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A study of the stoneflies (Plecoptera) of the Yampa River Drainage System Moffat and Routt Co. Colorado

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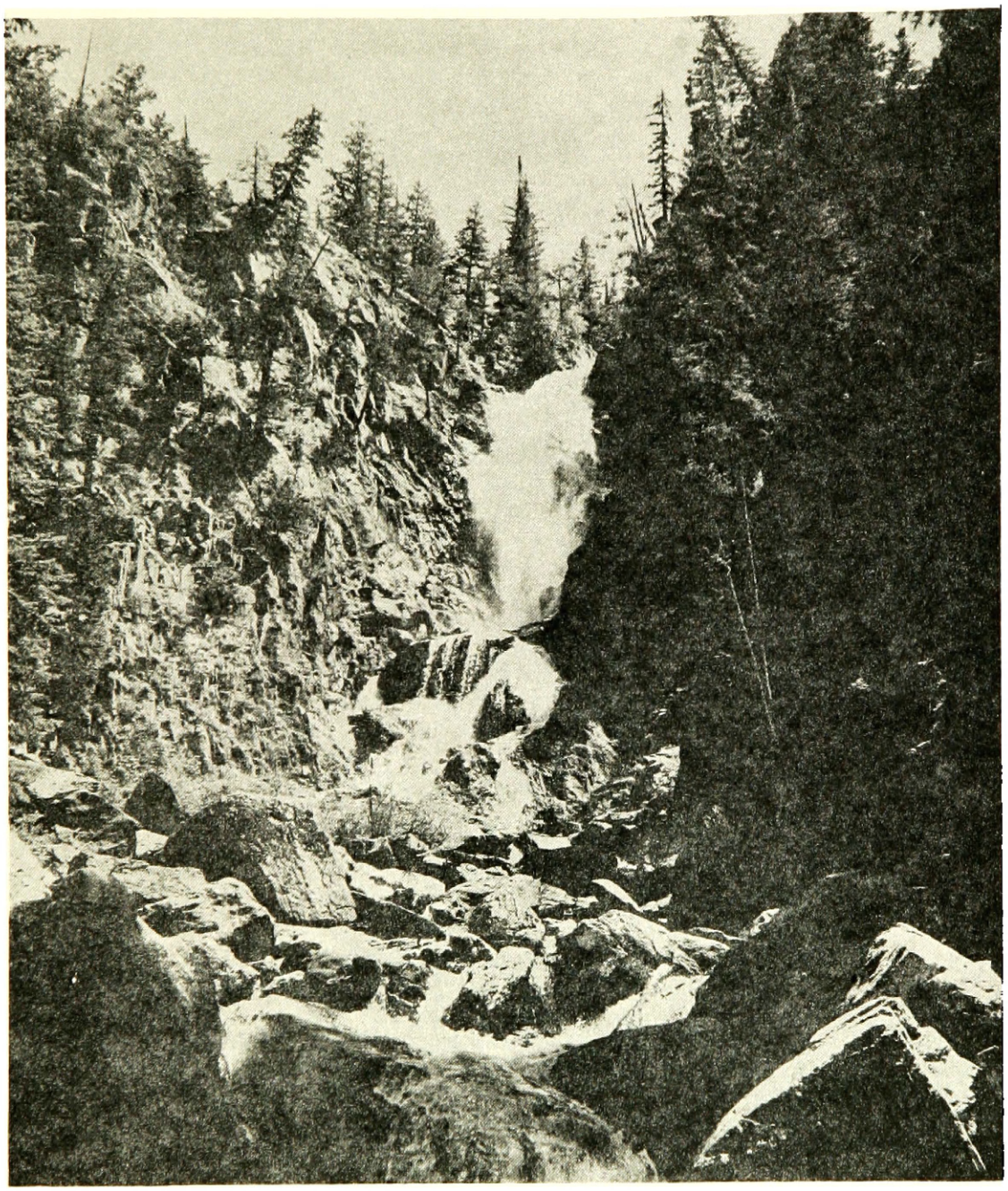

Fish Creek Falls, Steamboat Springs,

Colorado

A STUDY OF THE STONEFLIES (PLECOPTERA) OF THE YAMPA RIVER DRAINAGE SYSTEM, MOFFAT AND ROUTT CO., COLORADO

By

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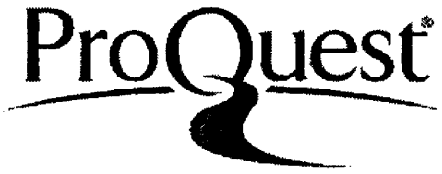

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CHAPTER I

INTRODUCTION

This study is part of a larger Intermountain Region project which has been in progress for the past ten years. Its purpose is an extensive study of the stonefly fauna in the western states, especially in the Rocky Mountain region. Because of the rich diversity of species collected in the Yampa River drainage system by Dr. Arden Gaufin in 1961 and 1962, further studies were justified in this particular area.

I. OBJECTIVES

The primary objectives of the study were:

1. To determine the genera and species of stoneflies found in the study area.
2. To prepare a dichotomous key including illustrations for the identification of species.
3. To determine the geographic and altitudinal distribution of the species within the drainage.
4. To obtain chemical and physical data and determine its relation to stonefly distribution.
5. To determine seasonal adult emergence patterns.
6. To present relevant ecological findings, such as habitat preferences, and adult behavior patterns.
7. To review previous work done in the study area and present it with current findings.

II. DESCRIPTION OF AREA

The Yampa River Drainage System lies in the extreme northwestern portion of Colorado. The river flows through Routt and Moffat counties, passing by the towns of Yampa, Oak Creek, Steamboat Springs, Craig, Maybell, and Sunbeam. The Yampa is a tributary of the Green River, their junction being located at Echo Park, Dinosaur National Monument. The river is about 180 miles in length and has a drainage area of 5,900 square miles. It heads in Egeria Park, flows north for about 35 miles and then turns abruptly to the west, holding a comparatively straight course to its mouth.

The elevational range of the river is quite varied making it an excellent area for the altitudinal studies of Plecoptera. The river itself varies from about 8,000 feet at its source to 5,000 feet at its mouth. One of the tributaries, Bear River, reaches an elevation of 9,700 feet.

The drainage area includes the Park Range and the Elkhead Mountains. The Park Range is a subordinate portion of the Rocky Mountain Range and lies to the east of the upper Yampa River. The Elkhead Mountains, a group formed by volcanic activity of late Tertiary or Quarternary times, is located to the north of the Yampa. Its eastern extremity is Hahn's Peak (George and Crawford, 1908). Hahn's Peak is a landmark famous for gold diggings. South of Hahn's Peak near Hayden, are found cretaceous and post-cretaceous strata while to the east outcropings of tertiary rocks are found. Beds belonging to the Silurian and Carboniferous eras are found near the town of Oak Creek (George and Crawford, 1908).

A major portion of the Yampa tributaries drain the Routt National Forest. This area has lush vegetation. Predominating are Engelmann spruce, lodgepole pine, other conifers, stands of quaking aspen, mountain alder, and various willows along the creek banks.

Between the towns of Yampa and Steamboat Springs is the Yampa Valley. Here the land is used for agricultural and pastoral purposes.

The country from Steamboat Springs to the mouth of the Yampa River at Echo Park is quite varied. There are many basins and canyons with spots of well developed valley. The climate near Maybell is very dry and vegetation becomes scant. Due to the bareness of the land frequent flooding has washed off top soil and exposed bare stratified rock (Hayden, 1878). The geologic history of this section of the Yampa is of interest. It is believed that the river first flowed over and cut into relatively soft rock. After the course was well established uplift occurred in the region forcing the river to cut into harder substrata. The resulting gorge is a deep canyon and lies just southeast of the Uinta Mountains. The walls are from 500 to 1,500 feet high (U. S. Dept. of Interior, 1966). The semidesert country of plateaus adjacent to the canyons is typical of the lower Yampa River and produces peculiar stonefly fauna quite different from the upper portion of the stream.

III. REVIEW OF THE LITERATURE

Literature concerning the stoneflies (Plecoptera) of Colorado is very limited. The initial study in this area was carried on between the years of 1872 and 1874 by H. A. Hagen. Available literature since

that time consists only of an occasional description of a new species or a new state record. Plecopterists Nathan Banks (1918), P. W. Claassen (1931), and T. H. Frison (1944) have made some contributions. The "Systematic List of Plecoptera of the Intermountain Region" by Arden Gaufin summarizes the earlier workers' findings and presents a listing of species found up to 1964 in Colorado. Allen Knight's study (1965) increased that listing. There is no literature concerning the stoneflies of the Yampa River drainage.

Many taxonomic papers have been published concerning Plecoptera in states adjacent to Colorado. "The Stoneflies of Utah" by Gaufin, et. al. (1966); "Systematic Studies in Plecoptera" by Ricker (1952); "The Stoneflies (Plecoptera) of the Pacific Northwest" by Jewett (1959) and the recent publications on the Capnia by Nebeker and Gaufin (1965, 1967) proved very valuable for this study. Other necessary works were by Ricker (1943, 1965); and Hanson (1946, 1949, and 1961). The monograph by J. G. Needham and P. W. Claassen (1925) along with Frison's works (1929, 1935a, 1937, and 1944) remain classics.

Ecological studies dealing with stoneflies are few. The works of Hynes (1941) and Brinck (1949) present various ecological factors which tend to control stonefly distributions. Such things as water movement, oxygen supply of the water, temperature, substrates, and food are mentioned in both papers. Other major papers dealing with stonefly ecology are: Frison (1935a), Macan (1962), Rauser (1968), Sowa (1965), and Kamler (1965).

In the Intermountain Region several excellent ecological studies on stoneflies have been completed. Dodds and Hisaw (1925) made a study

on the altitudinal range and zonation of stoneflies in Colorado. More recent publications by Knight and Gaufin (1966, 1967) present interesting ecological data from the Gunnison River drainage in Colorado. The work by R. A. Muttkowski "The Ecology of Trout Streams" (1929) aided this study. The book "Freshwater Ecology" by T. T. Macan (1963) brings together much of the recent literature concerning aquatic ecology and includes a discussion of factors which cause alterations in community composition.

CHAPTER II

FIELD METHODS AND PROCEDURES

Ten locations along the Yampa River, twenty primary tributaries, and fourteen secondary creeks were chosen for qualitative sampling. (See Figure 1.). The collections of Dr. Arden Gaufin (1961, 1962, and 1963) plus those of Dr. Allen Nebeker (1965) were also included in this study.

An attempt was made to collect in all four seasons. The dissolved oxygen content, free CO_2, carbonate and bicarbonate alkalinity, pH, and temperature were the chemical parameters determined. The methods used follow those described by Welch (1948).

Stonefly Collection Techniques. Stonefly naiads were collected most often by means of a handscreen. When taking a sample the lower edge of the screen was placed next to the stream bottom while upstream, stones and bottom detritus were loosened by the collector by scuffing the bottom with his boot. The stoneflies were dislodged and carried downstream into the screen by the current. Frequently nymphs were taken by examining log jams while other mature naiads were occasionally found near the rivers' edge.

Several methods were used in collecting the adult stoneflies. Winter forms (Capniidae, Nemourinae) were taken with forceps from the snow and ice or under rocks. Aerial nets or beating nets were effective in the spring and summer seasons for the many stoneflies which prefer the lush vegetation along the stream banks. Both naiads and adults

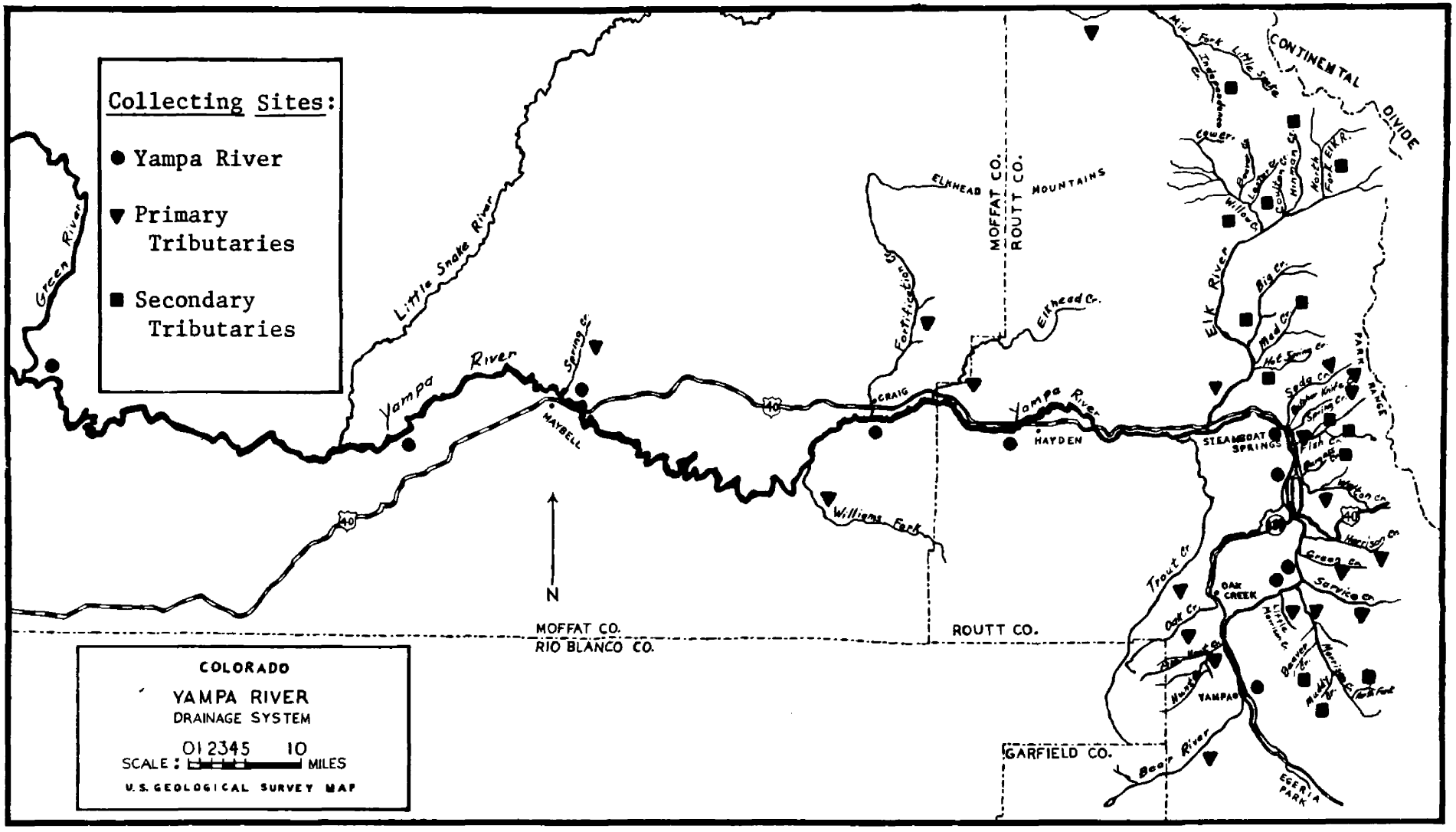


Fig. 1. Map of the Yampa River Drainage System.

were preserved in 80% ethanol in three dram vials.

Dissolved Oxygen (O_2). The unmodified Winkler-method was employed for determining the amount of dissolved oxygen in the water. Samples were taken in a 250 cc. ground-glass stoppered bottle. Sodium thiosulfate ($Na_2S_2O_3$) N/40 was used in titration. This was standardized using potassium dichromate ($K_2Cr_2O_7$). The dissolved oxygen was reported in parts per million.

Free Carbon Dioxide (CO_2). The amount of free carbon dioxide was approximated by employing phenolphthalein indicator and titrating with N/44 sodium hydorxide until a faint pink color remained for at least 30 seconds.

Alkalinity. Phenolphthalein alkalinity was determined by titrating with N/50 sulfuric acid, employing phenolphthalein as an indicator. Results were expressed in parts per million $CaCO_3$. Brom-creosol green-methyl red alkalinity was determined by titrating with N/50 sulfuric acid employing the brom-creosol green-methyl red indicator. This alkalinity was also expressed in parts per million $CaCO_3$.

Temperature. Air temperatures as well as water temperatures were taken. Water temperatures were taken by placing the bulb of a mercury glass thermometer just below the surface.

Hydrogen Ion Concentration (pH). The Hellige Standard Comparator pH Kit was used in determing the hydrogen ion concentration. Non-fading class color standards with appropriate indicators were used.

Bottom type. The bottom type was observed directly and a general size evaluation was made of the substrate in the different rivers. The substrate ranged from silt and sand to large boulders over one meter in diameter.

Elevation. Elevational readings were taken with a standard altimeter.

CHAPTER III

TAXONOMY AND DISTRIBUTION
OF STONEFLIES, YAMPA RIVER DRAINAGE, COLORADO

The following chapter presents the taxonomical and distributional portion of the thesis. The systematics presented follow closely to those outlined by Ricker (1952). The taxonomic keys and nomenclatures from "The Stoneflies of Utah", Gaufin et.al. (1966), have been used where applicable to the species in the study area. Other taxonomical aids in preparation of the keys were Jewett (1959), Ricker (1943, 1952), and Nebeker and Gaufin (1965). The publication of Hanson (1946) was referred to in preparing a taxonomic key for the genus Paracapnia. The recent work, "Katalog der rezenten Plecoptera", by J. Illies (1966) was also used in preparation of the nomenclatures for many of the species.

I. CHECK LIST

Suborder FILIPALPIA

Family NEMOURIDAE

Subfamily NEMOURINAE

Genus Nemoura Latreille, 1796

Subgenus Amphinemura Ris, 1902

Nemoura venusta Banks, 1911

Subgenus Malenka Ricker, 1952

Nemoura californica Claassen, 1923

Nemoura coloradensis Banks, 1897

Subgenus Podmosta Ricker, 1952

Nemoura decepta Frison, 1942

Nemoura delicatula Claassen, 1923

Subgenus Prostoia Ricker, 1952

Nemoura besametsa Ricker, 1952

Subgenus Zapada Ricker, 1952

Nemoura cinctipes Banks, 1897

Nemoura haysi Ricker, 1952

Nemoura oregonensis Claassen, 1923

Subfamily LEUCTRINAE

Genus *Paraleuctra* Hanson, 1941

Paraleuctra occidentalis (Banks), 1907

Paraleuctra sara (Claassen), 1937

Subfamily CAPNIINAE

Genus *Capnia* Pictet, 1841

Subgenus Utacapnia Nebeker and Gaufin, 1967

Capnia lemoniana Nebeker and Gaufin, 1965

Capnia logana Nebeker and Gaufin, 1965

Capnia poda Nebeker and Gaufin, 1965

Subgenus Capnia s. s.

