upper surface with many minute, spinelike processes; spines also present on margins; those on posterior margin being longer; tarsal claws short. Gills present on segments 1-7; each gill composed of ventral plate-like element and dorsal tuft of filaments; lamellate portions of 1st and 7th pairs meet beneath body; margins of intermediate pairs overlap one another, free edge of each being deflected and pressed against surface to which nymph clings, forming an adhesive disk on venter; lamellae of 1st pair of gills is largest, anterior lobe much elongated; posterior lobe of 7th pair of gills elongated; others more oval in

outline. Three caudal filaments. Body length 5-12 mm. Illustration: Burks, 1953, fig. 390; Eaton, 1883-88, pl. 54.

Habitat of Nymphs	Live attached to stones in swift currents; often found on irregularly-shaped, smooth stones and in water several inches in depth. In southeast sometimes found in moderately rapid streams. Western nymphs have been found at an elevation as high as 10,400 feet.
Habits of Nymphs	When a rock is lifted from water, nymphs may move quickly from upper side to under side or slip into a crevice. Others may remain perfectly still until an attempt is made to remove them. Difficulty may be experienced as nymphs adhere so tightly to rocks that they can be removed without injury only with considerable care.
Life History	Probably one year required to develop from egg to adult. Nymphs do not leave water to emerge. Mating swarms are small, occurring in late afternoon. Emergence in southern Ontario at 6:45 p.m. in early June. Adults present from May to August.
Taxonomy	Eaton, 1881. Ent. Mo. Mag. 18: 23. Type species: <i>R. semicolorata</i> (Curtis); type locality: Europe.

SIPHONISCA NEEDHAM

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>aerodromia</i> Needham	o	x	o	o	o	o	o	o

Characteristics of Nymphs	Body streamlined. Head rounded; eyes lateral. Spines present on the meso- and metasterna of the thorax. Lateral margins of apical, abdominal segments more or less expanded into flat, lateral extensions so that abdominal segments 5-9 are widely flaring. Gills single, very broad and platelike with abundant tracheation. Three caudal filaments, with middle one slightly shorter than the laterals. Body length 19-20 mm. Illustration: not illustrated in full, parts in Burks, 1953, fig. 234; parts in Clemens, 1915, pl. X, figs. 1-5, pl. XI, figs. 1-5.
Habitat of Nymphs	Found in small, temporary pools resulting from stream overflow.
Life History	Little known. Earliest observations of nymphs made on May 25; emergence noted on this same day. By May 28, pool completely dry, but all nymphs emerged. Nymphs crawl from water 3-4 inches up rush stems to emerge; occurs at all hours of day, but more common in late forenoon; all emergence seems to terminate early in June.

Taxonomy Needham, 1908. N. Y. St. Mus. Bull. 134: 72. Type species: *S. aerodromia* Needham; type locality: Scandaga Park, New York.

SIPHLONURUS EATON

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>alternatus</i> (Say)	o	x	x	o	o	x	o	o
<i>autumnalis</i> McDunnough	o	o	o	o	o	o	o	x
<i>barbaroides</i> McDunnough	o	x	o	o	o	x	o	o
<i>barbus</i> McDunnough	o	x	o	o	o	x	o	o
<i>columbianus</i> Eaton	o	o	o	x	o	o	o	x
<i>decorus</i> Traver	x	o	o	o	o	o	o	o
<i>inflatus</i> McDunnough	o	o	o	o	o	o	o	x
<i>luridipennis</i> (Burmeister)	x	o	o	o	o	o	o	o
<i>marginatus</i> Traver	x	o	o	o	o	o	o	o
<i>marshalli</i> Traver	o	o	x	o	o	o	o	o
<i>mirus</i> Eaton	x	x	o	o	o	o	o	o
<i>occidentalis</i> Eaton	o	o	o	x	x	o	o	x
<i>phyllis</i> McDunnough	o	o	o	o	o	x	o	x
<i>quebecensis</i> (Provancher)	x	x	o	o	o	x	o	o
<i>rapidus</i> McDunnough	o	x	x	o	o	x	o	o
<i>securifer</i> McDunnough	o	x	o	o	o	x	o	o
<i>spectabilis</i> Traver	o	o	o	x	o	o	o	o
<i>typicus</i> Eaton	o	x	x	o	o	x	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral. Tarsal claws long and slender. Postero-lateral angles of apical abdominal segments expanded into flat, lateral extensions terminating in postero-lateral spines. Gills double on abdominal segments 1 and 2 only or all 7 pairs double; large and platelike with abundant tracheation. Three caudal filaments; median filament with long hairs on both sides, lateral with hairs on inner side. Body length: 9-20 mm. Illustration: Eaton, 1883-88, pl. 50.