Capnia coloradensis Claassen, 1937

Capnia confusa Claassen, 1937

Capnia gracilaria Claassen, 1924

Capnia limata Frison, 1944

Genus Eucapnopsis Okamoto, 1923

Eucapnopsis brevicauda (Claassen), 1924

Genus Paracapnia Hanson, 1946

Paracapnia angulata Hanson, 1961

Subfamily TAENIOPTERYGINAE

Genus Brachyptera Newport, 1851

Subgenus Oemopteryx Klapalek, 1902

Brachyptera fosketti Ricker, 1965

Subgenus Taenionema Banks, 1905

Brachyptera nigripennis (Banks), 1918

Brachyptera pacifica (Banks), 1900

Family PTERONARCIDAE

Genus Pteronarcella Banks, 1900

Pteronarcella badia (Hagen), 1873

Genus Pteronarcys Newman, 1838

Suborder SETIPALPIA

Family PERLODIDAE

Subfamily ISOGENINAE

Genus Arcynopteryx Klapalek, 1904

Subgenus Megarcys Klapalek, 1912

Arcynopteryx signata (Hagen), 1874

Subgenus Skwala Ricker, 1943

Arcynopteryx parallela Frison, 1936

Genus Isogenus Newman, 1833

Subgenus Cultus Ricker, 1952

Isogenus aestivalis (Needham and Claassen), 1925

Subgenus Isogenoides Klapalek, 1912

Isogenus colubrinus Hagen, 1874

Isogenus elongatus Hagen, 1874

Subgenus Kogotus Ricker, 1952

Isogenus modestus (Banks), 1908

Subfamily ISOPERLINAE

Genus *Isoperla* Banks, 1906

Isoperla ebria (Hagen), 1875

Isoperla fulva Claassen, 1937

Isoperla longiseta Banks, 1906

Isoperla patricia Frison, 1942

Isoperla pinta Frison, 1937

Isoperla 5-punctata (Banks), 1902

Subfamily PERLODINAE

Genus *Diura* Billberg, 1820

Subgenus Dolkrila Ricker, 1952

Diura knowltoni (Frison), 1937

Family CHLOROPERLIDAE

Subfamily PARAPERLINAE

Genus *Paraperla* Banks, 1906

Paraperla frontalis (Banks), 1902

Subfamily CHLOROPERLINAE

Genus *Alloperla* Banks, 1906

Subgenus Alloperla Banks, 1906

Alloperla severa (Hagen), 1861

Subgenus Suwallia Ricker, 1943

Alloperla lineosa Banks, 1918

Alloperla pallidula (Banks), 1904

Subgenus Sweltsa Ricker, 1943

Alloperla borealis (Banks), 1895

Alloperla coloradensis (Banks), 1898

Alloperla lamba Needham and Claassen, 1925

Subgenus Triznaka Ricker, 1952

Alloperla diversa Frison, 1935

Alloperla pintada Ricker, 1952

Alloperla signata (Banks), 1895

Family PERLIDAE

Subfamily ACRONEURINAE

Genus *Acroneuria* Pictet, 1841

Subgenus Calineuria Ricker, 1954

Acroneuria californica (Banks), 1905

Subgenus Hesperoperla Banks, 1938

Acroneuria pacifica Banks, 1900

Genus *Claassenia* Wu, 1934

Claassenia sabulosa (Banks), 1900

II. A KEY TO THE FAMILIES AND GENERA OF THE STONEFLIES

Adults

1. Paraglossae and glossae of about equal length . . . . . Suborder FILIPALPIA 2

   Paraglossae much longer than the glossae . . . . . Suborder SETIPALPIA 10

2. Abdomen without branched gills on ventral side; anal area of the forewing without cross-veins or with only one row of them . . . . . NEMOURIDAE 4

   Abdominal segments 1 and 2 with branched gills on the ventral side . . . . . PTERONARCIDAE 3

3. Ventral gill remnants on first 3 abdominal segments . . . . . *Pteronarcella*

   Ventral gill remnants on first 2 abdominal segments only . . . . . *Pteronarcys*

4. Second tarsal segment much shorter than the first 5

   Second tarsal segment at least as long as the first . . . . . TAENIOPTERYGINAE . . . . . *Brachyptera*

5. Wings lying nearly flat when at rest; 2nd anal vein of forewing forked; cerci 1-segmented . . . . . NEMOURINAE . . . . . *Nemoura*

   Wings either rolled around the body at rest or wings flat when at rest and with 2nd anal vein of the

forewing simple; cerci either 1-segmented or with more than 4 segments 6

6. Wings flat with 1 or rarely 2 intercubital cross-veins in the forewing; 2nd anal vein of the forewing simple; cerci with at least 4 segments . . . . . CAPNIINAE 7

Wings rolled around the body; intercubital cross-veins of the forewing usually more than 5; 2nd anal vein of the forewing forked; cerci 1-segmented . . . . . LEUCTRINAE . . . . . Paraleuctra

7. R_1 of forewing bowed upward at its origin; 1st anal vein of forewing bent abruptly caudad at its junction with Cu-A and then curved outwardly again . . . . . Capnia

R_1 of forewing not bowed upward at its origin; 1st anal vein of forewing without abrupt bend at its junction with Cu-A 8

8. Paraglossae rounded, usually narrower than the glossae; 2nd anal vein very short and lying on the margin of the wing; R_1 of forewing bent caudally, shortly beyond its base . . . . . Paracapnia

Paraglossae pointed, as broad or broader than the glossae; 2nd anal vein not lying on margin of forewing; R_1 of forewing not bent caudally 9

9. Cerci with 4 to 5 segments; mesothoracic postfurcasternal

plates entirely surrounded by membrane . . . . . Eucapnopsis

Cerci with more than 11 segments; mesothoracic postfurcast-
ernal plates united with mesothoracic furcasternum. . . Isocapnia

10. Profusely branched gills at the lower angles of the thorax; cubito-anal cross-vein of forewing usually either in the anal cell or distant from it by no more than its own length . . . . . PERLIDAE . . . . . ACRONEURINAE 16

Branched gills absent from the thorax; cubital-anal cross-vein, if present, usually distant from the anal cell by more than its own length 11

11. Gills absent or simple gills present on submentum, thorax, or abdomen; fork of 2nd anal vein of the forewing included in the anal cell so that its branches leave the cell separately . . . . . PERLODIDAE 12

External gills entirely lacking; 2nd anal vein of the forewing not forked or forked beyond the anal cell . . . . . CHLOROPERLIDAE 15

12. Male tenth tergite completely cleft . . . . . ISOGENINAE 13

Male tenth tergite entire or at most slightly notched 14

13. Wings with 4 to many cross-veins beyond the cord, and these usually arranged in an irregular network;

7th abdominal sternite of male without a lobe . . . Arcynopteryx

Wings with no more than 2 cross-veins beyond the cord; 7th abdominal sternite of male with a lobe behind . . . . . Isogenus

14. Subanal lobes of male either formed into hooks or little modified . . . . ISOPERLINAE . . . . . Isoperla

Subanal lobes of male produced inward and backward, meeting along their inner face . . . . . PERLODINAE . . . . . Diura

15. Eyes usually small and set far forward; anal veins with 5 to 7 branches reaching to the margin of the wing . . . . . PARAPERLINAE . . . . . Paraperla

Eyes large and normally situated; anal veins with 4 branches at most . . . . . CHLOROPERLINAE . . . . . Alloperla

16. Male tenth tergite with hooks arising from the lateral angles; subanal lobes normal . . . . . Claassenia

Male tenth tergite without prolongations; subanal lobes of male modified into hooks . . . . . Acroneuria

Naiads

1. Paraglossae and glossae of about equal length . . . . . Suborder FILIPALPIA 2

Paraglossae much longer than the glossae . . . . . Suborder SETIPALPIA 10

2. Abdomen without branched gills on the ventral side . . . . . NEMOURIDAE 4

Abdomen with branched gills on the ventral side of segments 1 and 2 . . . . . PTERONARCIDAE 3

3. Abdominal gills on first 3 segments . . . . . Pteronarcella

Abdominal gills on first 2 segments only . . . . . Pteronarcys

4. Second tarsal segment much shorter than the first 5

Second tarsal segment at least as long as the first . . . . . TAENIOPTERYGINAE . . . . . Brachyptera

5. Stout body with hindwing pads strongly diverging from the axis of the body . . . . . NEMOURINAE . . . . . Nemoura

Cylindrical, elongate body with hindwing pads nearly parallel with the axis of the body 6

6. Abdominal segments 1 to 9 divided by a membranous fold laterally . . . . . CAPNIINAE 7

At most only the first seven abdominal segments divided by a membranous fold . . . . . LEUCTRINAE . . . . . Paraleuctra

7. Paraglossae usually narrower than the glossae . . . . . Paracapnia

Paraglossae usually broader than the glossae 8

8. Cerci without mesal and lateral fringes of long silky hairs and abdominal segments without bristles . . . . . Capnia

Cerci with fringes of long silky hairs or abdominal

segments with bristles. 9

9. Abdominal segments with a few slender bristles; cerci without long silky hairs . . . . . Eucapnopsis

Abdominal segments without bristles; cerci with fringes of long silky hairs . . . . . Isocapnia

10. Profusely branched gills at the lower angles of the thorax. . . . . PERLIDAE . . . . . ACRONEURINAE 17

Branched gills absent from the thorax 11

11. Body usually pigmented in a distinct pattern; cerci generally at least as long as abdomen; pads of the hindwing in nearly mature nymphs set at an angle so that their central axis diverges considerably from the axis of the body; gills absent or simple gills present on submentum, thorax or abdomen . . . . . PERLODIDAE 12

Body almost concolorous without a pattern; cerci not more than 3/4 as long as the abdomen; pads of hindwings nearly parallel to the axis of the body; external gills entirely lacking . . . . . CHLOROPERLIDAE 16

12. A strongly checkered or striped pattern on abdomen . . . . . ISOPERLINAE . . . . . .Isoperla

No checkered or striped pattern on abdomen 13

13. Thoracic gills present or submental gills at least twice as long as wide . . . . . .

. . . . . ISOGENINAE (in part). 14

Thoracic gills absent; submental gills lacking or their length less than twice their width 15

14. Either thoracic gills present or submental gills at least twice as long as their greatest width and the mesosternal ridge pattern lacks a median ridge . . . . . Arcynopteryx

Thoracic gills absent and either submental gills lacking or their length is less than twice their width except in subgenus Isogenoides where a median ridge joins the transverse ridge to the fork of the Y in the mesosternal ridge pattern . . . . . Isogenus (in part)

15. Maxilla with one or two spines in which the major spine is equal to more than 1/3 of the length of the lacinia . . . . . Isogenus (in part)

Maxilla with two spines, the major spine equal to 1/3 the length of the lacinia . . . . . .PERLODINAE . . . . . Diura

16. Eyes usually small and set far forward; body narrow and elongate . . . . . PARAPERLINAE . . . . . Paraperla

Eyes large and normally situated; body less elongate . . . . . CHLOROPERLINAE . . . . . Alloperla

17. Head with a complete occipital ridge composed of closely set spinules . . . . . Claassenia

Head without a complete occipital ridge . . . . . Acroneuria

III. A KEY TO THE SUBGENERA AND SPECIES OF THE STONEFLIES, WITH DISTRIBUTION LISTS, MAPS, AND ILLUSTRATIONS

Suborder FILIPALPIA

Family NEMOURIDAE

Subfamily NEMOURINAE

Genus Nemoura Latreille

Males

1. Cervical gills present. 2

   Cervical gills absent 4

2. Gills unbranched except in N. cinctipes, which has less than 6 branches . . . . . Subgenus Zapada

   Gills with six or more branches 3

3. Subanal lobes divided almost to the base into 2 parts; one or both of them spinulose; cerci without basal processes . . . . . Subgenus Amphinemura

   Subanal lobes variously modified, never spinulose; cleft, if at all, for less than half their length; cerci with a membranous or sclerotized process mesally near their base . . . . . Subgenus Malenka

4. Supra-anal process slender, completely recurved along the 10th and 9th tergites, sometimes with basal appendages . . . . . Subgenus Prostoia

   Supra-anal process rather short, thick, complex in

structure, only slightly bent forward, never with basal appendages. . . . . .Subgenus Podmosta

Females

1. Cervical gills present 2

Cervical gills absent 4

2. Gills unbranched (except in N. cinctipes); 7th sternite produced completely over 8th, which is very weak . . . . . Subgenus Zapada

Gills with six or more branches 3

3. Notch on the 8th sternite in a sclerotized band set before the hind margin of the segment . . . . Subgenus Amphinemura

Notch on the 8th sternite terminal . . . . . Subgenus Malenka

4. Sternite 8 with a terminal subgenital plate note separated from hind margin of the sternite, and uniformly colored . . . . . Subgenus Prostoia

Sternite 8 with a narrow median sclerotized band contrasting sharply with the unsclerotized field at either side . . . . . Subgenus Podmosta

Subgenus Amphinemura

Nemoura venusta Banks (Figs. 21a, 21b, 22, 27)

1911 Nemoura venusta Banks, Trans. Amer. Ent. Soc. 37: 337.

1925 Nemoura venusta, Needham and Claassen, Monog. Plecop., p. 209; p. 362.

1952 Nemoura (Amphinemura) venusta, Ricker, Indiana Univ. Publ., Sci. Ser., 18:27.

1955 Nemoura venusta, Gaufin, Proc. Utah Acad., 32:117.

Type locality: Arizona.

Geographic range: Arizona, Colorado, Utah, Wyoming, and New Mexico.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 4 females, 26-VIII-67, B.R.O.; Yampa River at Little Morrison Creek Junction - 1 male, 25-VI-68, B.R.O.; Yampa River at Steamboat Springs - 1 female, 12-VIII-64, G.F.K; Elk River at Clark - 47 males, 63 females, 17-VII-68, B.R.O.; Fish Creek - 1 female, 23-VIII-67, R.W.B.; Green Creek - 1 male, 16-VII-68, J.N.O.; Oak Creek - 2 females, 26-VIII-67, B.R.O.; Beaver Creek - 1 male, 1 female, 15-VII-68, J.L.O.; Coulton Creek - 3 females, 18-VII-68, B.R.O.; Cow Creek - 1 male, 4 females, 17-VII-68, B.R.O.

Subgenus Malenka

Males

1. Mesobasal lobe of the cercus sclerotized and sharply pointed; appearing to be a part of the 10th tergite . . . . . N. californica

   Mesobasal lobe of the cercus usually membranous, rounded, distinct from the 10th tergite . . . . . N. coloradensis

Females

1. Produced portion of the 7th sternite bearing a distinct

nipple whose base is often anterior to the hind margin of the sternite . . . . . N. californica

Seventh sternite slightly produced, but lacking a nipple . . . . . N. coloradensis

Nemoura californica Claassen (Figs. 20, 26)

1923 Nemoura californica Claassen, Can. Ent. 55, p. 284.

1925 Nemoura californica, Needham and Claassen, Monog. Plecop., p. 207.

1936 Nemoura lobata, Frison, Ann. Ent. Soc. Amer. 29:260.

1952 Nemoura (Malenka) californica, Ricker, Indiana Univ. Publ., Sci. Ser., 18:33.

Type locality: Oakland Hills, Alameda County, California.

Geographic range: Alberta and British Columbia to New Mexico, California, Colorado, and Utah.

Distribution, Yampa River Drainage, Routt Co.: Oak Creek - 7 males, 4 females, 26-VIII-67, R.W.B.

Nemoura coloradensis Banks (Figs. 19a, 19b, 25)

1897 Nemoura coloradensis Banks, Trans. Amer. Ent. Soc. 24, p. 21.

1925 Nemoura coloradensis, Needham and Claassen, Monog. Plecop., p. 210, p. 363, (Figs. 13-16).

1931 Nemoura coloradensis, Claassen, Plecop. Nymphs, p. 96.

1952 Nemoura (Malenka) coloradensis, Ricker, Indiana Univ. Publ., Sci. Ser., 18:33.

Type locality: Colorado.

Geographic range: Montana to New Mexico.

Distribution in Yampa River Drainage, Routt Co.: Yampa River at Yampa -

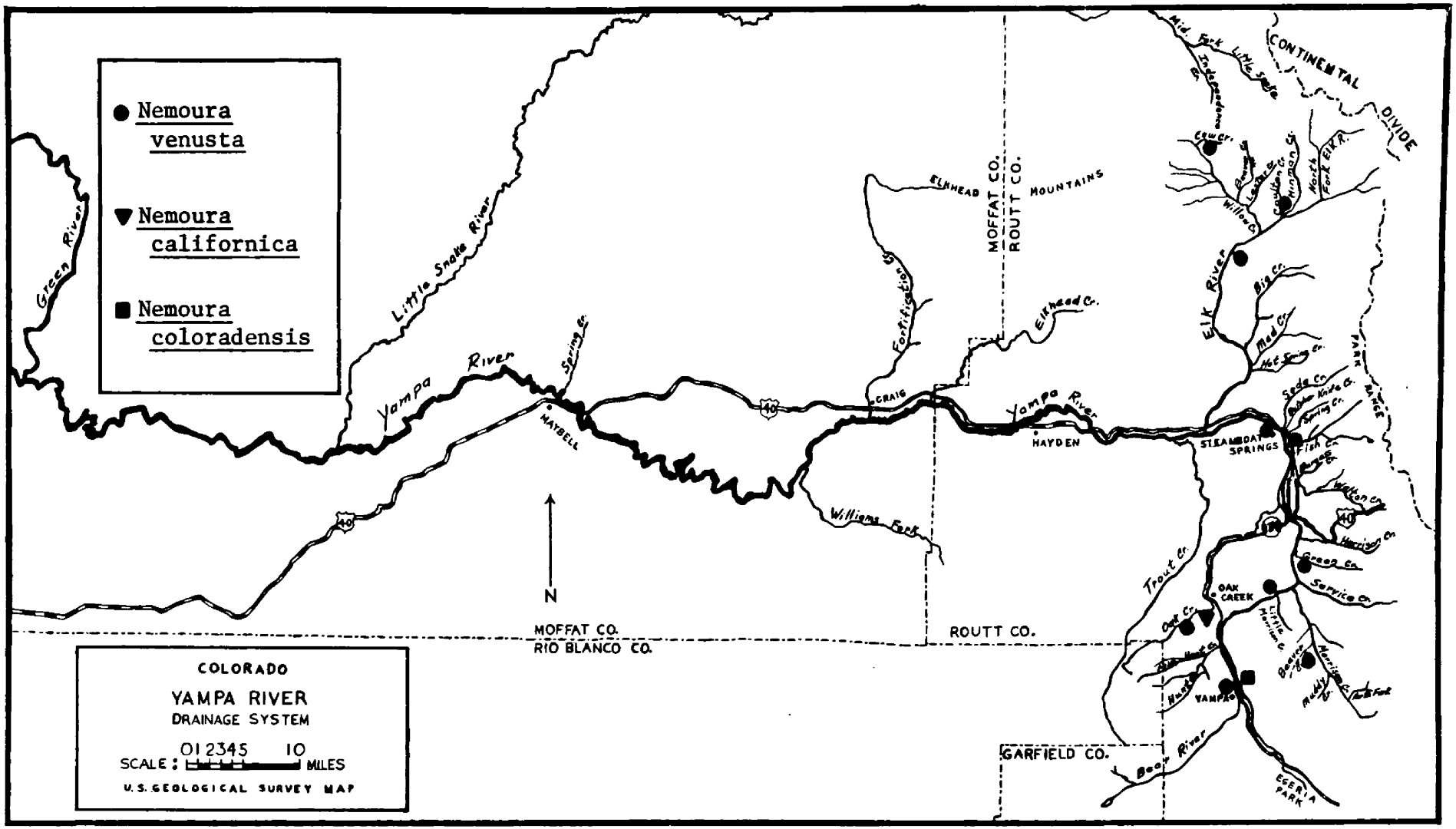


Fig. 2. Distribution map of Nemoura venusta, N. californica and N. coloradensis.

1 male, 27-VI-68, B.R.O.

Subgenus Podmosta

Males

1. Supra-anal process with sharp, curved, laterally-directed horns near the tip. . . . . N. decepta

   Spura-anal process without such horns . . . . . N. delicatula

Females

1. Median sclerotized stripe of the 8th sternite not more than twice as long as its greatest breadth, sometimes rather obscure. . . . . N. decepta

   Median sclerotized stripe of the 8th sternite 3 to 4 times as long as its greatest breadth of nearly uniform width throughout. . . . . N. delicatula

Nemoura decepta Frison (Figs. 29, 31)

1942b Nemoura decepta Frison, Pan-Pac. Ent. 18:13, male.

1943 Nemoura decepta, Ricker, Indiana Univ. Publ., Sci. Ser., 12:69.

1952 Nemoura (Podmosta) decepta, Ricker, Indiana Univ. Publ., Sci. Ser., 18: 43.

1952 Nemoura rossi, Ricker, ibid., p. 45.

1954 Nemoura decepta, Ricker, Trans. Ent. Soc. B.C., 51:37; above synonymy indicated.

Type locality: Estes Park, Colorado.

Geographic range: Colorado, British Columbia to Oregon.

Distribution, Yampa River Drainage, Routt Co.: Fish Creek - 1 female, 21-VI-68, B.R.O.; Harrison Creek - 1 female, 28-VI-68, B.R.O.; Walton Creek - 1 female, 29-VI-67, B.R.O.; Walton Creek at Rabbit Ears Pass - 1 female, 27-VI-68, J.L.O.; Walton Creek 3 miles west of Rabbit Ears Pass - 6 females, 23-VIII-67, B.R.O.; Fish Creek Falls Trickle - 1 male, 17-VI-68, B.R.O.; Independence Creek - 4 males, 1 female, 17-VII-68, J.N.O.; Muddy Creek - 1 female, 24-VI-68, B.R.O.; North Fork of Morrison Creek - 4 males, 5 females, 24-VI-68, B.R.O.

Nemoura delicatula Claassen (Figs. 30, 32)

1923 Nemoura delicatula Claassen, Can. Ent. 55:285.

1925 Nemoura delicatula, Needham and Claassen, Monog. Plecop., p. 204.

1952 Nemoura (Podmosta) delicatula, Ricker, Indiana Univ. Publ. Sci. Ser., 18:43.

Type locality: Boulder, Colorado.

Geographic range: Central British Columbia south to Utah and California.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 1 male, 21-VI-68, B.R.O.; 1 male, 23-VI-68, B.R.O.; Yampa River west of Highway 131 - 1 male, 21-VI-68, B.R.O.; Yampa River east of Highway 131 - 1 male, 26-VI-68, B.R.O.; Yampa River at Steamboat Springs - 84 males, 64 females, 25-VI-62, A.R.G.; 1 male, 1 female, 29-VI-67, B.R.O.; 1 male, 3 females, 1-VII-67, B.R.O.; 3 males, 2 females, 18-VI-68, B.R.O.; 1 female, 21-VI-68, B.R.O.; 14 males, 24 females, 26-VI-68, J.N.O.; 1 male, 1 female, 28-VI-68, B.R.O.; 1 female, 17-VII-68, B.R.O.; Butcher Knife Creek - 2 females, 21-VI-68, B.R.O.; Fish Creek - 17 males, 23 females, 25-VI-62,

A.R.G.; 1 male, 1 female, 27-VI-67, B.R.O.; 4 males, 9 females, 29-VI-67, B.R.O.; 1 male, 1 female, 21-VI-68, B.R.O.; 2 males, 2 females, 25-VI-68, B.R.O.; 1 male, 2 females, 28-VI-68, B.R.O.; 3 males, 15-VII-68, B.R.O.; 1 female, 16-VII-68, J.L.O.; Fish Creek Falls - 1 female, 18-VI-68, B.R.O.; Fish Creek Falls Trickle - 1 male, 17-VI-68, B.R.O.; 2 females, 25-VI-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Green Creek - 11 males, 19 females, 16-VII-68, B.R.O.; 13 males, 20 females, 28-VI-68, B.R.O.; Harrison Creek - 2 females, 15-VII-68, B.R.O.; Little Snake River at Focus Ranch - 1 female, 17-VII-68, B.R.O.; Morrison Creek - 3 females, 24-VI-68, B.R.O.; Oak Creek - 1 male, 1 female, 22-VI-68, B.R.O.; Sarvice Creek - 20 males, 10 females, 24-VI-68, B.R.O.; Soda Creek - 20 males, 16 females, 19-VI-62, A.R.G.; 49 males, 42 females, 25-VI-65, A.R.G.; 11 males, 8 females, 1-VII-67, B.R.O.; 46 males, 25 females, 21-VI-68, B.R.O.; 40 males, 35 females, 25-VI-68, B.R.O.; Spring Creek - 1 female, 1-VII-67, B.R.O.; 1 male, 1 female, 20-VI-68, B.R.O.; 6 males, 3 females, 21-VI-68, B.R.O.; 6 males, 13 females, 25-VI-68, J.L.O.; Trout Creek - 1 male, 1 female, 22-VI-68, B.R.O.; Walton Creek - 12 males, 9 females, 29-VI-67, B.R.O.; 1 male, 30-VI-67, B.R.O.; 4 males, 1 female, 18-VI-68, B.R.O.; 34 males, 12 females, 25-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 4 males, 105 females, 23-VII-67, B.R.O.; 3 females, 15-VII-68, J.N.O.; Beaver Creek - 2 males, 7 females, 24-VI-68, B.R.O.; Burgess Creek - 2 males, 4 females, 28-VI-68, B.R.O.; Hinman Creek - 2 males, 4 females, 28-VI-68, B.R.O.; Hot Springs Creek - 1 male, 19-VI-68, B.R.O.; Independence Creek - 5 males, 3 females, 17-VII-68, J.L.O.; North Fork of Elk River - 1 male, 18-VII-68, B.R.O.; North Fork of Morrison Creek - 1 female, 24-VI-68, B.R.O.; Lester Creek - 8 males,

8 females, 19-VI-68, B.R.O.; 2 males, 24 females, 17-VII-68, B.R.O.; Willow Creek south of Hahn's Peak - 1 male, 2 females, 19-VI-68, B.R.O.; 1 female, 17-VII-68, B.R.O.; Willow Creek north of Hahn's Lake - 2 males, 2 females, 19-VI-68, B.R.O.

Subgenus Prostoia

Nemoura besametsa Ricker (Figs. 23, 24, 28)

1923 Nemoura glabra Claassen, Can. Ent. 55:281 (as is applied to western specimens).

1925 Nemoura glabra, Needham and Claassen, Monog. Plecop., p. 202.

1938 Nemoura glabra, Hoppe, Univ. Wash. Publ. Biol. 4(2), p. 160.

1943 Nemoura Species A Ricker, Stoneflies S.W.B.C., p. 72.

1943 Nemoura completa, Ricker, ibid., p. 68.

1952 Nemoura (Prostoia) besametsa Ricker, Indiana Univ. Publ., Sci. Ser., 18:48.

Type locality: Vedder Crossing, British Columbia.

Geographic range: Southern British Columbia to California, Utah and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 7 males, 3 females, 10-V-68, B.R.O.; 1 male, 23-VI-68, B.R.O.; Yampa River at Steamboat Springs - 1 male, 1 female, 26-VI-68, B.R.O.; East Fork of Elk River - 1 female, 13-V-68, B.R.O.; Elk River 1 mile above Big Creek - 1 female, 13-V-68, B.R.O.; Elk River at Clark - 2 males, 13-V-68, B.R.O.; Fish Creek Falls - 3 males, 18-VI-68, B.R.O.; 1 female, 25-VI-68, B.R.O.; Fish Creek - 1 female, 23-VIII-67, B.R.O.; 2 females, 28-VI-68, B.R.O.; North Fork of Elk River - 1 female, 28-VI-68, B.R.O.; 2 females,

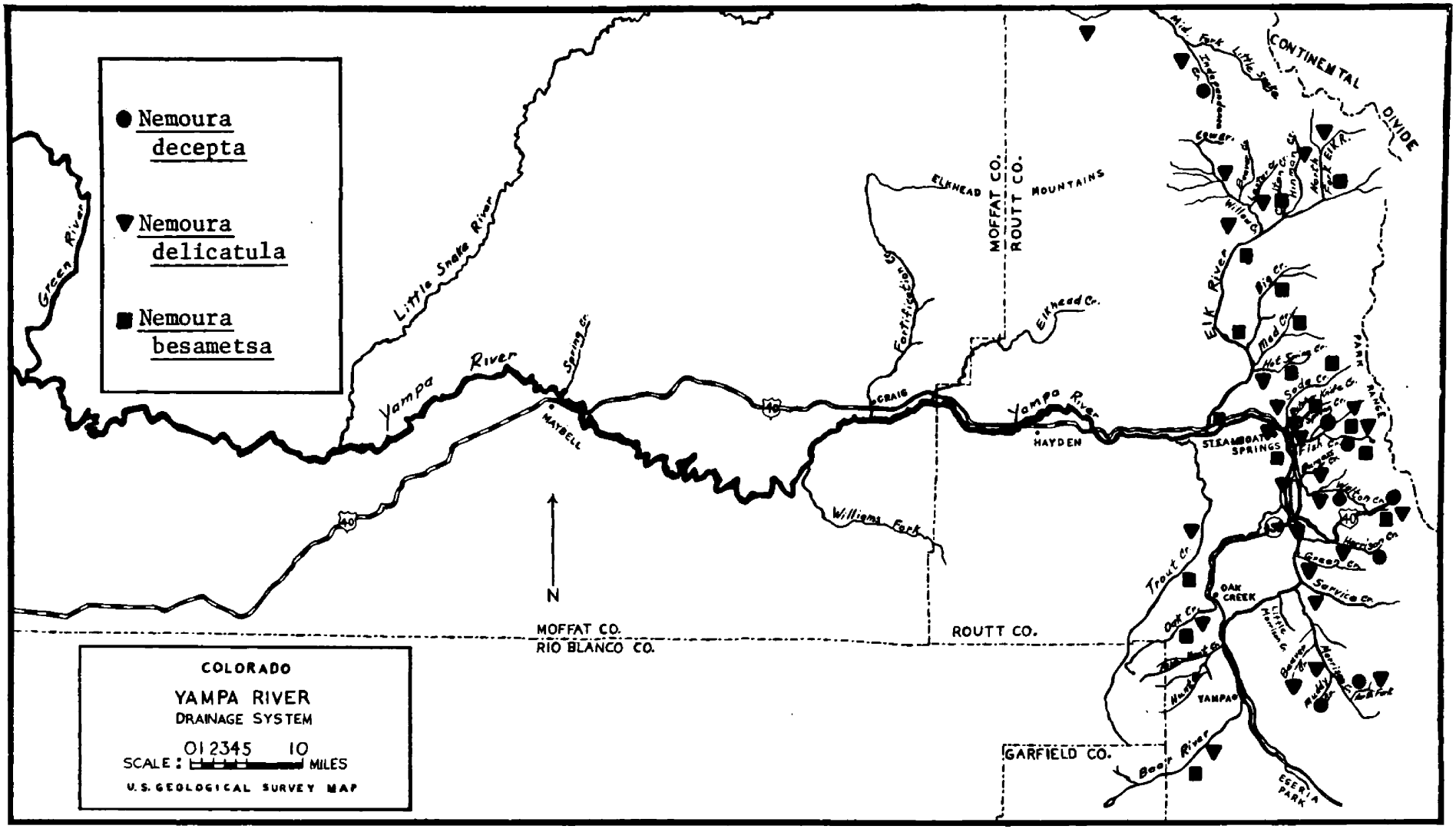


Fig. 3. Distribution map of Nemoura decepta, N. delicatula, and N. besametsa.

18-VII-68, B.R.O.; Oak Creek - 2 males, 1 female, 11-V-68, B.R.O.; 2 females, 22-VI-68, B.R.O.; Soda Creek - 14 males, 13 females, 9-V-68, B.R.O.; 1 male, 2 females, 12-V-68, B.R.O.; Spring Creek - 1 male, 12-V-68, B.R.O.; 1 female, 25-VI-68, B.R.O.; Trout Creek - 1 male, 1 female, 11-V-68, B.R.O.; Walton Creek - 6 males, 4 females, 10-V-68, B.R.O.; Big Creek - 8 males, 12 females, 13-V-68, B.R.O.; Coulton Creek - 1 male, 18-VII-68, B.R.O.; Hot Springs Creek - 1 male, 13-V-68, B.R.O.; Mad Creek - 1 female, 19-VI-68, B.R.O.

Subgenus Zapada

Males and Females

1. Gills branched one to several times . . . . . N. cinctipes

   Gills simple. 2

2. Subanal lobes with the inner terminal angle obtuse and rounded. Supra-anal process without median dorsal spines; produced part of female sternite 7 dark in color, at least along the broadly rounded or nearly straight hind margin . . . . . N. haysi

   Subanal lobes quadrangular, the inner terminal angle rather sharp; supra-anal process with two median dorsal spines; produced part of female sternite 7 light colored and narrowly rounded, almost semicircular . . . . . N. oregonensis

Nemoura cinctipes Banks (Figs. 33, 34, 39)

1897 Nemoura cinctipes Banks, Trans. Amer. Ent. Soc., 24:21.

1925 Nemoura cinctipes, Needham and Claassen, Thomas Say Found., 2:212; wings p. 355, (Fig. 2); male and female genitalia, p. 365.

1939 Nemoura cinctipes, Castle, Can. Ent. 71:208-209, description and figure of nymphal gills.

1952 Nemoura (Zapada) cinctipes, Ricker, Indiana Univ. Publ., Sci. Ser., 18:57.

Type locality: Olympia, Washington.

Geographic range: Alaska, British Columbia and Alberta south to Utah and California.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 1 male, 6-IV-63, A.R.G.; Fish Creek Falls - 1 male, 27-VI-67, B.R.O.; 1 female, 18-VI-68, B.R.O.; Fish Creek - 2 males, 6-IV-63, A.R.G.; Harrison Creek - 1 male, 2 females, 10-V-68, B.R.O.; Oak Creek - 4 males, 11-V-68, B.R.O.; Soda Creek - Naiads, 22-VIII-67, B.R.O.; Walton Creek at Rabbit Ears Pass - 2 males, 10-V-68, B.R.O.; 1 male, 2 females, 18-VI-68, B.R.O.; 2 males, 5 females, 19-VI-68, B.R.O.; 1 female, 20-VI-68, B.R.O.; 1 male, 1 female, 21-VI-68, B.R.O.; 3 males, 2 females, 23-VI-68, B.R.O.; 2 females, 27-VI-68, B.R.O.; 1 female, 29-VI-68, B.R.O.; 2 females, 15-VII-68, B.R.O.; Hot Springs Creek - Naiad, 18-III-68, B.R.O.; Mad Creek - Naiads, 18-III-68, B.R.O.

Nemoura haysi Ricker (Figs. 35, 36, 40)

1952 Nemoura (Zapada) haysi Ricker, Indiana Univ. Publ., Sci. Ser., 18:58, (Fig. 32-35).

Type locality: Upper Gallatin River, Yellowstone National Park, Wyoming.

Geographic Range: Alaska south to Colorado, Utah and California.

Distribution, Yampa River Drainage, Routt Co.: Fish Creek Falls - 1 female, 27-VI-67, B.R.O.; 1 male, 25-VI-68, B.R.O.

Nemoura oregonensis Claassen (Figs. 37, 38, 41)

1923 Nemoura oregonensis Claassen, Can. Ent. 55:288, description and figure of male, pl. 14, (Fig. 24).

1937 Nemoura oregonensis Frison, Bull. Illinois Nat. Hist. Surv. 21, p. 83-84.

1943 Nemoura oregonensis, Ricker (in part), Stoneflies SW B.C., p. 61, p. 67, (Fig. 31), nymph.

1952 Nemoura (Zapada) oregonensis, Ricker, Indiana Univ. Publ., Sci. Ser., 18:60.

Type locality: Harney County, Oregon.

Geographic range: Western United States and Canada (Alaska, Colorado, Oregon, Utah, and Washington).

Distribution, Yampa River Drainage Routt Co.: Yampa River at Steamboat Springs - 1 female, 26-VI-48, B.R.O.; 1 male, 28-VI-68, B.R.O.; Fish Creek Falls - 1 male, 18-VI-67, B.R.O.; Fish Creek - 1 female, 28-VI-68, B.R.O.; Walton Creek - 2 males, 2 females, 21-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 1 male, 25-VI-68, B.R.O.; 1 male, 27-VI-68, B.R.O.; 1 female, 29-VI-68, B.R.O.

Subfamily LEUCTRINAE

Genus Paraleuctra Hanson

Males

1. Titillator with a large membranous bulb at the tip; the upper,

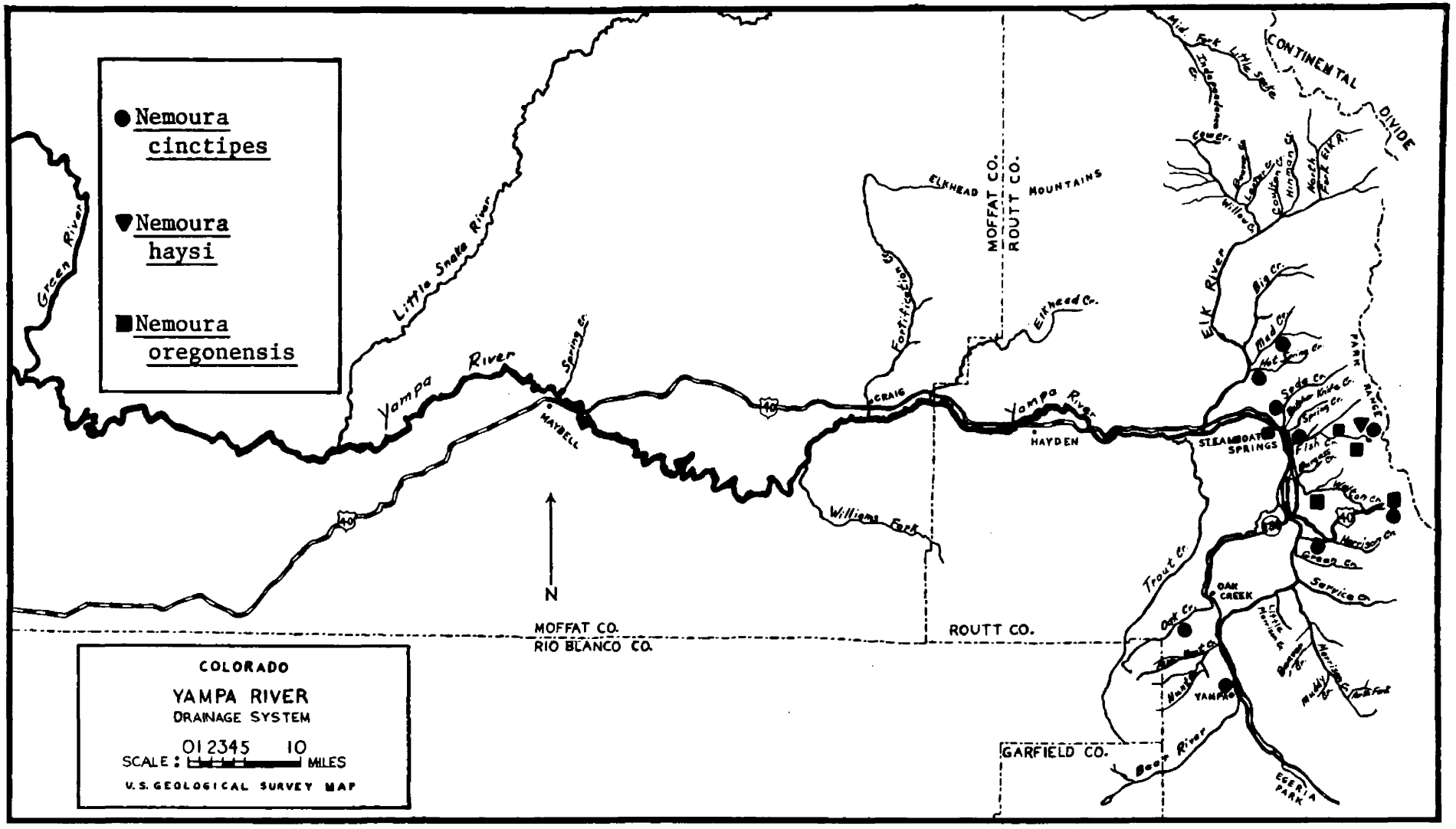


Fig. 4. Distribution map of Nemoura cinctipes, N. haysi, and N. oregonensis.

longer prong of the bifurcate cercus hooked . . . . . .

. . . . . P. occidentalis

Titillator without a bulbous tip; upper prong of

cercus not hooked . . . . . P. sara

Females

1. Subgenital plate extending little beyond the 8th

sternite . . . . . P. occidentalis

Subgenital plate extending approximately its own

length beyond the 8th sternite . . . . . P. sara

Paraleuctra occidentalis (Banks) (Figs. 47, 48, 49)

1907a Leuctra occidentalis Banks, Can. Ent. 39:329-330.

1923 Leuctra bradleyi, Claassen, Can. Ent. 55:257, description of male.

1925 Leuctra bradleyi, Needham and Claassen, Thomas Say Found., 2:225-226, wing p. 355, (Fig. 1); male genitalia, p. 373.

1943 Leuctra bradleyi, Ricker, Indiana Univ. Publ., Sci. Ser., 12:76; female and nymph; nymph, p. 79; placed in Paraleuctra.

1954 Leuctra (Paraleuctra) occidentalis, Ricker, Proc. Ent. Soc. B.C., 51:38, above synonymy indicated.

Type locality: Laggan (Lake Louise), Alberta.

Geographic range: Alberta and British Columbia south to Utah and California.

Distribution, Yampa River Drainage, Routt Co.; Yampa River at Steamboat Springs - 1 male, 12-V-68, B.R.O.

Paraleuctra sara (Claassen) (Figs. 50a, 50b, 51)

1925 Leuctra occidentalis, Needham and Claassen, Thomas Say Found., 2:231, male and female description, male genitalis, p. 373; female genitalia, p. 375.

1937b Leuctra sara Claassen, Jour. Kans. Ent. Soc., 10:44, description and figures of male and female.

1941 Leuctra sara, Hanson, Bull. Brooklyn Ent. Soc., 36:64, description and figure of nymph, placed in new genus Paraleuctra.

1954 Leuctra (Paraleuctra) sara, Ricker, Proc. Ent. Soc. B.C., 51:38, above synonymy indicated.

Type locality: Ringwood Lloyd Preserve, near Ithaca, New York.

Geographic range: Eastern United States; British Columbia, south to Colorado and California.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 2 males, 7 females, 14-VII-68, B.R.O.; Yampa River at Yampa - 1 female, 22-VI-68, B.R.O.; Yampa River at Steamboat Springs - 4 males, 12 females, 25-VI-62, A.R.G.; 4 males, 4 females, 1-VII-67, B.R.O.; 8 males, 5 females, 26-VI-68, B.R.O.; 1 female, 28-VI-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Elk River at Hinman Creek - 2 males, 2 females, 28-VI-68, B.R.O.; Fish Creek Falls - 1 male, 27-VI-67, B.R.O.; 1 female, 18-VI-68, B.R.O.; 1 male, 25-VI-68, B.R.O.; 2 males, 14-VII-68, B.R.O.; 1 male, 2 females, 15-VII-68, B.R.O.; Fish Creek Falls Trickle - 12 males, 6 females, 17-VI-68, B.R.O.; 7 males, 6 females, 28-VI-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Fish Creek at Steamboat Springs - 9 males, 12 females, 25-VI-62, A.R.G.; 9 males, 22 females, 29-VI-67, B.R.O.;

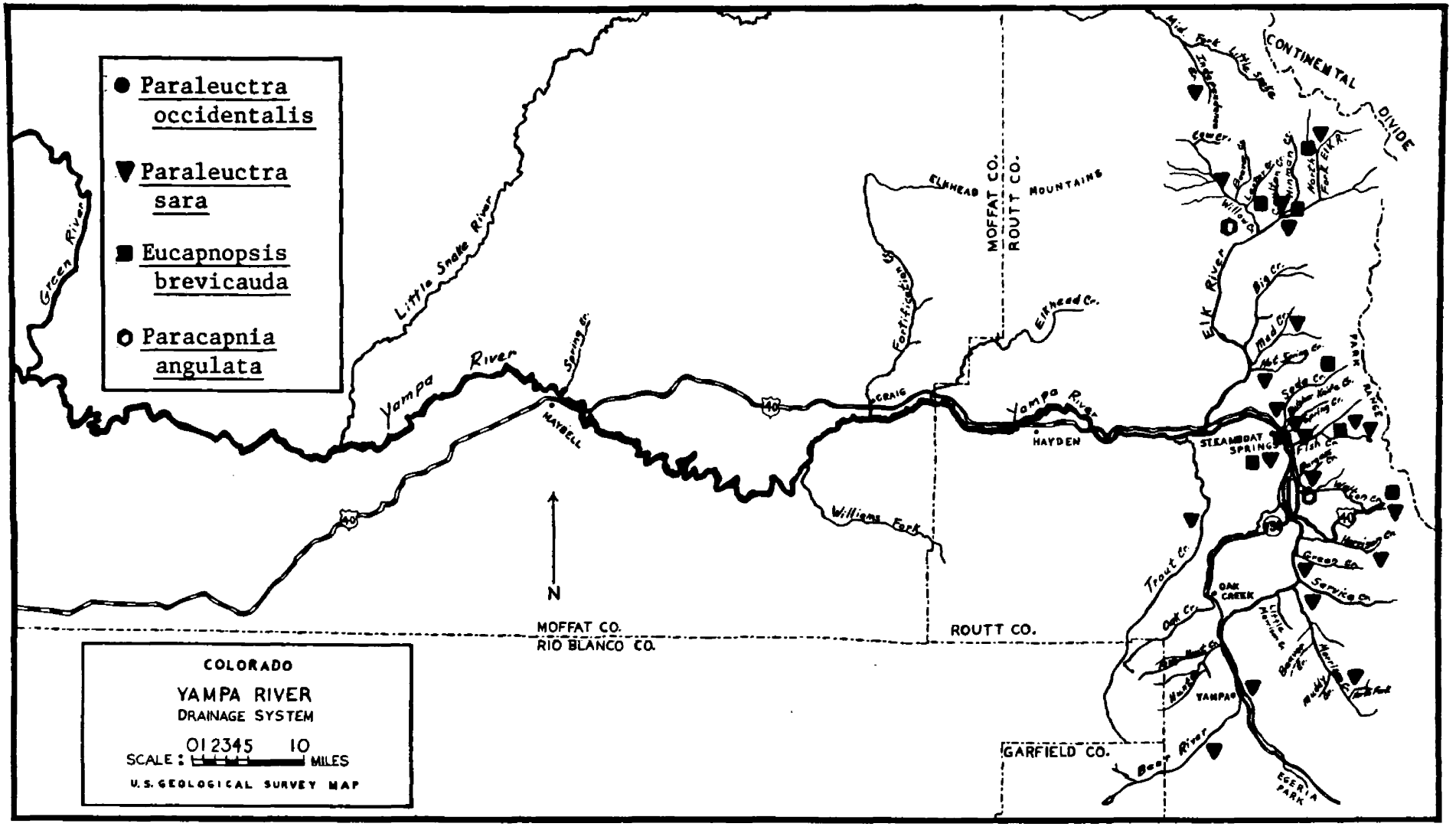


Fig. 5. Distribution map of Paraleuctra occidentalis, P. sara, Eucapnopsis brevicauda, and Paracapnia angulata.