Habitat of Nymphs Usually found in shallow, quiet pools along edges of streams where they climb among the vegetation or move over the bottom. Sometimes found in shallow pools, filled by seepage water, on rock ledges, and in shallow pools fed intermittently with fresh water. Some species recorded from margins of lakes and from vegetation in ponds. Younger nymphs of some species may be found in flowing water; mature nymphs migrate to quiet water.

Habits of Nymphs *S. occidentalis*, a pond-dwelling species, swims moderately well, but spends most of its time half-buried in silty bottom. When disturbed swims rapidly to another place, then comes to rest on bottom. When resting can be detected by flickering move-

ments of its large gills which are in constant motion. Swims by rapidly vibrating caudal filaments. When swimming, legs extended laterally and backward in position assumed while resting on the bottom.

Life History Emergence of adults from April through July. Nymphs crawl entirely out of water to emerge. Emergence in morning or early afternoon. Subimagal stage lasts from 26-53 hours. Length of nymphal life not determined; probably one year.

Taxonomy Eaton, 1868. Ent. Mag. 5: 89. Type species: *S. flavidus* (Pictet); type locality: San Ildefonso, Spain.

SIPHLOPLECTON CLEMENS

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>basale</i> (Walker)	x	x	x	o	o	x	x	o
<i>costalense</i> Spieth	x	o	o	o	o	o	o	o
<i>interlineatum</i> (Walsh)	o	o	x	o	o	o	x	o
<i>signatum</i> Traver	x	o	o	o	o	o	o	o
<i>speciosum</i> Traver	x	o	o	o	o	o	o	o

Characteristics of Nymphs Body streamlined. Head rounded; eyes lateral. Tarsal claws of fore legs bifid; all other claws slender and longer than tibiae. Gills present on abdominal segments 1-7; single and platelike on segments 4-7, double on segments 1-3, or with small, recurved ventral flaps on gills 1-3. Three caudal filaments; middle filament with fringe of long hairs on both sides, lateral caudal filaments fringed on medial side only. Body length: 9-16 mm. Illustration: not illustrated in full; parts in Burks, 1953, figs. 302, 303, 305.

Habitat of Nymphs In slowly flowing, larger streams where they occur close to shore among vegetation; in water from 3-4 inches to 2 feet. Nymphs also occur at shores of lakes in Canada and North Carolina.

Habits of Nymphs Very active and vigorous swimmers if disturbed in quiet water. When attempts made to pick them up, they hop about like small minnows. Swim very rapidly in short spurts.

Life History Unknown. Development probably takes one year. Subimagal stage in Georgia specimens required approximately 48 hours. In southeast adult specimens have been taken from late March through mid-April; farther north, adults have been taken in June.

Taxonomy Clemens, 1915. Can. Ent. 47: 258. Type species: *S. basale* (Walker); type locality: Lake Winnipeg, Manitoba.