1 male, 3 females, 21-VI-68, B.R.O.; 5 males, 2 females, 25-VI-68, B.R.O.; 7 males, 16 females, 28-VI-68, B.R.O.; Green Creek - 3 females, 28-VI-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Harrison Creek - 2 males, 1 female, 28-VI-68, B.R.O.; 1 male, 3 females, 15-VII-68, B.R.O.; Sarvice Creek - 1 male, 2 females, 24-VI-68, B.R.O.; Soda Creek - 2 males, 4 females, 19-VI-61, A.R.G.; 3 males, 1 female, 1-VII-67, B.R.O.; 6 males, 6 females, 21-VI-68, B.R.O.; 14 males, 11 females, 25-VI-68, B.R.O.; 1 male, 16-VII-68, B.R.O.; Spring Creek - 4 males, 2 females, 1-VII-67, B.R.O.; 1 male, 20-VI-68, B.R.O.; 8 males, 5 females, 21-VI-68, B.R.O.; 5 females, 25-VI-68, B.R.O.; 1 male, 16-VII-68, B.R.O.; Trout Creek - 11 males, 5 females, 22-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 3 females, 15-VII-68, B.R.O.; Willow Creek northwest of Hahn's Peak - 5 males, 5 females, 17-VII-68, B.R.O.; Burgess Creek - 1 male, 28-VI-68, B.R.O.; Coulton Creek - 5 males, 9 females, 28-VI-68, B.R.O.; Hot Springs Creek - 1 female, 19-VI-68, B.R.O.; Independence Creek - 2 females, 17-VII-68, B.R.O.; Mad Creek - 7 males, 5 females, 19-VI-68, B.R.O.; North Fork of Elk River - 3 males, 2 females, 18-VII-68, B.R.O.; North Fork of Morrison Creek - 1 male, 24-VI-68, B.R.O.

Subfamily CAPNIINAE

Genus Capnia Pictet

Males

1. Supra-anal process slender, completely divided into a dorsal and ventral part, the tips of each of which are separate and the upper furcate. . . . . .

. . . . . .(Subgenus Utacapnia) 5

Supra-anal process variable, often slender, not divided . . . . . (Subgenus Capnia s.s.). 2

2. A hump or process on 8th tergite 3

No hump on 8th tergite 4

3. Hump on the 8th tergite high and set behind the middle of the tergite . . . . . C. coloradensis

Hump on 8th tergite rather low, at or anterior to the middle of the tergite in side view; supra-anal process reaching the tubercle of the 8th tergite . . . . . C. gracilaria

4. Apical third of supra-anal process rapidly tapering to a point that is slightly recurved downwards at extreme tip . . . . . C. limata

Supra-anal process uniformly tapering from base to tip and not abruptly recurved downwards . . . . . C. confusa

5. Upper process short and slender with fork forming bulbous prongs at tip; lower process with distinct foot-like enlargement at tip; lower process wider than stem of upper process; posterior end of supra-anal process slightly notched . . . . . C. poda

Upper process thick with two widely divergent, horn-like processes at tip; lower process without foot-like enlargement 6

6. Lower process of supra-anal process same length as upper . . . . . C. logana

Lower process 1/3 longer than upper . . . . . C. lemoniana

Females

1. Body length over 7 mm; produced subgenital plate on 8th sternite which is bounded on either side by a well defined lateral sclerotized plate . . . . . .(Subgenus Utacapnia) 5

   Body length under 7 mm; 8th sternite often sclerotized, but subgenital plate not produced . . . . . (Subgenus Capnia s.s.) 2

2. Seventh and 8th sternites united by a median sclerotized connection of varying widths 3

   Seventh and 8th sternites not connected, separated by membranous area 4

3. Connection between 7th and 8th sternites constricted, narrow; posterior edge of 8th sternite, subgenital plate, divided medially by narrow membranous separation, separated from lateral sclerotized patches by deep, wide membranous areas . . . . . C. limata

   Connection between 7th and 8th sternites only moderately constricted; posterior edge of 8th sternite entire . . . . . C. coloradensis

4. Posterior edge of 7th sternite membranous with narrow median sclerotized projection reaching to or overlapping part of 8th sternite . . . . . C. confusa

   Posterior edge of 7th sternite sclerotized, uniform,

unmodified medially . . . . . C. gracilaria

5. Pigmentation of 8th abdominal sternite extensive, covering 80% of ventral surface . . . . . C. logana

Pigmentation of 8th abdominal sternite restricted to posterior lobe and median line 6

6. Subgenital plate extending posteriorly as notched lobe with two clearly defined points, being narrow, 1/5 width of abdomen . . . . . C. lemoniana

Subgenital plate with shallow notch with two rectangular lobes giving the appearance of four low corners, being wide, 1/2 to 1/3 width of abdomen . . . . . C. poda

Subgenus Utacapnia

Capnia lemoniana Nebeker and Gaufin

1955 Capnia columbiana, Gaufin, Utah Academy Proc., 32:118 (in part).

1965 Capnia lemoniana Nebeker and Gaufin, Trans. Am. Ent. Soc., 91:477-479, description of male and female.

Type locality: Provo River, Utah.

Geographic range: Idaho, Western Wyoming and Utah.

Distribution, Yampa River Drainage, Routt Co.: Willow Creek south of Hahn's Peak - 2 males, 13-V-68, B.R.O.

Capnia logana Nebeker and Gaufin

1955 Capnia columbiana, Jewett, Wasmann Jour. Biology, 13(1): 146-147.

1965 Capnia logana Nebeker and Gaufin, Trans. Am. Ent. Soc. 91:472-473, description of male and female.

Type locality: Logan River, Utah.

Geographic range: Southern Wyoming and Colorado to Utah.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa, 16 females, 6-II-63, A.R.G.; 14 males, 6-IV-63, A.R.G.; Little Morrison Creek - 1 male, 2 females, 19-III-68, B.R.O.

Capnia poda Nebeker and Gaufin

1955 Capnia columbia, Jewett, Wasmann Jour. Biology, 13(1):146-147.

1965 Capnia poda Nebeker and Gaufin, Trans. Am. Ent. Soc. 91:475-477, description of male and female.

Type locality: Gunnison River at the junction with Soap Creek, Gunnison Co., Colorado.

Geographic range: Northern Montana to southern Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 1 male, 1 female, 4-VI-63, A.R.G.; Yampa River at Little Morrison Creek Junction - 21 males, 41 females, 19-III-68, B.R.O.; Yampa River at Steamboat Springs - 10 males, 16 females, 17-III-68, B.R.O.; 50 males, 30 females, 18-III-68, B.R.O.; 6 females, 10-V-68, B.R.O.; Yampa River 8 miles east of Hayden - 162 males, 55 females, 20-III-68, B.R.O.; Little Morrison Creek - 1 male, 3 females, 19-III-68, B.R.O.; Soda Creek - 1 female, 9-V-68, B.R.O.; Trout Creek - 1 male, 19-III-68, B.R.O.; Walton Creek - 1 female, 10-V-68, B.R.O.; Big Creek - 3 males, 1 female, 18-III-68, B.R.O.; Butcher Knife Creek - 1 male, 2 females, 18-III-68, B.R.O.; Willow Creek south of Hahn's Peak - 1 male, 1 female, 13-V-68,

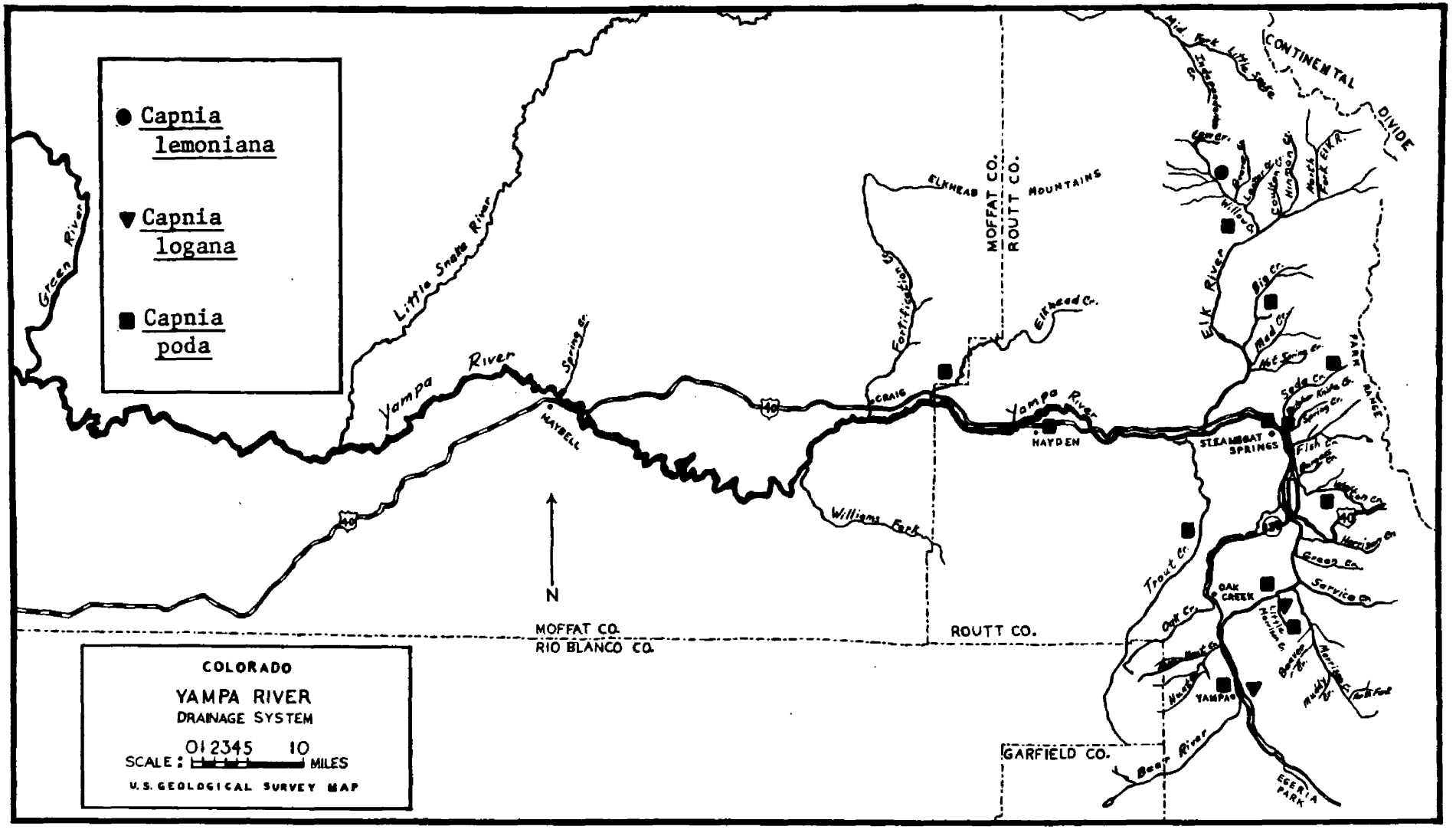


Fig. 6. Distribution map of Capnia lemoniana, C. logana, and C. poda.

B.R.O.; Moffat Co.: Elkhead Creek - 1 female, 20-III-68, B.R.O.

Subgenus Capnia s.s.

Capnia coloradensis Claassen

1937a Capnia coloradensis Claassen, 1937, Can. Ent. 69:78-80, male, female described was not coloradensis.

1965 Capnia coloradensis, Ricker, J. Fish. Res. Bd. Canada 22:487-491.

Type locality: Seven Falls, N. Cheyenne Canyon, Colorado.

Geographic range: Colorado, Wyoming, and Idaho.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 2 males, 6-IV-63, A.R.G.; Yampa River at Steamboat Springs - 1 male, 18-III-68, B.R.O.; Oak Creek - 1 male, 11-V-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 46 males, 103 females, 10-V-68, B.R.O.; 1 male, 4 females, 19-VI-68, B.R.O.; 2 males, 3 females, 20-VI-68, B.R.O.; 1 female, 21-VI-68, B.R.O.; 1 female, 23-VI-68, B.R.O.; 2 females, 24-VI-68, B.R.O.; 1 female, 25-VI-68, B.R.O.; Walton Creek - 1 male, 1 female, 6-IV-63, A.R.G.; East Fork of Elk River - 1 male, 1 female, 11-IV-65, A.V.N.; Soda Creek - 2 males, 2 females, 6-IV-63, A.R.G.; Fish Creek - 108 males, 114 females, 6-IV-63, A.R.G.; Big Creek - 1 male, 1 female, 18-III-68, B.R.O.; Hot Springs Creek - 2 females, 13-V-68, B.R.O.; 1 female, 19-VI-68, B.R.O.; Willow Creek south of Hahn's Peak - 7 males, 11 females, 13-V-68, B.R.O.

Capnia confusa Claassen

1929 Capnia nivalis Neave, Contr. Biol. Fish. 4:163, male and female.

1936 Capnia confusa Claassen, Ann. Ent. Soc. Amer. 29:623, new name.

1943a Capnia ligulata Hanson, Proc. Ent. Soc. Wash. 45(4):85-88.

Type locality: Maligne Lake, Jasper Park, Alberta.

Geographic range: Alberta and British Columbia south to Utah and Wyoming.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 25 males, 16-IV-63, A.R.G.; Oak Creek - 1 male, 2 females, 11-V-68, B.R.O.; Soda Creek - 2 females, 9-V-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 1 male, 18-VI-68, B.R.O.; North Fork of Elk River - 1 female, 28-VI-68, B.R.O.; Willow Creek south of Hahn's Peak - 2 males, 2 females, 13-V-68, B.R.O.

Capnia gracilaria Claassen

1924 Capnia gracilaria Claassen, 1924, Can. Ent., 56:57, male.

1943 Capnia gracilaria, Ricker, Stoneflies S.W.B.C., pp. 99-100, female and nymph.

Type locality: Aweme, Manitoba.

Geographic range: Wide spread and common in the western United States.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 15 males, 10 females, 6-IV-63, A.R.G.; Soda Creek - 1 male, 6-IV-63, A.R.G.; Cow Creek - 4 females, 19-VI-68, B.R.O.; Mad Creek - 2 males, 1 female, 18-III-68, B.R.O.

Capnia limata Frison

1944 Capnia limata Frison, Trans. Amer. Ent. Soc. 69:155-157.

Type locality: South Platte River, Littleton, Colorado.

Geographic range: Colorado, Wyoming, Montana, Utah, and Idaho.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Steamboat Springs - 23 males, 23 females, 11-IV-65, A.V.N.; 5 males, 1 female,

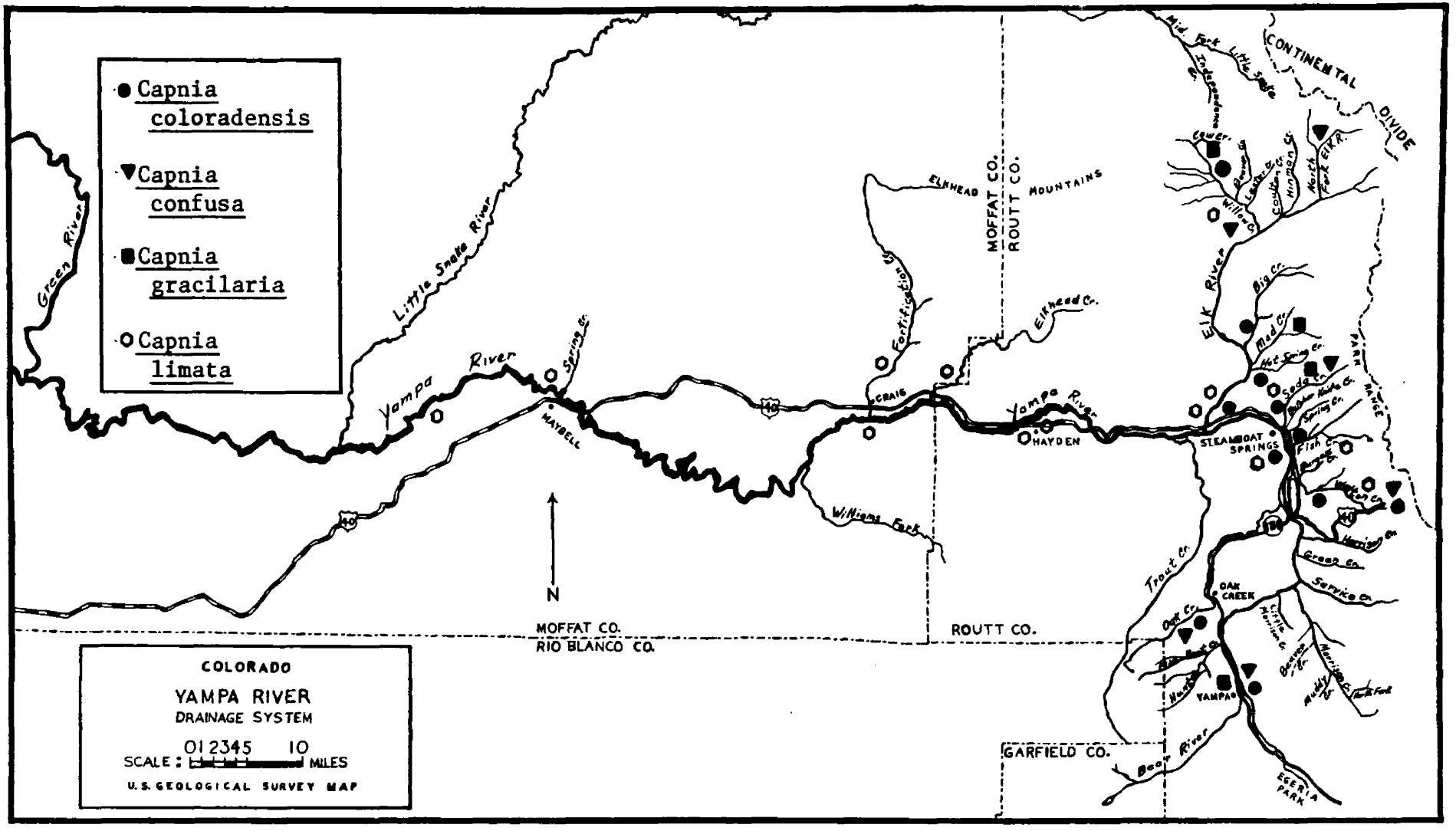


Fig. 7. Distribution map of Capnia coloradensis, C. confusa, C. gracilaria, and C. limata.

18-III-68, B.R.O.; 1 female, 12-V-68, B.R.O.; Yampa River at Hayden - 62 males, 11 females, 11-IV-65, A.V.N.; Yampa River 2 miles west of Hayden - 48 males, 29 females, 11-IV-65, A.V.N.; 25 males, 6 females, 20-III-68, B.R.O.; Yampa River west of Steamboat Springs - 187 males, 27 females, 5-IV-63, A.R.G.; East Elk Creek near Milner - 2 females, 5-III-63, A.R.G.; East Fork of Elk River - 80 males, 20 females, 11-IV-65, A.V.N.; Fish Creek - 3 females, 6-IV-63, A.R.G.; Walton Creek - 1 female, 6-IV-63, A.R.G.; Soda Creek - 1 female, 6-IV-63, A.R.G.; 2 females, 9-V-68, B.R.O.; Willow Creek south of Hahn's Peak - 1 male, 1 female, 13-V-68, B.R.O.; Moffat Co.: Yampa River 6 miles east of Little Snake River Junction - 84 males, 30 females, 16-III-68, B.R.O.; Yampa River at Maybell - 3 males, 14 females, 5-IV-63, A.R.G.; 235 males, 310 females, 12-IV-65, A.V.N.; 61 males, 3 females, 16-III-68, B.R.O.; 17 males, 15 females, 20-III-68, B.R.O.; Yampa River at Craig - 54 males, 24 females, 5-IV-63, A.R.G.; 19 males, 69 females, 11-IV-65, A.V.N.; Fortification Creek - 22 males, 22 females, 20-III-68, B.R.O.; Elkhead Creek - 5 males, 4 females, 5-IV-63, A.R.G.; 19 males, 20 females, naiads, 20-III-68, B.R.O.