STENONEMA TRAVER

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>alabamæ</i> Traver	x	0	0	0	0	0	0	0
<i>annexum</i> Traver	x	0	0	0	0	0	0	0
<i>areion</i> Burks	0	0	x	0	0	0	0	0
<i>ares</i> Burks	0	0	x	0	0	0	0	0
<i>bipunctatum</i> (McDunnough)	0	0	x	0	0	x	0	0
<i>canadense</i> (Walker)	0	x	x	0	0	x	0	0
<i>carolina</i> (Banks)	x	x	0	0	0	x	0	0
<i>exiguum</i> Traver	x	0	x	0	0	0	0	0
<i>femoratum</i> (Say)	x	0	x	0	0	x	0	0
<i>frontale</i> (Banks)	x	x	x	0	0	x	0	0
<i>fuscum</i> (Clemens)	0	x	0	0	0	x	0	0
<i>gildersleevei</i> Traver	0	0	x	0	0	0	0	0
<i>heterotarsale</i> (McDunnough)	x	0	x	0	0	0	0	0
<i>integrum</i> (McDunnough)	x	0	x	0	0	0	0	0
<i>interpunctatum</i> (Say)	x	0	x	0	0	0	0	0
<i>ithaca</i> (Clemens and Leonard)	x	x	x	0	0	x	0	0
<i>lepton</i> Burks	0	0	x	0	0	0	0	0
<i>luteum</i> (Clemens)	0	0	0	0	0	x	0	0
<i>mediopunctatum</i> (McDunnough)	0	x	0	0	0	x	0	0
<i>metriotes</i> Burks	0	0	x	0	0	0	0	0
<i>minnetonka</i> Daggy	0	0	x	0	0	0	0	0
<i>modestum</i> (Banks)	0	x	0	0	0	0	0	0
<i>nepotellum</i> (McDunnough)	0	x	x	0	0	x	0	0
<i>puadicum</i> (Hagen)	x	x	0	0	0	0	0	0
<i>pulchellum</i> (Walsh)	0	x	x	0	0	x	0	0
<i>rubromaculatum</i> (Clemens)	x	x	x	0	0	x	0	0
<i>rubrum</i> (McDunnough)	x	x	0	0	0	x	0	0
<i>scitulum</i> Traver	0	0	x	0	0	0	0	0
<i>smithæ</i> Traver	x	0	0	0	0	0	0	0
species ?	0	0	0	x	x	0	0	0
<i>terminatum</i> (Walsh)	0	x	x	0	0	x	x	0
<i>tripunctatum</i> (Banks)	0	x	x	0	0	x	0	0
<i>varium</i> Traver	x	0	0	0	0	0	0	0
<i>vicarium</i> (Walker)	x	x	0	0	0	x	0	0

Characteristics of Nymphs: Body flattened. Head flattened; eyes dorsal. Femora flattened; tarsal claws short. Seventh pair of gills reduced to slender filament. Three types of abdominal gills (1) those on segments 1-6 pointed at the apexes; each gill of 7th pair with one longitudinal trachea; (2) first 6 pairs of gills rounded at apexes; each gill of 7th pair with 1 or 2 longitudinal tracheae; (3) gills on segments 1-6 truncate at the apexes, and gills of 7th pair without tracheae. Three caudal filaments. Body length: 6-20 mm. Illustration: Berner, 1950, pl. II.

Habitat of Nymphs May be found in variety of situations; generally occur in moderate to swift-flowing streams of all sizes. On under surfaces of stones and rocks in streams where they tend to hide in crevices, or on debris lodged in stream, or among leaves that accumulate in more slowly flowing portion of stream; occasionally in pools and backwaters. May also be found on rooted vegetation at banks of streams. Some species occur in lakes where there is some wave action near shore; nymphs attach to debris or stones along the edge.

Habits of Nymphs. Cling tenaciously to objects on which they live within streams. When lifted from water, nymphs frequently scramble to underside of rock or stick to which they are attached. Sometimes rather difficult to detach because of their strong hold. When water drains away from support on which nymphs are located they cease moving, and detection becomes rather difficult. If a little water is dashed over object, the nymphs again become active. Some reach rim of the support and drop off. Swimming is awkward, accomplished by an undulating motion of the body; swim forward only; can walk in almost any direction with equal ease. Strongly thigmatactic. If several nymphs are placed together in a dish of water with nothing to which they may hold, form in a clump and remain thus until some other object is placed in the water with them. Desire for contact so strong that nymphs crawl into a crevice until even the dorsum of body is in contact with some object. Strongly flattened femora, and spreading legs of nymphs reduce resistance to a minimum in flowing-water habitat.

Life History Time required for development has not been determined. In southeastern United States development may be completed in less than one year; in colder areas of North America probably one year required. Ovipositing female flies low over water, touching surface intermittently, dropping a few eggs with each contact. Development of eggs of several species take from 11-23 days in laboratory. Total number of instars estimated to be between 40 and 45 for *Stenonema canadense*. Thigmotactic and phototropic responses present in nymphs upon hatching. Emergence occurs while nymph floats at the surface of water; emergence takes only a few seconds; subimago appears almost immediately and flies away. Subimagal stage lasts from 20-36 hours.

Taxonomy Traver, 1933. Jour. Elisha Mitchell Sci. Soc. 48: 173. Type species: *S. tripunctatum* (Banks); type locality: Milwaukee, Wisconsin.

THRAULODES ULMER

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>arizonicus</i> McDunnough	o	o	o	x	o	o	o	o
<i>speciosus</i> Traver	o	o	o	x	o	o	o	o
Characteristics of Nymphs	Body depressed. Head in South American species flattened. Seven pairs of double, lanceolate gills diminishing in size posteriorly. Postero-lateral angles of abdominal segments 2-9 produced as slender spines. Three caudal filaments of equal length. Illustration: not illustrated in full; parts in Traver, 1944, figs. 2d, 3, 4.							
Habitat of Nymphs	Occur in streams. No observations have been made on these nymphs in North America.							
Life History	Adults have been collected in June and July.							
Taxonomy	Ulmer, 1919. Arch. Naturg. 85:33. Type species: <i>T. laetus</i> (Eaton); type locality: New Granada (Columbia).							

TORTOPUS NEEDHAM AND MURPHY

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>circumfluus</i> Ulmer	o	o	x	o	o	o	o	o
<i>incertus</i> Traver	x	o	o	o	o	o	o	o
<i>primus</i> (McDunnough)	o	o	x	o	o	o	x	o
Characteristics of Nymphs	Mandibles with external tusks projecting forward and visible from above head. Tusks with heavy spines on outer margins; inner margin bears weak spines; large thumb-like spine proximal to tip on medial side. Front of head rounded, lacking frontal process. Fore leg with the tibia somewhat flattened, fossorial. Seven pairs of abdominal gills. First gill rudimentary and single. Other 6 pairs fully developed; margined with long filaments. Gills bilobed, each lobe has a prominent central trachea with inconspicuous lateral branches. Three caudal filaments, median equal to or shorter and thinner than laterals. Illustration: Scott, Berner and Hirsch, 1959, figs. 3-14.							
Habitat of Nymphs	Burrow in clay banks of large rivers; in some places literally honeycomb banks at almost every bend of river. Where bank is suitable nymphs may be located between bends.							
Life History	Unknown. Estimated that 2 years required for development.							
Taxonomy	Needham and Murphy, 1924. Bull. Lloyd Lib. 24, Ent. Ser. 4: 23. Type species: <i>T. igaranus</i> Needham and Murphy; type locality: Rio Igara-Parana, Peru.							

TRAVERELLA EDMUNDS

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>albertana</i> (McDunnough)	o	o	o	x	o	o	o	x
<i>presidiana</i> (Traver)	o	o	x	o	o	o	o	o

Characteristics of Nymphs Body depressed. Head rectangular; eyes dorsal; labrum as wide as head. Legs depressed; tarsal claws with about 12 denticles, those on fore legs short and wartlike, those of middle and hind legs usually well developed. Postero-lateral corners of abdominal segments 8 and 9 developed into spines. All gills double; 1st pair largest, others diminishing in size to gill 7; 1-5 bilamellate, each lamella with a fimbriate margin, posterior member of each pair about $\frac{2}{3}$ to $\frac{3}{4}$ as large as anterior member. Gill 6 similar to anterior gills except that body of posterior member so reduced as to make gill fibrilliform. Gill 7 with both members fibrilliform, posterior member smaller. Three caudal filaments; median filament slightly longer than laterals. Body length: 7-10 mm. Illustration: Edmunds, 1948, pl. V, figs. 8-15, pl. VI.

Habitat of Nymphs In rapids of medium-sized to large streams where nymphs may be found on underside of rocks. On some rocks nymphs occur in large numbers, more than a hundred being found per square foot of surface.