Genus *Eucapnopsis* Okamoto

Eucapnopsis brevicauda (Claassen) (Figs. 52, 53, 54)

1924 *Capnia brevicauda* Claassen, Can. Ent. 56:55, description of female.

1925 *Capnia brevicauda*, Needham and Claassen, Thomas Say Found., 2:269; wing p. 385, (Fig. 2); female genitalia, p. 389, (Fig. 12)

1934 *Eucapnopsis brevicauda*, Neave, Can. Ent. 66:6, description of

male.

1937 Eucapnopsis brevicauda, Frison, Bull. Ill. Nat. Hist. Sur. 21:86, male and female genitalia, (Fig. 73).

1943 Eucapnopsis brevicauda, Ricker, Indiana Univ. Publ. Sci Ser., 12:85, description of nymph.

Type locality: Boulder, Colorado.

Geographic range: British Columbia to California and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Steamboat Springs - 31 males, 10 females, 12-V-68, B.R.O.; Elk River at Hinman Creek - 1 male, 28-VI-68, B.R.O.; Fish Creek Falls - 1 male, 19 females, 18-VI-68, B.R.O.; 2 females, 25-VI-68, B.R.O.; Fish Creek at Steamboat Springs - 1 female, 15-VII-68, B.R.O.; Soda Creek - 1 male, 1 female, 9-V-68, B.R.O.; 1 male, 12-V-68, B.R.O.; 1 female, 21-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 2 males, 2 females, 21-VI-68, B.R.O.; 2 females, 23-VI-68, B.R.O.; 1 male, 24-VI-68, B.R.O.; 1 male, 1 female, 27-VI-68, B.R.O.; 1 male, 2 females, 28-VI-68, B.R.O.; Lester Creek - 1 female, 17-VII-68, B.R.O.; North Fork of Elk River - 4 males, 12 females, 28-VI-68, B.R.O.; 1 female, 18-VII-68, B.R.O.

Genus Paracapnia Hanson

Paracapnia angulata Hanson (Figs. 55a, 55b, 56)

1942a Capnia opis, Frison, Bull. Illinois Nat. Hist. Survey 22(2)264-5, figures of male and female (collection data in part not Newman, 1839).

1961 Paracapnia angulata Hanson, Bull. Brooklyn Ent. Soc., Vol. 56, No. 2, p. 29, (Fig. 1-4).

Type locality: Pelham, Massachusetts.

Geographic range: Eastern United States, Common in the Black Hills to Albany Co., Wyoming.

Distribution, Yampa River Drainage, Routt Co.: Walton Creek Bridge - 1 male, 1 female, 10-V-68, B.R.O.; Willow Creek south of Hahn's Peak - 8 males, 25 females, 13-V-68, B.R.O.

Subfamily TAENIOPTERYGINAE

Genus Brachyptera Newport

Males (females, by color)

1. Tenth tergite with 2 raised, rearward pointing appendages . . . . . *B. pacifica*

   Tenth tergite without 2 raised, rearward pointing appendages 2

2. Wings often heavily infuscated; frequently red or orange pigment on abdominal segments; supra-anal process of male gradually tapering to a point . . . . . *B. nigripennis*

   Wings never heavily infuscated though there may be an infuscated area in the vicinity of the cord; the supra-anal process is divided into four parts . . . . . *B. fosketti*

Subgenus Oemopteryx

Brachyptera fosketti Ricker (Figs. 57, 58)

1851 Nemoura (Brachyptera) glacialis Newport, Trans. Linn. Soc. Lon. 20:451.

1878 Perla chicoutimienses Provancher, Petite Fauna Canada, Nevr., p. 75 New Synonymy.

1938 Taeniopteryx glacialis Ricker, Trans. Royal Canadian Inst. 22(1), p. 131.

1938 Taeniopteryx (oemopteryx) alex Hanson, Bull. Brooklyn Ent. Soc. 33(2), p. 79.

1942a Brachyptera glacialis Frison, Bull. Illinois Nat. Hist. Surv. 22, p. 251.

1965 Brachyptera zelona, Ricker, J. Fish. Res. Bd. Canada, 22(2): 477-478.

1965 Brachyptera fosketti Ricker, J. Fish. Res. Bd. Canada, 22(2): 475-476.

Type locality: South Saskatchewan River, Clarksboro, Saskatchewan.

Geographic range: Saskatchewan, Montana, Utah and Colorado.

Distribution, Yampa River Drainage, Moffat Co.: Yampa River 6 miles east of Little Snake River Junction - 77 males, 12 females, naiads, 16-III-68, B.R.O.; Yampa River at Maybell - 1 male, 1 female, 5-IV-63, A.R.G.; 7 males, 10 females, 16-III-68, B.R.O.; 18 males, 9 females, 20-III-68, B.R.O.

Subgenus Taenionema Banks

Brachyptera nigripennis (Banks) (Figs. 62, 63, 64)

1918 Taeniopteryx (Rhabdiopteryx) nigripennis Banks, Bull. Mus. Comp. Zool. 62(1):8.

1925 Taeniopteryx nigripennis, Needham and Claassen, Thomas Say Found., 2:245; male genitalia, p. 381, (Figs. 7, 8); female genitalia, p. 383, (Fig. 4).

1943 Taeniopteryx (Taenionema) nigripennis, Ricker, Indiana Univ. Publ., Sci. Ser., 12:53.

1959 Brachyptera (Taenionema) nigripennis, Jewett, Oregon St. Monogr., 3:54, (Fig. 19).

Type locality: Wenatchee, Washington.

Geographic range: British Columbia and Alberta to California, Utah, and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 14 males, 15 females, 21-VI-68, B.R.O.; 8 males, 8 females, 23-VI-68, B.R.O.; 7 females, 15-VII-68, B.R.O.; East Fork of Elk River - 1 female, 13-V-68, B.R.O.; Elk River at Hinman Creek - 1 female, 28-VI-68, B.R.O.; Fish Creek Falls - 1 male, 27-VI-67, B.R.O.; 20 males, 11 females, 18-VI-68, B.R.O.; 7 males, 5 females, 25-VI-68, B.R.O.; Fish Creek at Steamboat Springs - 1 female, 21-VI-68, B.R.O.; 2 females, 25-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 1 male, 2 females, 27-VI-68, B.R.O.; 1 female, 15-VII-68, B.R.O.; Walton Creek Branch to Harrison - 1 female, 20-VI-68, B.R.O.; Hot Springs Creek - 1 female, 13-V-68, B.R.O.; Mad Creek - 1 female, 19-VI-68, B.R.O.; North Fork of Elk River - 1 female, 18-VII-68, B.R.O.

Brachyptera pacifica (Banks) (Figs. 59, 60, 61)

1900 Taenioptaryx pacifica Banks, Trans. Amer. Ent. Soc. 26:244.

1918 Taeniopteryx pacifica, Newcomer, Jour. Ag. Res. 13(1):37-41; figures of males, female and nymph.

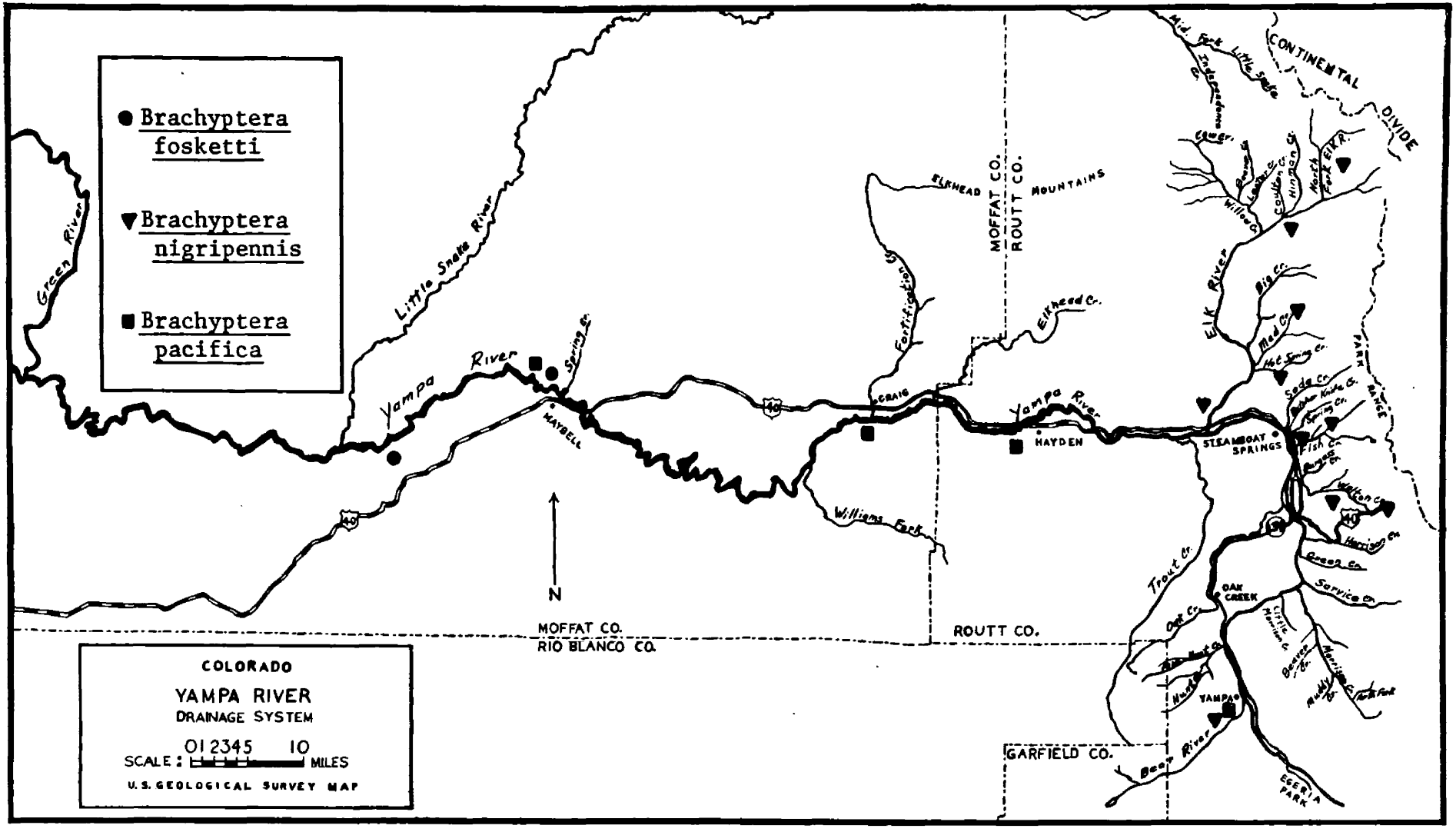


Fig. 8. Distribution map of Brachyptera fosketti, B. nigripennis, and B. pacifica.

1925 Taeniopteryx pacifica, Needham and Claassen, Thomas Say Found., p. 246; wing, p. 357; male genitalia, p. 381, (Fig. 11-12); female genitalia, p. 383, (Fig. 3).

Type locality: Pullman, Washington.

Geographic range: British Columbia and Alberta to California, Utah, and Colorado; Labrador to Virginia.

Distribution, Yampa River Drainage, Routt Co.: Bear River - Naiads, 10-V-68, B.R.O.; Yampa River 2 miles west of Hayden - 1 male, 11-IV-65, A.V.N.; Moffat Co.: Yampa River at Craig - 15 males, 4 females, 5-IV-63, A.R.G.; Yampa River at Maybell - 1 male, 1 female, 5-IV-63, A.R.G.; 18 males, 7 females, 7-IV-63, A.R.G.; 1 male, 1 female, 12-IV-65, A.R.G.

Family PTERONARCIDAE

Genus Pteronarcella Banks

Pteronarcella badia (Hagen) (Figs. 42, 43, 44)

1874 Pteronarcys badia Hagen, Bull. Geol. Surv. Terr., p. 573.

1907b Pteronarcella badia, Banks, Cat. Neur. Ins. U.S. p.10.

1925 Pteronarcella badia, Needham and Claassen, Thomas Say Found., pp. 46-47.

1931 Pteronarcella badia, Claassen; Plecop. Nymphs, pp. 35-36.

Type locality: Bridger Basin, Wyoming.

Geographic range: Rocky Mountain States, Montana to Arizona.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 1 female, 17-VI-61, A.R.G.; 1 male, exuviae, 19-VI-61, A.R.G.; 1 male, 4 females, 26-VI-62, A.R.G.; naiad, 19-III-68, B.R.O.; naiads, 10-V-68, B.R.O.; 15 males, 26 females; naiads, 22-VI-68, B.R.O.; exuviae, 15-VII-68, B.R.O.; 7 females, 27-VI-68, B.R.O.; Yampa River at Little Morrison

Creek Junction - 1 female, 24-VI-68, B.R.O.; Yampa River at Sarvice Creek Junction - 1 female, 27-VI-68, B.R.O.; Yampa River east of Highway 131 - Exuviae, 25-VI-68, B.R.O.; Yampa River at Steamboat Springs - Naiad, 19-VI-61, A.R.G.; 1 female, 25-VI-62, A.R.G.; naiad, 18-III-68, B.R.O.; 1 male, 18-VI-68, B.R.O.; exuviae, 21-VI-68, B.R.O.; 3 females, 26-VI-68, B.R.O.; 1 male, 1 female, 28-VI-68, B.R.O.; Yampa River south of Steamboat Springs - Naiad, 17-VII-68, B.R.O.; Yampa River 2 miles west of Steamboat Springs - 1 female, 25-VI-62, A.R.G.; 1 female, 26-VI-68, B.R.O.; Yampa River 2 miles west of Hayden - 1 female, 18-VI-68, B.R.O.; Butcher Knife Creek - Naiads, 23-VIII-67, B.R.O.; naiad, 18-III-68, B.R.O.; East Fork of Elk River - Naiads, 22-VIII-67, B.R.O.; naiads, 20-III-68, B.R.O.; West Fork of Elk River - Naiads, 20-III-68, B.R.O.; Elk River 1 mile above Big Creek - Exuviae, 13-V-68, B.R.O.; Elk River 3 miles south of Clark - Naiads, 18-III-68, B.R.O.; Elk River at Clark - Naiads, 18-III-68, B.R.O.; exuviae, 13-V-68, B.R.O.; 2 males, 2 females; exuviae, 17-VII-68, B.R.O.; Elk River at Willow Creek Junction - Exuviae, 28-VI-68, B.R.O.; Elk River at Hinman Creek - 3 females, 18-VII-68, B.R.O.; Fish Creek at Steamboat Springs - 1 male, 25-VI-62, B.R.O.; naiads, 29-VI-67, B.R.O.; exuviae, 16-VII-68, B.R.O.; Harrison Creek - 1 male, 1 female, 15-VI-68, C.K.; Hunt Creek - Naiads, 19-III-68, B.R.O.; naiad, 11-V-68, B.R.O.; Little Snake River at Focus Ranch - Exuviae, 17-VII-68, B.R.O.; Morrison Creek - Exuviae, 24-VI-68, B.R.O.; Oak Creek - Exuviae, 26-VIII-67, B.R.O.; naiads, 19-III-68, B.R.O.; exuviae, 22-VI-68, B.R.O.; exuviae, 15-VII-68, B.R.O.; Sarvice Creek - 1 male, exuviae, 30-VI-67, B.R.O.; Soda Creek - Naiads, 19-VI-61, A.R.G.; naiads, 22-VIII-67, B.R.O.; naiads, 24-XI-67, B.R.O.; naiad,

20-III-68, B.R.O.; exuviae, 25-VI-68, B.R.O.; exuviae, 16-VII-68, B.R.O.; Spring Creek - Naiads, 23-VIII-67, B.R.O.; naiads, 24-XI-67, B.R.O.; naiads, 18-III-68, B.R.O.; exuviae, 28-VI-68, B.R.O.; Trout Creek - Naiads, 19-III-68, B.R.O.; naiads, 11-V-68, B.R.O.; 1 male, 1 female, exuviae, 22-VI-68, B.R.O.; exuviae, 15-VII-68, B.R.O.; Walton Creek - Naiad, 29-VI-67, B.R.O.; 1 female, 23-VII-67, B.R.O.; naiad, 25-VI-68, B.R.O.; Big Creek - Naiads, 18-III-68, B.R.O.; Hinman Creek - 1 male, exuviae, 28-VI-68, B.R.O.; Mad Creek - Naiads, 18-III-68, B.R.O.; exuviae, 17-VII-68, B.R.O.; North Fork of Elk River - 5 females, 18-VII-68, B.R.O.

Genus Pteronarcys Newman

Pteronarcys californica Newport (Figs. 45, 46)

1851 Pteronarcys californica Newport, Trans. Linn. Soc. London, 20:450.

1925 Pteronarcys californica, Needham and Claassen, Monog. Plecop., pp. 37-38, male and female genitalia, p. 305, (Figs. 5, 6).

1931 Pteronarcys californica, Claassen, Plecop. Nymphs, p.32, description of nymph.

Type locality: California.

Geographic range: British Columbia to California, Montana, Colorado, and New Mexico.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Little Morrison Creek Junction - Exuviae, 19-III-68, B.R.O.; exuviae, 24-VI-68, B.R.O.; Yampa River at Sarvice Creek Junction - Exuviae, 16-VII-68, B.R.O.; Yampa River east of Highway 131 - Exuviae, 25-VI-68, B.R.O.;

1 female, exuviae, 26-VI-68, B.R.O.; Yampa River west of Highway 131 - Exuviae, 21-VI-68, B.R.O.; Yampa River at Steamboat Springs - 1 female, 1-VII-67, B.R.O.; Yampa River 8 miles east of Hayden - 1 male, exuviae, 20-VI-68, B.R.O.; Yampa River 2 miles west of Hayden - Naiad, 22-VIII-67, B.R.O.; exuviae, 20-VI-68, B.R.O.; East Fork of Elk River - Naiad, 22-VIII-67, B.R.O.; exuviae, 24-XI-67, B.R.O.; naiad, 20-III-68, B.R.O.; 1 male, exuviae, 20-VI-68, B.R.O.; Elk River 3 miles south of Clark - Exuviae, 18-III-68, B.R.O.; Elk River at Willow Creek Junction - Exuviae, 28-VI-68, B.R.O.; Little Snake River at Focus Ranch - Exuviae, naiads, 17-VII-68, B.R.O.; Big Creek - Naiad, 18-III-68, B.R.O.; exuviae, 17-VII-68, B.R.O.; Mad Creek - Exuviae, 17-VII-68, B.R.O.

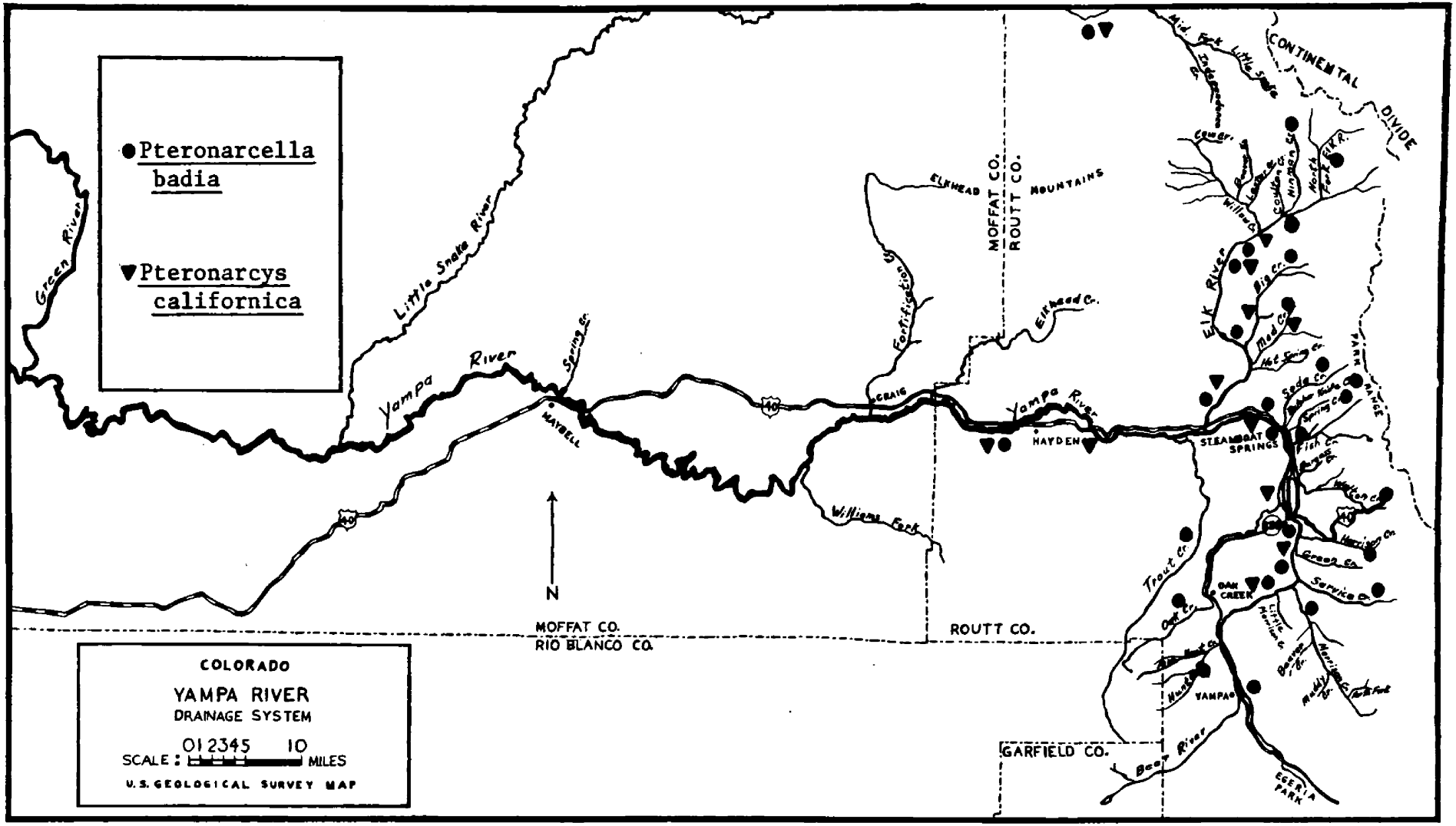


Fig. 9. Distribution map of Pteronarcella badia, and Pteronarcys californica.