Life History Observations have only been made on *T. albertana*. Emergence occurs in late August and probably through September. Subimagoes begin emergence at about 7:10 p.m. when light intensity reduced to approximately 5 foot candles. Great majority of individuals emerge within 20 minutes of this period, followed by an abrupt cessation as light intensity dropped to less than 1 foot candle.

Taxonomy Edmunds, 1948. Proc. Biol. Soc. Wash. 61: 141. Type species: *T. albertana* (McDunnough); type locality: Medicine Hat, Alberta.

TRICORYTHODES ULMER

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>albilineatus</i> Berner	x	o	o	o	o	o	o	o
<i>allectus</i> Needham	o	x	o	o	o	o	o	o
<i>atratus</i> McDunnough	o	o	x	o	o	x	o	o
<i>explicatus</i> (Eaton)	o	o	x	x	o	o	o	o

Species	United States					Canada		
	S.E.	N.E.	C.	S.W.	N.W.	E.	C.	W.
<i>fallax</i> Traver	o	x	o	x	x	x	x	o
<i>fictus</i> Traver	o	o	x	o	o	o	o	o
<i>minutus</i> Traver	o	o	o	x	o	o	o	x
<i>peridius</i> Burks	o	o	x	o	o	o	o	o
<i>stygiatus</i> McDunnough	o	o	x	o	o	x	o	o
<i>texanus</i> Traver	o	o	x	o	o	o	o	o

Characteristics of Nymphs Short, stout. Head rounded; eyes lateral; apical margin of labrum rather deeply notched at median line. No hind wing pads present. Legs relatively long; tarsal claws long and hooked at apex. Gills present on abdominal segments 2-6; those on 2 subtriangular and operculate; segments 3-6 with a pair of double, platelike gills, each has the margins entire. Three caudal filaments which are relatively long and stout and have a whorl of setae at each articulation. Body length: 3-7 mm. Illustration: Berner, 1950, pl. XV.

Habitat of Nymphs In streams which have at least a perceptible current. May be found amid fine sand and gravel on stream beds or in moss or other plant growth on large stones; sometimes at bank near bases of rooted vegetation or among exposed, washed roots of terrestrial plants. All streams from which nymphs have been taken are permanent, varying in size from rather small creeks to large rivers.

Habits of Nymphs Principally herbivores. Awkward swimmers; undulatory action of abdomen produces forward movement. Seldom swim; move almost entirely by crawling.

Life History Time required for nymphal development not determined; but in southern portion of range, probably less than one year. When ready to emerge nymph comes to surface, and subimago immediately bursts free. Emergence occurs after dark in some species or in very early hours of morning in others. At time of emergence large number of adults come out simultaneously. Length of subimaginal stage not determined, but very brief. In southeastern position of range, especially in Florida, emergence occurs from February to October; farther north the period of emergence from May to August. Some species of *Tricorythodes* are said to shed subimaginal skin while in flight; however, this point is in dispute. The general impression is that adults alight to molt.

Taxonomy Ulmer, 1920. Stett. Ent. Zeit. 81: 122. Type species: *T. explicatus* (Eaton); type locality: North Sonora, Mexico.

SELECTED REFERENCES

Berner, Lewis

1950. The mayflies of Florida. University of Florida Press, Gainesville. Bio. Sci. Ser. xii + 267 p. 88 figs., 24 pls., 19 maps.
1955. The southeastern species of *Baetisca* (Ephemeroptera: Baetiscidae). Quart. Jour. Fla. Acad. Sci. 18(1): 1-19, 23 figs.
1956. The genus *Neoephemera* in North America (Ephemeroptera: Neoephem-eridae). Ann. Ent. Soc. Amer. 49(1): 33-42, 26 figs.

Burks, B. D.

1953. The mayflies, or Ephemeroptera, of Illinois. Bull. Ill. Nat. Hist. Survey. Vol. 26, Art. 1, 1-216, 395 figs.

Clemens, W. A.

1915. Mayflies of the *Siphonurus* group. Can. Ent. 47: 245-260, pl. 9-11.

Day, W. C.

1955. New genera of mayflies from California (Ephemeroptera). Pan-Pacific Ent. 31(3): 121-137, pls. I-V.
1956. Ephemeroptera. (Chap. 3 in Aquatic insects of California. R. L. Using-er, Ed., U. of Calif. Press. Berkeley) p. 79-105, 28 figs.

Eaton, A. E.

- 1883-88. A revisional monograph of recent Ephemeridae or mayflies. Trans. Linn. Soc. London. Sec. Ser. Zool. Vol. 3, pp. 1-352, 65 pls.

Edmunds, G. F., Jr.

1948. A new genus of mayflies from western North America (Leptophlebiinae). Proc. Biol. Soc. Wash. 61: 141-148, pl. V-VI.
1951. New species of Utah mayflies. I. Oligoneuriidae (Ephemeroptera). Proc. Ent. Soc. Wash. 53(6): 327-331, pl. 41.

Edmunds, G. F., and R. K. Allen

1957. A checklist of the Ephemeroptera of North America north of Mexico. Ann. Ent. Soc. Amer. 50(4): 317-324.

Edmunds, G. F., Jr., L. Berner, and Jay R. Traver

1958. North American mayflies of the family Oligoneuriidae. Ann. Ent. Soc. Amer. 51(4): 375-382, 31 figs.

Edmunds, George F., Jr., and Jay R. Traver

1959. The classification of the Ephemeroptera I. Ephemeroidea: Behningiidae. Ann. Ent. Soc. Amer. 52(1): 43-51, 32 figs.

Hunt, B. P.

1953. The life history and economic importance of a burrowing mayfly, *Hexagenia limbata*, in southern Michigan lakes. Bull. Inst. for Fish. Res., Mich. Dept. Conserv. no. 4. 151 p., 45 figs., 62 tabs.

Ide, F. P.

1935. The effect of temperature on the distribution of the mayfly fauna of a stream. Univ. of Toronto Studies, Biol. Ser. 39, Pub. Ont. Fish. Res. Lab. 50: 9-76, pls. 1-10.

McDunnough, J.

1931. The *bicolor* group of the genus *Ephemerella*, with particular reference to the nymphal stages. Can. Ent. 63: 30-42, 61-68, pls. 2-5.
1931. The eastern North American species of the genus *Ephemerella* and their nymphs. Can. Ent. 63: 187-197, 201-216, pls. 11-14.
1933. The nymph of *Cinygma integrum* and description of a new Heptagenine genus. Can. Ent. 65: 73-76, pl. 2-3.

Needham, J. G.

1921. Burrowing mayflies of our larger lakes and streams. U.S. Bur. Fish. Bull. for 1917-18. 36: 265-292, pls. 70-82.

Needham, J. G., and Helen E. Murphy

1924. Neotropical mayflies. Bull. Lloyd Lib. no. 24. Ent. Ser. 4: 1-79, pls. 1-13.

Neewham, J. G., J. R. Traver, and Yin-Chi Hsu

1935. The biology of mayflies with a systematic account of North American species. Comstock Pub. Co., Ithaca, xvi + 759, 40 pls., 168 figs.

Pennak, R. W.

1953. Fresh-water invertebrates of the United States. Ronald Press Co., New York. ix + 769 p., 470 figs.

Scott, D. C., L. Berner, and A. Hirsch

1959. The nymphs of the mayfly genus *Tortopus* (Ephemeroptera: Polymitarcidae). Ann. Ent. Soc. Amer. 52(2): 205-213, 14 figs.

Spieth, H. T.

1941. Taxonomic studies on the Ephemeroptera. II. The genus *Hexagenia*. Amer. Mid. Nat. 26: 233-280, 50 figs., 12 maps.
1947. Taxonomic studies on the Ephemeroptera. IV. The genus *Stenonema*. Ann. Ent. Soc. Amer. 40(1): 87-122, figs. 29-31, pls. 1-2.

Traver, Jay R.

- 1932-33. Mayflies of North Carolina. Jour. Elisha Mitchell Sci. Soc. 47(1): 85-161, pls. 5-12; (2): 163-236; 48(2): 141-206, pl. 15.
1944. I. Notes on Brazilian mayflies. Boletim do Museu Nacional—Zool. No. 22: 2-53, 20 figs.

Walley, G. S.

1930. Review of *Ephemerella* nymphs of western North America. Can. Ent. 62: 12-20, pls. 1-3.

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