Suborder SETIPALPIA

Family PERLODIDAE

Subfamily ISOGENINAE

Genus Arcynopteryx Klapalek

Males and Females

1. Finger-like gills present on all 3 thoracic segments; female subgenital plate narrowly notched; apical crossveins commonly present from R_1 to M_1 or M_2 . . . . . (Subgenus Megarcys) . . . . . signata

   Thoracic gills absent; female subgenital plate broadly excavated; apical crossveins present no farther back than the branches of R_S, or rarely M_1 . . . . . (Subgenus Skwala) . . . . . parallela

Subgenus Skwala Ricker

Arcynopteryx parallela Frison (Figs. 65, 66)

1925 Perlodes americana, Needham and Claassen (not Klapalek, 1912), Thomas Say Found., p. 61.

1931 Perlodes americana, Claassen, Plecop. Nymphs, p. 44.

1936 Hydroperla parallela Frison, Ann. Ent. Soc. Amer. 29:261.

1937 Hydroperla parallela Frison, Bull. Ill. Nat. Hist. Sur. 21:90.

1942a Hydroperla parallela Frison, ibid., 22:298.

1942 Arcynopteryx americana, Hanson, Amer. Midland Nat. 28:394.

1943 Arcynopteryx parallela parallela, Ricker, Stoneflies S.W.B.C., p. 113.

Type locality: Corvallis, Oregon.

Geographic range: Southern British Columbia to Utah and California.

Distribution, Yampa River Drainage, Routt Co.: Bear River - Exuviae, 15-VII-68, B.R.O.; Yampa River east of Highway 131 - Exuviae, 25-VI-68, B.R.O.; Yampa River at Steamboat Springs - 1 male, 12-V-68, B.R.O.; exuviae, 21-VI-68, B.R.O.; exuviae, 16-VII-68, B.R.O.; Yampa River east of Steamboat Springs - Naiads, 17-III-68, B.R.O.; 1 male, 10-V-68, B.R.O.; exuviae, 26-VI-68, B.R.O.; Yampa River 8 miles east of Hayden - Naiads, 20-III-68, B.R.O.; Yampa River 2 miles west of Hayden - Naiads, 22-VIII-67, B.R.O.; 1 female, 13-V-68, B.R.O.; exuviae, 20-VI-68, B.R.O.; exuviae, 14-VII-68, B.R.O.; exuviae, 18-VII-68, B.R.O.; Butcher Knife Creek - Naiads, 23-VIII-67, B.R.O.; naiad, 18-III-68, B.R.O.; East Fork of Elk River - Naiads, 20-III-68, B.R.O.; 1 male, 2 females, exuviae, 13-V-68, B.R.O.; West Fork of Elk River - Naiad, 20-III-68, B.R.O.; Elk River 1 mile above Big Creek - Exuviae, 13-V-68, B.R.O.; Elk River at Clark - Naiad, 18-III-68, B.R.O.; exuviae, 15-VII-68, B.R.O.; exuviae, 17-VII-68, B.R.O.; Fish Creek at Steamboat Springs - Naiad, 29-VI-67, B.R.O.; naiad, 24-XI-67, B.R.O.; 1 female, 25-VI-68, B.R.O.; exuviae, 25-VI-68, B.R.O.; Little Snake River at Focus Ranch - Exuviae, 17-VII-68, B.R.O.; Oak Creek - Naiads, 19-III-68, B.R.O.; exuviae, 15-VII-68, B.R.O.; Soda Creek - Naiads, 22-VIII-67, B.R.O.; naiads, 24-XI-67, B.R.O.; naiads, 20-III-68, B.R.O.; 2 males, exuviae, naiads, 12-V-68, B.R.O.; Spring Creek - Naiads, 23-VIII-67, B.R.O.; naiads, 24-XI-67, B.R.O.; naiads, 18-III-68, B.R.O.; Trout Creek - Exuviae, 11-V-68, B.R.O.; Walton Creek - Exuviae, 23-VIII-67, B.R.O.; 3 males, 1 female, exuviae, 10-V-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 1 female, 21-VI-68,

B.R.O.; 1 male, 1 female, 25-VI-68, B.R.O.; 1 female, 27-VI-68, B.R.O.; Big Creek - Naiad, 18-III-68, B.R.O.; naiad, 13-V-68, B.R.O.; Hinman Creek - Exuviae, 18-VII-68, B.R.O.; Hot Springs Creek - Naiads, 18-III-68, B.R.O.; 3 males, 10 females, 13-V-68, B.R.O.; exuviae, 17-VII-68, B.R.O.; Mad Creek - Exuviae, 19-VI-68, B.R.O.; North Fork of Elk River - Exuviae, 28-VI-68, B.R.O.; exuviae, 18-VII-68, B.R.O.; Willow Creek near Hahn's Peak - Naiads, 13-V-68, B.R.O.; Moffat Co.: Elkhead Creek - Naiads, 22-VIII-67, B.R.O.; naiad, 20-III-68, B.R.O.

Arcynopteryx signata (Hagen) (Figs. 67, 68)

1874 Dictyopteryx signata Hagen, U. S. Geol. Surv. Terr., 1873, p. 576.

1931 Perlodes signata, Claassen, Thomas Say Found., 3:43, description and figures of nymphs.

1942 Megarcys signata, Hanson, (in part) Amer. Midland Nat., 28:398, male and female; head and female genitalia, p. 405, (Figs. 9, 16); male genitalia, p. 405, (Fig. 23).

1952 Arcynopteryx (Megarcys) signata, Ricker, Indiana Univ. Publ., Sci. Ser., 18:75, (Fig. 42).

Type locality: Colorado.

Geographic range: Northern British Columbia south to Utah, Colorado and New Mexico.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 1 male, 23-VI-68, B.R.O.; Yampa River at Yampa - 1 male, 1 female, 22-VI-68, B.R.O.; Yampa River east of Highway 131 - Exuviae, 26-VI-68, B.R.O.; Fish Creek Falls - Naiad, 23-VIII-67, B.R.O.; Harrison Creek - 2 females,

28-VI-68, B.R.O.; Spring Creek - Naiads, 23-VIII-67, B.R.O.; Walton Creek below Rabbit Ears Pass - Naiads, 23-VIII-67, B.R.O.; Moffat Co.: Yampa River 6 miles east of the Little Snake River Junction - 1 wing, 29-VI-68, B.R.O.

Genus Isogenus Newman

Males (Females in part)

1. A median mesosternal ridge present running from the fork of the Y-ridge to the transverse ridge; submental gills several times as long as their greatest diameter. . . . . (Subgenus Isogenoides) 2

   Median mesosternal ridge absent from the fork of the Y-ridge to the transverse ridge; submental gills at most 2 or 3 times as long as their greatest diameter 3

2. Supra-anal process of male without lobes posteriorly; subgenital plate of female only a little produced, with a deep U-rounded notch . . . . . I. colubrinus

   Supra-anal process with a pair of acute lobes posteriorly; subgenital plate of female little produced, broadly truncate, with or without small median notch . . . . . I. elongatus

3. Lateral stylets absent from the male supra-anal apparatus; submental gills short, but present; produced tip of the anterior sclerotized band of the supra-anal process normally coiled within

the process . . . . . (Subgenus Kogotus) . . . . . I. modestus

Lateral stylets present; submental gills completely lacking . . . . . (Subgenus Cultus) . . . . . I. aestivalis

Subgenus Cultus

Isogenus aestivalis (Needham and Claassen) (Figs, 69, 70)

1925 Perla aestivalis Needham and Claassen, Thomas Say Found., p. 87, male and female; wings, p. 319, (Fig. 5); male and female genitalia, eggs, p. 327, (Figs. 7-10).

1931 Perla aestivalis, Claassen, Plecop. Nymphs, p. 53, nymph.

1943 Diploperla fraseri Ricker, Stoneflies S.W.B.C., p. 106, head and pronotum, male and female genitalia, (Figs. 83-90), p. 107,

1952 Isogenus (cultus) aestivalis, Ricker, Syst. Studies Plecop., p. 96, above synonymy indicated and placed in new subgenus.

Type locality: Yellowstone National Park.

Geographic range: British Columbia to Utah, Colorado, and Wyoming.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 1 male, 27-VI-68, B.R.O.; Yampa River at Phippsburg - 1 male, 27-VI-68, B.R.O.; Yampa River at Little Morrison Creek Junction - 9 females, 24-VI-68, B.R.O.; 2 males, 6 females, 25-VI-68, B.R.O.; 8 males, 7 females, 27-VI-68, B.R.O.; Yampa River at Sarvice Creek Junction - 1 male, 27-VI-68, B.R.O.; East Fork of Elk River - 15 males, 14 females, 18-VII-68, B.R.O.; Fish Creek at Steamboat Springs - 1 female, 16-VII-68, B.R.O.; Moffat Co.: Yampa River at Maybell - 1 female, 29-VI-68, B.R.O.; Yampa

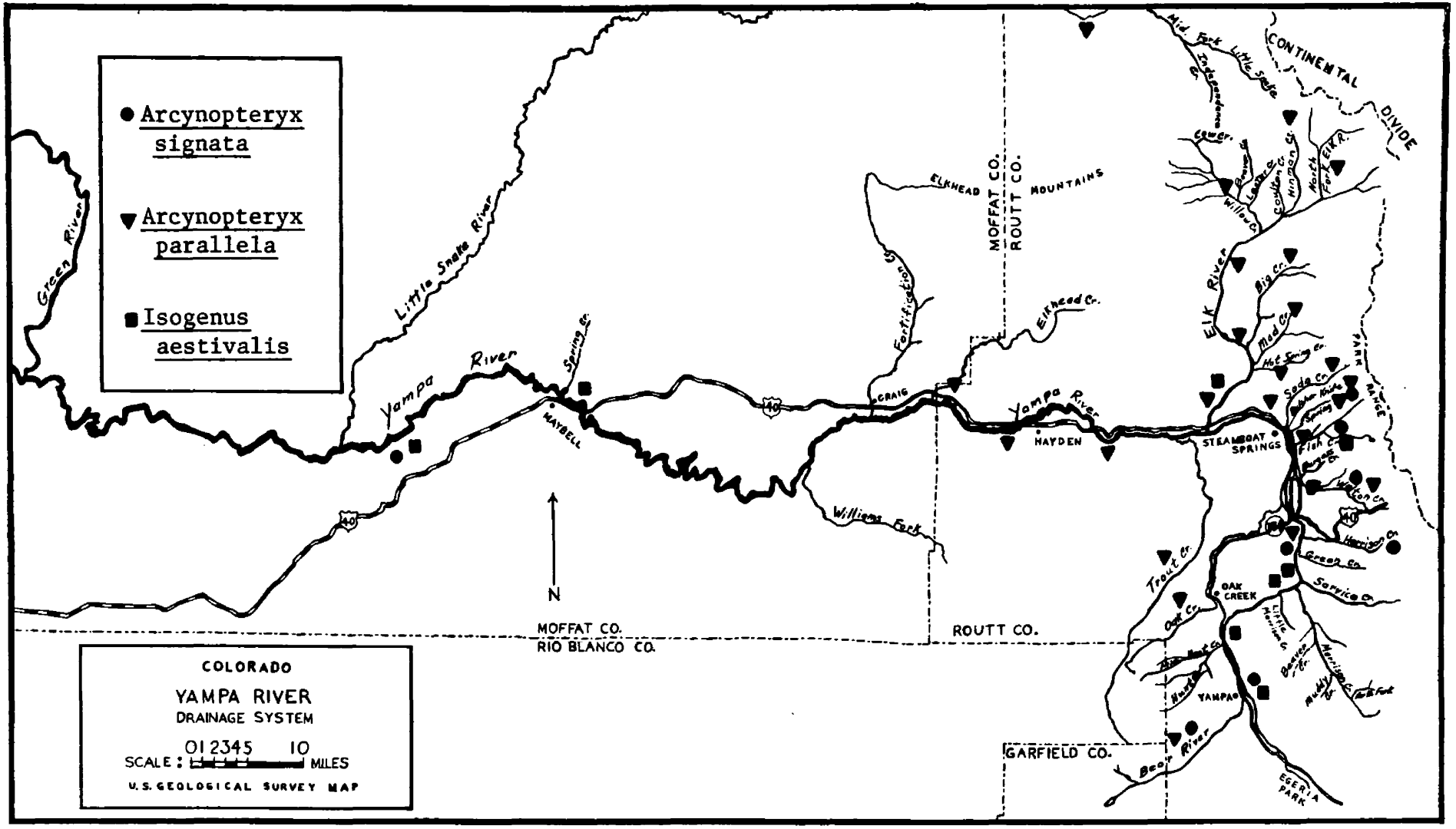


Fig. 10. Distribution map of Arcynopteryx signata, A. parallela, and Isogenus aestivalis.

River, 6 miles east of Little Snake River Junction - 1 male, 29-VI-68, B.R.O.

Subgenus Isogenoides

Isogenus colubrinus Hagen (Figs. 71, 72)

1874 Isogenus colubrinus Hagen, Bull. Geol. Surv. Terr., p. 576.

1918 Perla titusi Banks, Bull. Mus. Comp. Zool. 62:6.

1920 Isogenus incesta Banks, ibid., 64:318.

1925 Isogenus colubrinus, Needham and Claassen, Thomas Say Found., pp. 72-73.

1943b Isogenoides frontalis, Hanson, Amer. Midland Nat. 29:660, description of male and female; male genitalia, p. 667, (Fig. 3); female genitalia, p. 668 (Figs. 17, 18; not frontalis Newman).

1952 Isogenus (Isogenoides) frontalis colubrinus, Ricker, Syst. Studies Plecop., p. 110, placed as a subspecies of frontalis.

1964 Isogenus colubrinus, Ricker, Gew. U. Abw. 34/35:55,67, (Fig. 18).

Type locality: Snake River Idaho.

Geographic range: Alaska south to Oregon, Utah and Colorado, east in Mackenzie and northern Alberta to the Mackenzie River.

Distribution, Yampa River Drainage, Moffat Co.: Yampa River at Maybell - 2 males, 4 females, eggs, 29-VI-68, B.R.O.; Yampa River 6 miles east of Little Snake River Junction - 1 female, 29-VI-68, B.R.O.

Subgenus Isogenoides

Isogenus elongatus Hagen (Figs. 73, 74)

1874 Isogenus elongatus Hagen, Bull. Geol. Surv. Terr., p. 576.

1925 Isogenus elongatus, Needham and Claassen, Thomas Say Found., p. 71, description of male and female; male supra-anal process, p. 311, (Fig. 12), and female genitalia, (Fig. 17).

1943b Isogenoides elongatus, Hanson, Amer. Midland Nat., 29:660.

1952 Isogenus (Isogenoides) elongatus, Ricker, Syst. Studies Plecop., p. 108, description of nymph.

Type locality: Foothills of Colorado and Ogden, Utah.

Geographic range: British Columbia and Alberta south through Washington, Montana, Utah and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River near Little Morrison Creek - 1 female, 24-VI-68, B.R.O.; Yampa River at Sarvice Creek Junction - 1 female, 27-VI-68, B.R.O.; Yampa River at Steamboat Springs - Naiads, 19-VI-61, A.R.G.; 1 female, 25-VI-62, A.R.G.; 9 females, exuviae, 26-VI-68, B.R.O.; 1 female, 28-VI-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Yampa River 1 mile east of Hayden - 1 male, 1 female, 20-VI-68, B.R.O.; Yampa River 2 miles west of Hayden - 1 male, 3 females, 20-VI-68, B.R.O.

Subgenus Kogotus

Isogenus modestus (Banks) (Figs. 75, 76)

1908 Perla modesta Banks, Trans. Amer. Ent. Soc. 34: 255

1925 Perla modesta, Needham and Claassen, Thomas Say Found., p. 88, description of male and female; p. 315, (Fig. 1), wing; p. 325, (Figs. 16-19), male and female genitalia.

1931 Perla expansa, Claassen, Plecop. Nymphs, p. 55 (not expansa Banks).

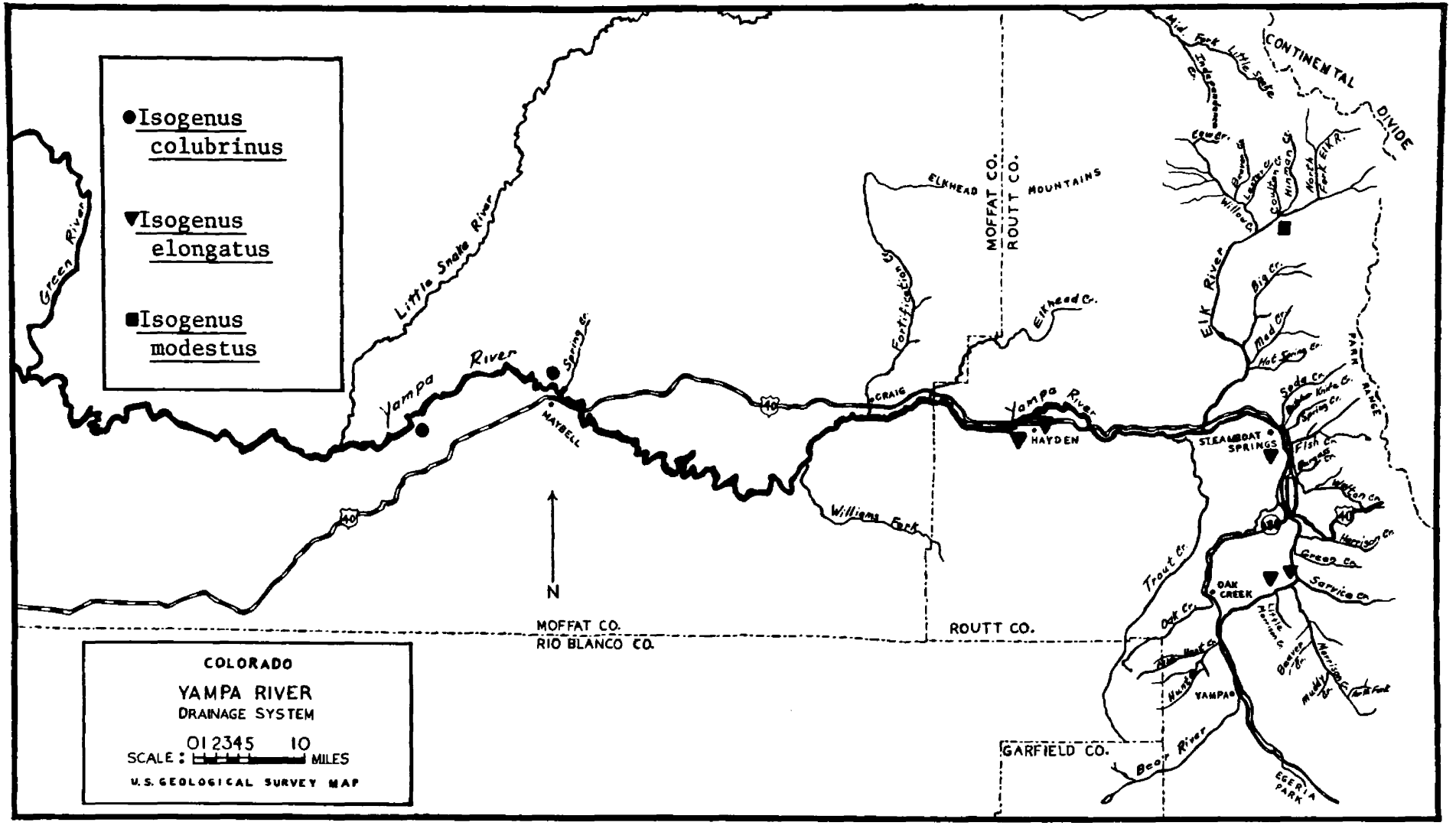


Fig. 11. Distribution map of Isogenus colubrinus, I. elongatus, and I. modestus.

1942a Diploperla modesta, Frison, Bull. Ill. Nat. Hist. Sur. 22:303-305, description and figures of nymph.

1952 Isogenus (Kogotus) modestus, Ricker, Syst. Studies Plecop., p. 116, placed in new subgenus.

Type locality: Boulder, Colorado.

Geographic range: Interior cordilleran ranges from southern British Columbia to New Mexico.

Distribution, Yampa River Drainage, Routt Co.: Coulton Creek at Elk River - 1 male, 28-VI-68, B.R.O.

Subfamily ISOPERLINAE

Genus Isoperla Banks

Males

1. Cerci about twice as long as the relaxed abdomen; the length of the 12th segment 6 to 8 times its greatest width; terminal 1/4 of segment conspicuously darker than basal part; 2 conspicuous patches of spinules on the 9th tergite . . . . . I. longiseta

   Cerci less than 1.5 times as long as the relaxed abdomen, the length of the 12th segment 3 to 5 times its greatest width; usually without spinules on the 9th tergite 2

2. Pronotum with a checkered pattern of black on yellow; subanal lobes flat, recurved; chisel-shaped, bent outward near the tips . . . . . I. pinta

   Pronotum striped or reticulately marked; subanal

lobes not bent outward close to the tips 3

3. Patches of short stout hairs on the posterior margin of the 9th tergite; often with a red cast to some of the abdominal segments . . . . . I. patricia

No patches of short hairs on 9th tergite; never with red tinge to abdominal segments 4

4. Lobe on 8th sternite obsolescent . . . . . I. ebria

Lobe on 8th sternite distinctive 5

5. Ninth sternite long and evenly rounded behind . . . . . I. fulva

Ninth sternite long and truncate behind . . . . . I. 5-punctata

Females

1. Cerci about twice as long as the relaxed abdomen; the length of the 12th segment 6 to 8 times its greatest width; subgenital plate somewhat produced and rounded; truncate, or slightly excavated . . . . I. longiseta

Cerci less than 1.5 times as long as the relaxed abdomen; the length of the 12th segment 3 to 5 times its greatest width; subgenital plate variable 2

2. Pronotum with a checkered pattern of black on yellow; subgenital plate moderatly produced, slightly excavated at the middle . . . . . I. pinta

Pronotum striped or reticulately marked; subgenital plate variable 3

3. Subgenital plate with a wide, deep excavation; often

with a red cast to some of the abdominal segments . . . . . I. patricia

Subgenital plate without a wide, deep excavation; never with a red tinge to abdominal segments 4

4. Subgenital plate shorter than the 7th sternite, its sides turned inward . . . . . I. fulva

Subgenital plate at least as long as the 7th sternite, its sides parallel or nearly so at the base 5

5. Subgenital plate semicircular in outline and without any emargination . . . . . I. ebria

Subgenital plate truncate in outline with a slight median emargination . . . . . I. 5-punctata

Isoperla ebria (Hagen) (Figs. 77, 78, 79)

1874 Perla ebria Hagen, Bull. Geol. Surv. Terr., p. 577.

1925 Clioperla ebria, Needham and Claassen, Monog. Plecop., pp. 141-142; male and female genitalia, p. 341 , (Figs. 1-3).

1931 Clioperla ebria, Claassen, Plecop. Nymphs, p. 71, description of nymph.

1943 Isoperla ebria, Ricker, Stoneflies S.W.B.C., pp. 121-122, description of nymph; nymph mouth-parts, and female subgenital plate, p. 123, (Figs. 107-110).

Type locality: Colorado.

Geographic range: British Columbia to Colorado and California.

Distribution, Yampa River Drainage, Routt Co.: Green Creek - 1 female, 16-VII-68, B.R.O.

Isoperla fulva Claassen (Figs. 80, 81)

1937a Isoperla fulva Claassen, Can. Ent. 69:80, description of male and female.

1938 Isoperla chrysannula Hoppe, Univ. Wash. Publ. Biol. 4:156; male genitalia, p. 173, (Figs. 13-14).

1938 Isoperla cascadensis Hoppe, ibid., p. 158, description of male and female; male and female genitalia, p. 173, (Figs. 17-19).

1942a Isoperla fulva, Frison, Bull. Ill. Nat. Hist. Sur. 22(2):337, Synonymy indicated.

Type locality: Logan River, Utah.

Geographic range: British Columbia to California, Utah and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 2 males, 5 females, 15-VII-68, B.R.O.; Yampa River at Yampa - 1 female, 23-VII-60, A.R.G.; 2 males, 4 females, naiads, 19-VI-61, A.R.G.; 14 males, 14 females, 26-VI-62, A.R.G.; naiads, 10-V-68, B.R.O.; 3 males, 6 females, naiad, 22-VI-68, B.R.O.; 1 male, 1 female, 23-VI-68, B.R.O.; 10 males, 12 females, 27-VI-68, B.R.O.; exuviae, 15-VII-68, B.R.O.; Yampa River at Steamboat Springs - Naiad, 18-III-68, B.R.O.; Butcher Knife Creek - Naiads, 18-III-68, B.R.O.; Elk River 3 miles south of Clark - Naiads, 18-III-68, B.R.O.; Elk River at Clark - 1 male, 1 female, 17-VII-68, B.R.O.; Elk River at Willow Creek Junction - Exuviae, 28-VI-68, B.R.O.; Green Creek - 1 female, 16-VII-68, B.R.O.; Middle Hunt Creek - Naiads, 19-III-68, B.R.O.; naiads, 11-V-68, B.R.O.; Morrison Creek - 1 female, 24-VI-68, B.R.O.; Oak Creek - Naiad, 19-III-68, B.R.O.; 4 males, 2 females, 22-VI-68, B.R.O.; Spring Creek - Naiad, 18-III-68, B.R.O.; Trout Creek - Naiad, 11-V-68, B.R.O.; Walton Creek below Rabbit Ears Pass -

1 female, 23-VIII-67, B.R.O.; Big Creek - Naiads, 18-III-68, B.R.O.; Burgess Creek - 1 male, 28-VI-68, B.R.O.; Hot Springs Creek - Naiads, 18-III-68, B.R.O.; Mad Creek - Exuviae, 17-VII-68, B.R.O.; North Fork of Elk River - 1 male, 1 female, 18-VII-68, B.R.O.

Isoperla longiseta Banks (Figs. 82, 83a, 83b, 84)

1906a Isoperla longiseta Banks, Can. Ent. 38:337, female.

1925 Isoperla longiseta, Needham and Claassen, Thomas Say Found., p. 156, description of male and female; male and female genitalia, p. 342, (Figs. 15-17).

1942a Isoperla longiseta, Frison, Bull. Ill. Nat. Hist. Sur. 22(2):318-320, description and illustration of nymph.

Type locality: Onaga, Kansas.

Geographic range: Midwest to British Columbia.

Distribution, Yampa River Drainage, Moffat Co.: Yampa River at Maybell - 4 males, 29-VI-68, B.R.O.; 1 male, 2 females, 18-VII-68, B.R.O.

Isoperla patricia Frison (Figs. 85a, 85b, 86)

1942a Isoperla patricia Frison, Bull. Ill. Nat. Hist. Sur. 22(2):313-315, description and figures of male, female, and nymph, (Fig. 87).

Type locality: Spearfish, South Dakota.

Geographic range: Western United States and Western Canada.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - Naiads, 19-VI-61, A.R.G.; 1 female, 26-VIII-67, B.R.O.; 1 female, 15-VII-68, B.R.O.; Yampa River at Little Morrison Creek Junction - 2 females, 28-VI-68, B.R.O.; 6 females, 25-VI-68, B.R.O.; 1 male, 10 females, 27-VI-68, B.R.O.; 2 females, 15-VII-68, B.R.O.; Yampa River at

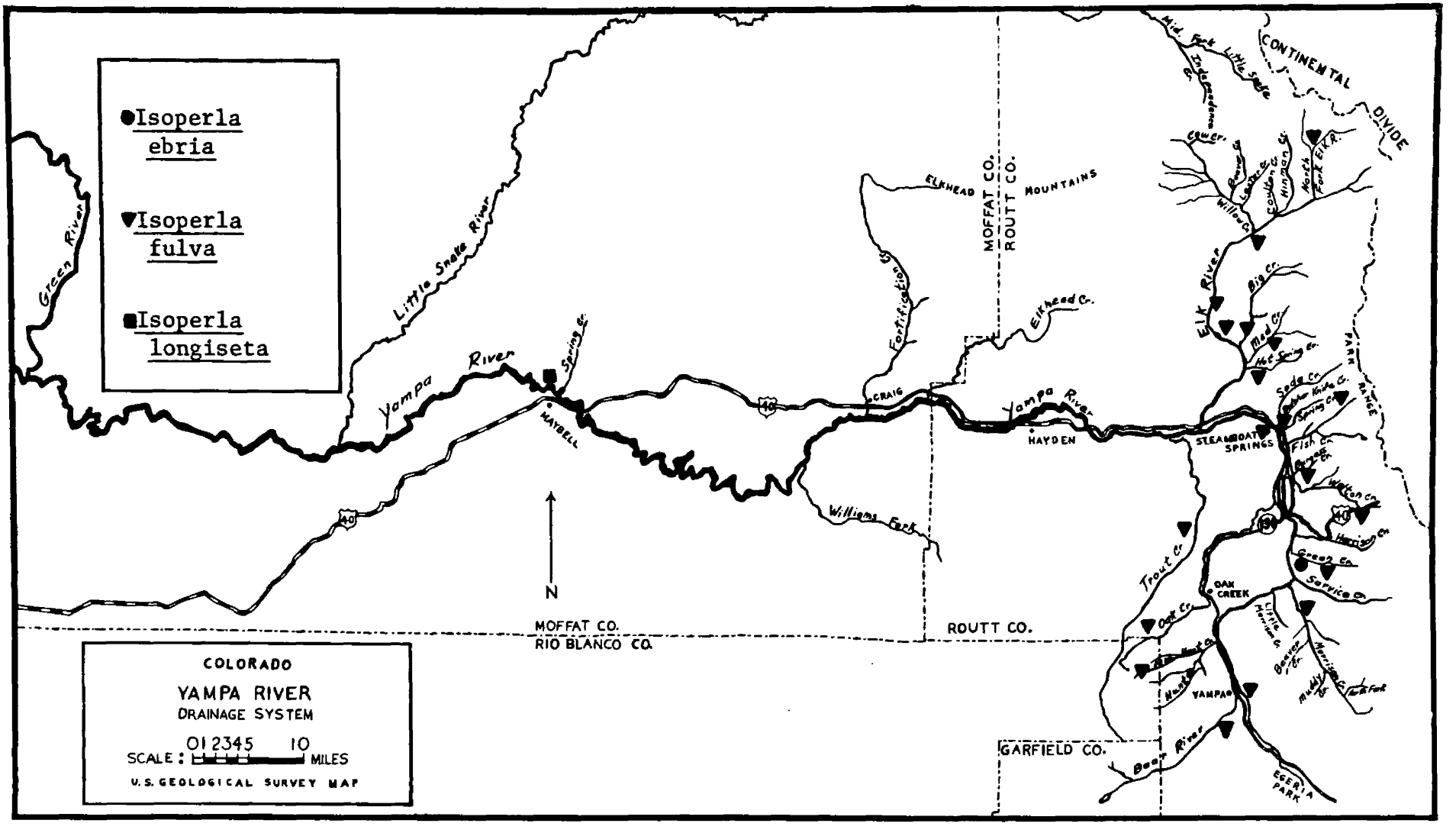


Fig. 12. Distribution map of Isoperla ebria, I. fulva, and I. longiseta.

Sarvice Creek Junction - Naiads, 30-VI-67, B.R.O.; 2 females, 27-VI-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Yampa River at Steamboat Springs - Naiad, 19-VI-61, A.R.G.; 6 males, 6 females, 25-VI-62, A.R.G.; 3 males, 4 females, 1-VII-67, B.R.O.; 2 males, 5 females, 26-VI-68, B.R.O.; 4 males, 1 female, 28-VI-68, J.L.O.; 26 males, 8 females, exuviae, 16-VII-68, B.R.O.; 1 female, 17-VII-68, B.R.O.; Yampa River 2 miles west of Hayden - Naiads, 18-VI-61, A.R.G.; 1 male, 20-VI-68, B.R.O.; 1 male, 1 female, 18-VII-68, B.R.O.; East Fork of Elk River - 1 male, 1 female, 18-VII-68, B.R.O.; Little Snake River at Focus Ranch - 2 males, 1 female, naiads, 17-VII-68, B.R.O.; Soda Creek - 1 male, 16-VII-68, B.R.O.; Moffat Co.: Yampa River at Maybell - 3 males, 1 female, 24-VI-62, A.R.G.; 5 males, 3 females, 29-VI-68, B.R.O.; Yampa River 6 miles east of Little Snake River Junction - 10 males, 3 females, 29-VI-68, B.R.O.; Yampa River, Green River Junction at Dinosaur National Park - Naiads, 25-VI-62, D.Q.A.

Isoperla pinta (Figs. 87a, 87b, 88)

1937 Isoperla pinta Frison, Bull. Ill. Nat. Hist. Sur. 21:92-93, description of male, female, and nymph; male and female genitalia and nymph, (Figs. 81, 82).

Type locality: Curry County, Oregon.

Geographic range: British Columbia to California, Utah, and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Little Morrison Creek Junction - 1 female, 27-VI-68, B.R.O.; Yampa River at Steamboat Springs - 1 female, 25-VI-62, A.R.G.; 1 male, 3 females, 1-VII-67, B.R.O.; naiad, 19-III-68, B.R.O.; 9 males, 9 females, 26-VI-68, B.R.O.; 2 males, 28-VI-68, B.R.O.; Yampa River west of Highway 131 -

Naiad, 17-III-68, B.R.O.; Yampa River 2 miles west of Hayden - 1 male, 5 females, 18-VI-68, B.R.O.; 1 male, 1 female, 20-VI-68, B.R.O.

Isoperla 5-punctata Banks (Figs. 89, 90)

1902 Choloperla 5-punctata Banks, Can. Ent., 34:124.

1906b Isoperla 5-punctata Banks, Ent. News, 17:175.

1925 Isoperla 5-punctata, Needham and Claassen, Plecop. Amer. North of Mexico, p. 151, description of male, and female; male and female genitalia, pl. 26, (Fig. 7, 8, 11).

1927 Isoperla 5-punctata Banks, Seemann, Journ. Ent. and Zool. 19:57, Nymphal description.

Type locality: Las Vegas, New Mexico.

Geographic range: New Mexico, Colorado, California, and Utah.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Little Morrison Creek Junction - 6 males, 25-VI-68, B.R.O.; 10 males, 27-VI-68, B.R.O.; Yampa River at Sarvice Creek Junction - 4 males, 27-VI-68, B.R.O.

Subfamily PERLODINAE

Subgenus Dolkrila

Diura knowltoni (Frison) (Figs. 91, 92)

1937 Dictyopterygella knowltoni Frison, Bull. Ill. Nat. Hist. Sur. 21:89, description of male and figures of color pattern, forewing, and male genitalia.

1942a Dictyopterygella knowltoni Frison, Ibid., 22:299, description of female and nymph; figures of female genitalia, nymphal color pattern, and nymphal mouth parts.

1952 Diura (Dolkrila) knowltoni, Ricker, Syst. Studies Plecop.,

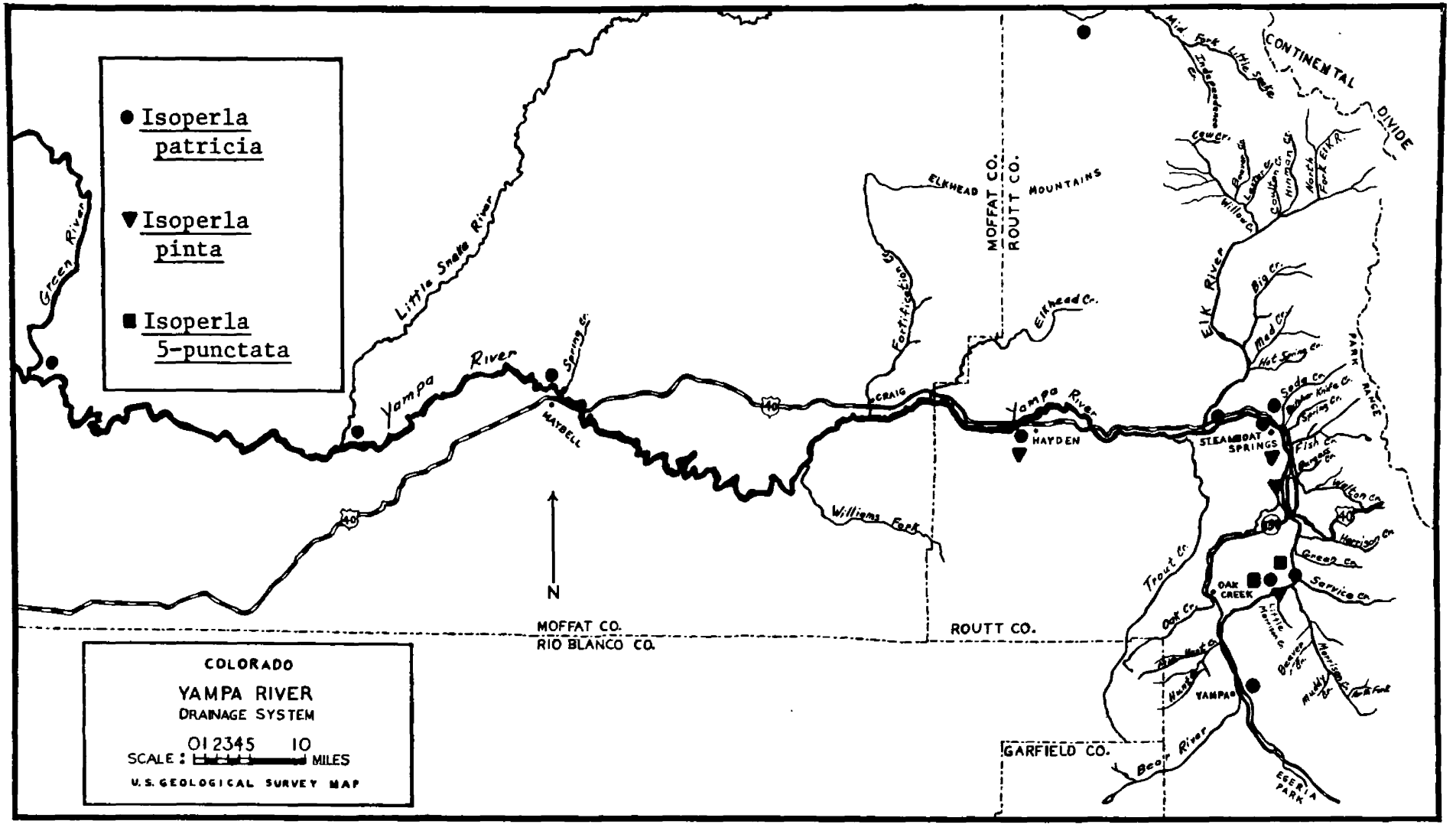


Fig. 13. Distribution map of Isoperla patricia, I. pinta, and I. 5-punctata.

p. 138; placed in genus Diura and new subgenus Dolkrila.

Type locality: Logan, Utah.

Geographic range: Vancouver Island to Oregon, Yukon south to Utah and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - Naiad, 10-V-68, B.R.O.; Yampa River at Steamboat Springs - Exuviae, 18-VI-68, B.R.O.; exuviae, 16-VII-68, B.R.O.; Elk River at Clark - Naiad, 18-III-68, B.R.O.; Elk River at Hinman Creek - 1 female, 28-VI-68, B.R.O.; Fish Creek - 1 male, 18-VI-68, B.R.O.; exuviae, 21-VI-68, B.R.O.; exuviae, 28-VI-68, B.R.O.; Soda Creek - Exuviae, 21-VI-68, B.R.O.; Spring Creek - Naiad, 24-XI-67, B.R.O.; Walton Creek - Exuviae, 25-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - Exuviae, 24-VI-68, B.R.O.; Hinman Creek - Exuviae, 28-VI-68, B.R.O.; Mad Creek - Exuviae, 19-VI-68, B.R.O.; North Fork of Elk River - Exuviae, 28-VI-68, B.R.O.

Family CHLOROPERLIDAE

Subfamily PARAPERLINAE

Genus Paraperla Banks

Paraperla frontalis (Banks) (Figs. 93, 94)

1902 Perlinella frontalis Banks, Can. Ent. 34:123.

1925 Paraperla frontalis, Needham and Claassen, Monog. Plecop., pp. 130-131.

1931 Paraperla frontalis, Claassen, Plecop. Nymphs, p. 65.

Type locality: New Mexico.

Geographic range: British Columbia to New Mexico and California.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Steamboat

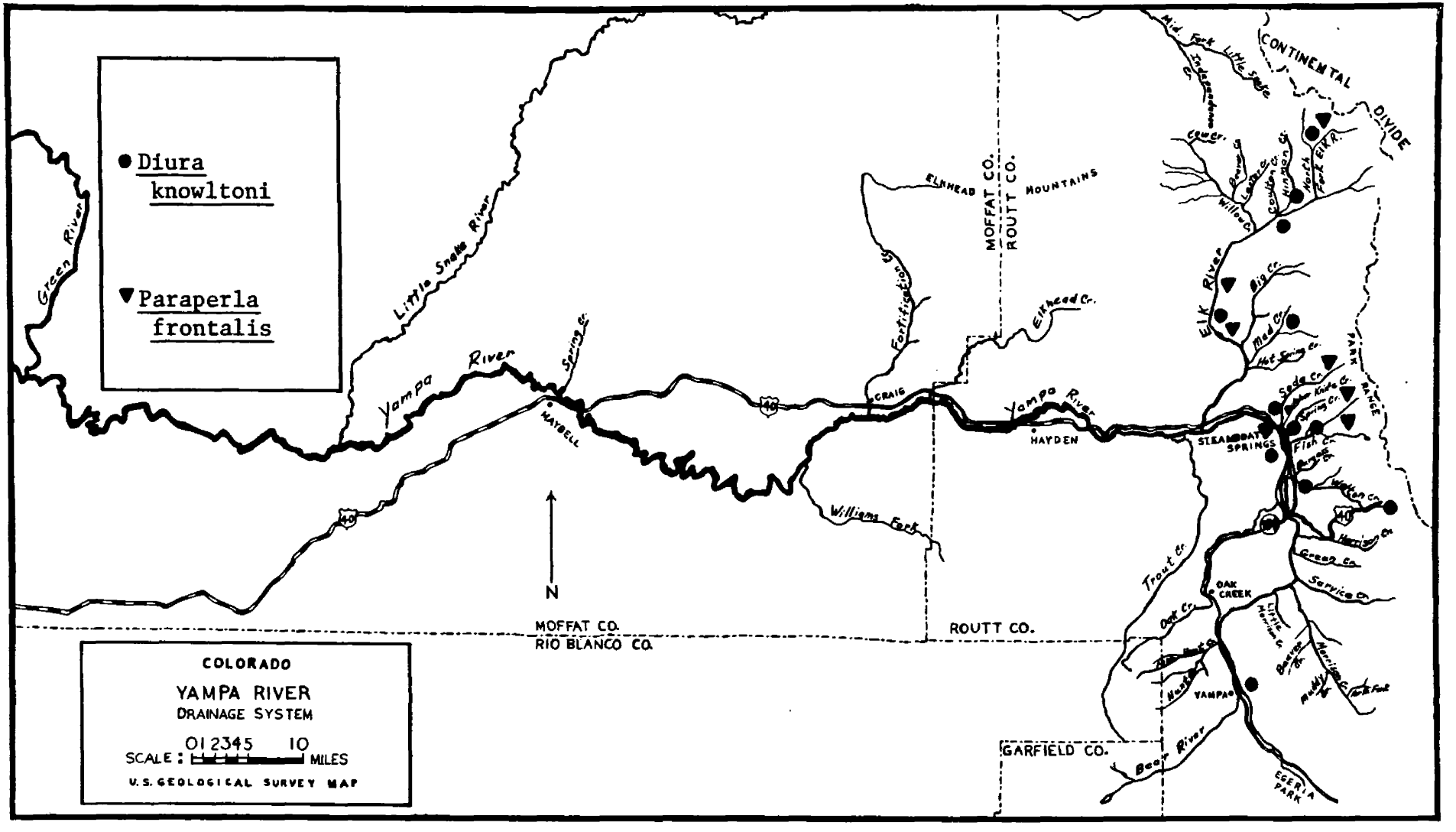


Fig. 14. Distribution map of Diura knowltoni, and Paraperla frontalis.

Springs - 1 female, 25-VI-62, A.R.G.; 1 male, exuviae, 26-VI-68, J.N.O.; Yampa River west of Steamboat Springs - 1 female, 1-VII-67, B.R.O.; Elk River 3 miles south of Clark - Naiad, 18-III-68, B.R.O.; Elk River at Clark - Exuviae, 17-VII-68, B.R.O.; Fish Creek - 3 females, 29-VI-67, B.R.O.; exuviae, 25-VI-68, B.R.O.; 1 female, exuviae, 28-VI-68; B.R.O.; exuviae, 15-VII-68, B.R.O.; Soda Creek - 1 female, 25-VI-68, B.R.O.; Spring Creek - Naiad, 23-III-67, B.R.O.; North Fork Elk River - Exuviae, 28-VI-68, B.R.O.

Subfamily CHLOROPERLINAE

Genus *Alloperla* Banks

Males (Females, in part)

1. A finger-like process pointing inward from the basal segment of each cercus; supra-anal body a membranous lobe with a very small hairy process at its tip . . . . . (Subgenus Suwallia) 2

   No process at the base of the cerci; supra-anal body elongate, its terminal process usually larger 3

2. Aedeagus with 3 ventral sclerotized patches of tiny spinules . . . . . *A. pallidula*

   Aedeagus with a single, V-shaped patch of sclerotized spinules . . . . . *A. lineosa*

3. Color green in life; no dark abdominal stripe; ninth tergite without a process . . . . . (Subgenus Alloperla) . . . . . *A. severa*

   Color mostly yellow in life; a dark dorsal abdominal

stripe present; usually a process on the 9th . . . . . tergite 4

4. Body of supra-anal apparatus lying in a deep groove of the 10th tergite and attached to its sides, bearing at its posterior end a terminal portion which is well marked off from the rest of the apparatus . . . . . (Subgenus Sweltsa) 5

Body of the supra-anal apparatus obscure, short, and lying along the surface of and fused with 10th tergite, usually in a slight depression, but never in deep groove . . . . . (Subgenus Triznaka) 7

5. Supra-anal process thick, broadly flattened in dorsal view 6

Supra-anal process slender, somewhat less broad near the tip than it is closer to the base . . . . . A. borealis

6. Supra-anal process with a slightly upturned spine at the tip; a bifurcate, darkly sclerotized, leaf-like appendage arising from the base of the aedeagus; high median carina on supra-anal process . . . A. lamba

Supra-anal process with a short, upturned hook at the tip; no leaf-like appendage arising from the aedeagus; no median carina . . . . . A. coloradensis

7. Head and pronotum with conspicuous median markings of black on yellow; a small posterior median lobe on the 7th sternite 8

Head unmarked except for the ocellar rings; pronotum

with dusky lateral margins, otherwise yellow; no lobe on the 7th sternite . . . . . A. diversa

8. Anterior mark on the head as long as broad, often produced in the midline back of the median ocellus; median pronotal mark broadly T-shaped, little produced laterally rearward; pronotal rugosities not pigmented or very slightly so . . . . . A. signata

Anterior mark of the head about twice as wide as long, not reaching to the median ocellus; median pronotal mark narrow, I-shaped, much produced laterally both at the front and at the rear; pronotal rugosities rather heavily pigmented, at least near the midline . . . . . A. pintada

Subfamily CHLOROPERLINAE

Only the one genus, Alloperla, was found in Colorado. This genus was divided by Ricker (1943, 1952) into the five subgenera, Alloperla, Neaviperla, Suwallia, Sweltsa, and Triznaka. Of the above, Neaviperla is the only subgenus of the genus Alloperla not represented in Colorado.

Genus *Alloperla* Banks

Subgenus Alloperla Ricker

Alloperla severa (Hagen) (Figs. 95, 96)

1861 *Perla severa* Hagen, Syn. Neur. North Amer., p. 30.

1935b *Alloperla elevata*, Frison, Trans. Amer. Ent. Soc. 61:335-336.

1952 *Alloperla* (Alloperla) *thalia*, Ricker, Syst. Studies Plecop.,

p. 178.

1954 Alloperla (Alloperla) severa, Ricker, Trans. Ent. Soc. B.C., 51:39.

Type locality: Alaska.

Geographic range: Alaska to Oregon, Montana and Utah.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 2 females, 23-VII-60, A.R.G.; 12 males, 15 females, 19-VI-61, A.R.G.; 81 males, 57 females, 26-VI-62, A.R.G.; 1 male, 22-VI-68, B.R.O.; 6 males, 10 females, 27-VI-68, B.R.O.; Yampa River at Phippsburg - 2 males, 3 females, 27-VI-68, B.R.O.; Yampa River at Little Morrison Creek Junction - 1 male, 1 female, 25-VI-68, B.R.O.; Yampa River east of Highway 131 - 2 males, 25-VI-68, B.R.O.; Yampa River west of Highway 131 - 2 males, 4 females, 29-VI-67, B.R.O.; Yampa River at Steamboat Springs - 1 male, 2 females, 25-VI-62, A.R.G.; 1 male, 1 female, 26-VI-68, B.R.O.; 1 male, 2 females, 16-VII-68, B.R.O.; 1 female, 17-VII-68, B.R.O.; East Fork of Elk River at Highway 40 - 1 male, 29-VI-68, B.R.O.; Elk River at Clark - 1 male, 17-VII-68, B.R.O.; Fish Creek - 2 males, 15-VII-68, B.R.O.; Sarvice Creek - 1 male, 30-VI-67, B.R.O.; Soda Creek - 3 males, 5 females, 16-VII-68, B.R.O.; Hot Springs Creek - 1 male, 17-VII-68, B.R.O.; Lester Creek - 10 females, 17-VII-68, B.R.O.; Mad Creek - 2 males, 1 female, 17-VII-68, B.R.O.; Willow Creek at Hahn's Peak - 1 male, 17-VII-68, B.R.O.

Subgenus Suwallia

Alloperla lineosa Banks (Figs. 100, 101)

1918 Alloperla lineosa Banks, Bull. Mus. Comp. Zool. 62:7.

1925 Alloperla lineosa, Needham and Claassen, Thomas Say Found., p. 123, description of male and female; male and female genitalia, p. 331, (Figs. 10, 11) (Fig. 10, male, is incorrectly identified).

1955 Alloperla (Suwallia) lineosa, Jewett, Wasmann Jour. Biol. 13(1):151-152, male and female.

Type locality: Grant, Colorado.

Geographic range: Montana to Colorado, Oregon and Washington.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Steamboat Springs - 1 female, 16-VII-68, B.R.O.; Fish Creek Falls - 5 females, 23-VIII-67, B.R.O.; Fish Creek Falls Trickle - 9 females, 16-VII-68, B.R.O.; Fish Creek - 1 female, 23-VIII-67, B.R.O.; Little Snake River at Focus Ranch - 1 female, 17-VII-68, B.R.O.; Spring Creek - 2 females, 16-VII-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 17 females, 6-VIII-63, A.R.G.; Walton Creek 3 miles west of Rabbit Ears Pass - 6 females, 20-VI-68, B.R.O.; Coulton Creek - 16 females, 18-VII-68, B.R.O.; Lester Creek - 1 female, 17-VII-68, B.R.O.; Willow Creek above Hahn's Peak - 5 females, 17-VII-68, B.R.O.; Independence Creek - 15 females, 17-VII-68, B.R.O.

Alloperla pallidula (Banks) (Figs. 97, 98, 99)

1904 Chloroperla pallidula Banks, Trans. Amer. Ent. Soc. 30:99, description of female.

1925 Alloperla pallidula, Needham and Claassen, Thomas Say Found., 2:108-109, description of male and female; male and female genitalia, p. 335, (Figs. 12, 13).

1935b Alloperla dubia Frison, Trans. Amer. Ent. Soc. 61:338, description of male and female; male genitalia. (pl. 11),

female genitalia (pl. 14).

Type locality: New Mexico.

Geographic range: Alaska and Alberta to California and Wyoming.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 57 males, 28 females, 23-VII-60, A.R.G.; 1 male, 26-VI-62, A.R.G.; 6 males, 7 females, 26-VIII-67, B.R.O.; 3 males, 2 females, 15-VII-68, B.R.O.; Yampa River at Little Morrison Creek Junction - 1 male, 27-VI-68, B.R.O.; Yampa River at Sarvice Creek Junction - Naiads, 30-VI-67, B.R.O.; East Fork of Elk River - 8 males, 4 females, 18-VII-68, B.R.O.; Elk River at Clark - 6 males, 3 females, 17-VII-68, B.R.O.; Fish Creek Falls - 42 males, 43 females, 23-VIII-67, B.R.O.; 1 female, 25-VI-68, B.R.O.; Fish Creek Falls Trickle - 2 males, 6 females, 25-VI-68, B.R.O.; 20 males, 19 females, 16-VII-68, B.R.O.; Fish Creek - 5 males, 22 females, 23-VIII-67, B.R.O.; Little Snake River at Focus Ranch - 20 males, 16 females, 17-VII-68, B.R.O.; Oak Creek - 4 males, 3 females, 15-VII-68, B.R.O.; Soda Creek - 1 male, 3 females, 22-VIII-67, R.W.B.; 3 males, 16-VII-68, B.R.O.; Spring Creek - 6 males, 12 females, 23-VIII-67, B.R.O.; Trout Creek - 1 male, 15-VII-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 40 males, 29 females, 6-VIII-53, A.R.G.; Walton Creek below Rabbit Ears Pass - 10 males, 14 females, 23-VIII-67, B.R.O.; Coulton Creek - 1 male, 18-VII-68, B.R.O.; Cow Creek - 1 male, 3 females, 17-VII-68, B.R.O.; Independence Creek - 1 male, 17-VII-68, B.R.O.; Lester Creek - 1 female, 17-VII-68, J.L.O.; Mad Creek - 2 females, 17-VII-68, B.R.O.; Willow Creek northwest of Hahn's Peak - 1 male, 1 female, 17-VII-68, B.R.O.; Willow Creek south of Hahn's Peak - 5 males, 17-VII-68, B.R.O.

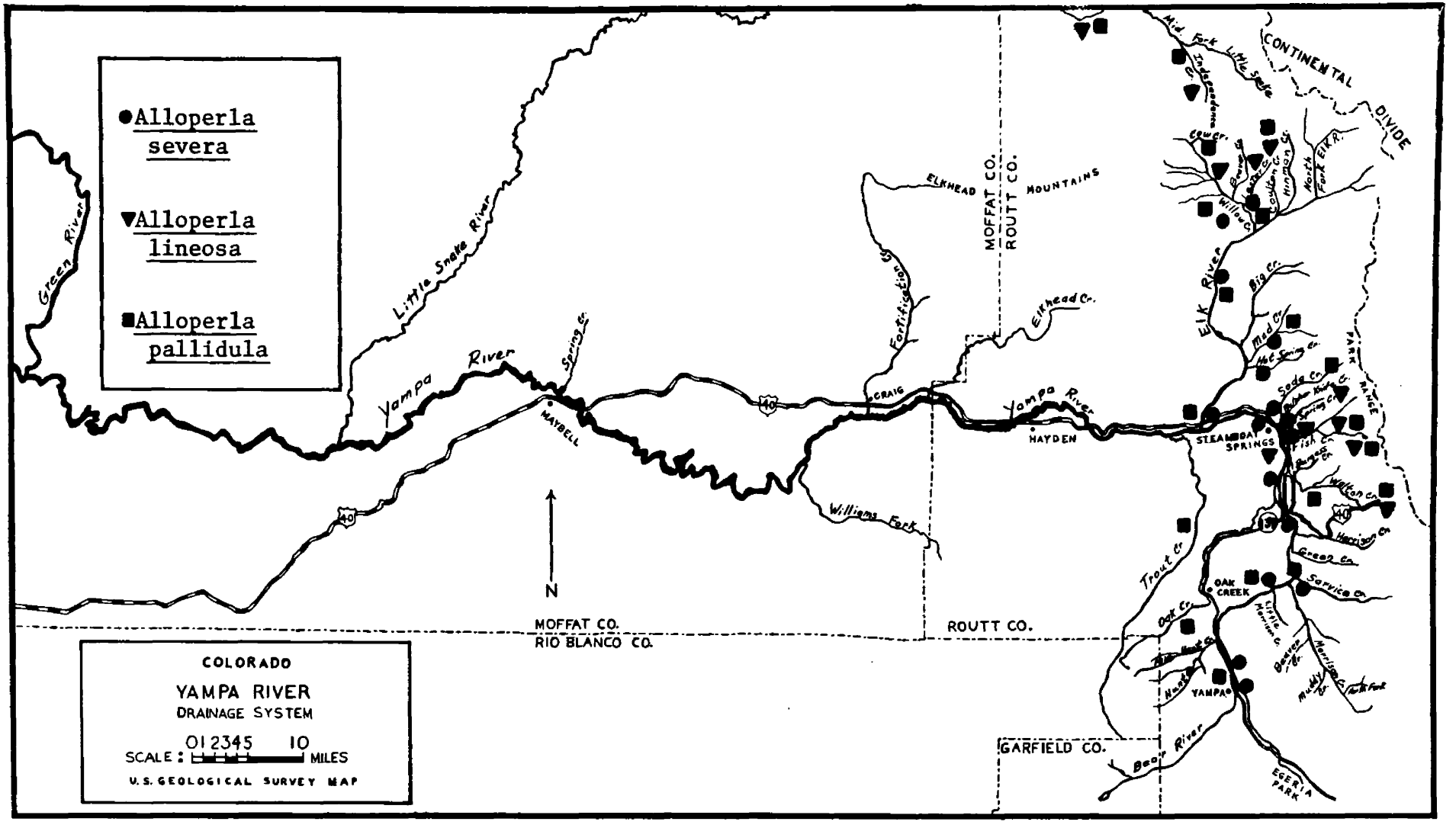


Fig. 15. Distribution map of Alloperla severa, A. lineosa, and A. pallidula.

Subgenus Sweltsa

Alloperla borealis (Banks) (Figs. 102, 103)

1895 Chloroperla borealis Banks, Trans. Amer. Ent. Soc. 22:313, description of male and female.

1925 Alloperla borealis, Needham and Claassen, Thomas Say Found., 2:118, description of male and female; wing, p. 319, (Fig. 1); male and female genitalia, p. 333, (Fig. 3. 1, 2, 3).

1931 Alloperla borealis, Claassen, Thomas Say Found., 3:60, description of nymph.

Type locality: Olympia, Washington.

Geographic range: Alaska to Colorado and California.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Steamboat Springs - 1 female, 26-VI-68, B.R.O.; Fish Creek - 1 male, 29-VI-67, B.R.O.; 1 male, 28-VI-68, B.R.O.; Walton Creek 3 miles west of Rabbit Ears Pass - 1 male, 20-VI-68, B.R.O.; Green Creek - 2 females, 28-VI-68, B.R.O.

Alloperla coloradensis (Banks) (Figs. 104, 105, 106)

1898 Chloroperla coloradensis Banks, Trans. Amer. Ent. Soc. 25:199.

1925 Alloperla coloradensis, Needham and Claassen, Monog. Plecop., pp. 113-114.

1931 Alloperla coloradensis, Claassen, Plecop. Nymphs, pp. 60-61.

Type locality: Colorado.

Geographic range: British Columbia, Utah, California, and Colorado to Montana.

Distribution, Yampa River Drainage, Routt Co.: Bear River - 1 female,

15-VII-68, B.R.O.; Yampa River at Yampa - 12 males, 8 females, 26-VI-60, A.R.G.; 7 males, 4 females, 17-VI-61, A.R.G.; 8 males, 6 females, 19-VI-61, A.R.G.; 14 males, 27 females, 26-VI-62, A.R.G.; 8 males, 6 females, 22-VI-68, B.R.O.; 2 males, 1 female, 23-VI-68, B.R.O.; 5 males, 5 females, 27-VI-68, B.R.O.; 1 female, 15-VII-68, B.R.O.; Yampa River east of Highway 131 - 2 females, 26-VI-68, B.R.O.; Yampa River at Steamboat Springs - 20 males, 11 females, 25-VI-62, A.R.G.; 2 males, 18 females, 1-VII-67, B.R.O.; 19 males, 16 females, 26-VI-68, B.R.O.; 2 males, 7 females, 28-VI-68, B.R.O.; Yampa River west of Steamboat Springs - 5 males, 11 females, 25-VI-62, A.R.G.; Butcher Knife Creek - 2 females, 25-VI-68, B.R.O.; Elk River at Clark - 5 males, 3 females, 28-VI-68, B.R.O.; 45 males, 71 females, 17-VII-68, B.R.O.; Fish Creek Falls - 2 females, 14-VII-68, B.R.O.; 1 male, 5 females, 15-VII-68, B.R.O.; Fish Creek - 20 males, 10 females, 25-VI-62, A.R.G.; 33 males, 39 females, 29-VI-67, B.R.O.; 13 males, 4 females, 28-VI-68, B.R.O.; 1 male, 14-VII-68, B.R.O.; 4 males, 9 females, 15-VII-68, B.R.O.; 1 male, 6 females, 16-VII-68, B.R.O.; Green Creek - 24 males, 12 females, 28-VI-68, B.R.O.; 8 males, 16 females, 16-VII-68, B.R.O.; Harrison Creek - 3 males, 10 females, 28-VI-68, B.R.O.; 2 males, 29 females, 15-VII-68, B.R.O.; Little Snake River at Focus Ranch - 2 females, 17-VII-68, B.R.O.; Oak Creek - 1 male, 4 females, 22-VI-68, B.R.O.; Sarvice Creek - 1 male, 30-VI-67, B.R.O.; 1 female, 24-VI-68, B.R.O.; Soda Creek - 20 males, 12 females, 19-VI-61, A.R.G.; 1 male, 19-VI-62, A.R.G.; 23 males, 12 females, 25-VI-62, A.R.G.; 6 males, 12 females, 1-VII-67, B.R.O.; 1 female, 21-VI-68, B.R.O.; 11 males, 6 females, 25-VI-68, B.R.O.; 4 males, 7 females, 16-VII-68, B.R.O.; Spring Creek - 1 female, 1-VII-67,

B.R.O.; 2 males, 4 females, 19-VI-68, B.R.O.; 11 males, 4 females, 20-VI-68, B.R.O.; 9 males, 4 females, 21-VI-68, B.R.O.; 10 males, 7 females, 25-VI-68, B.R.O.; Trout Creek - 3 males, 2 females, 22-VI-68, B.R.O.; Walton Creek - 1 female, 26-VI-62, A.R.G.; 1 male, 1 female, 25-VI-68, B.R.O.; Walton Creek 3 miles west of Rabbit Ears Pass - 1 female, 6-VII-53, A.R.G.; 1 male, 1 female, 15-VII-68, B.R.O.; Coulton Creek - 2 females, 28-VI-68, B.R.O.; 4 males, 23 females, 18-VII-68, B.R.O.; Hinman Creek - 1 male, 1 female, 28-VI-68, B.R.O.; 7 females, 18-VII-68, B.R.O.; Independence Creek - 5 females, 17-VII-68, B.R.O.; Mad Creek - 4 females, 17-VII-68, B.R.O.; North Fork of Elk River - 1 male, 28-VI-68, B.R.O.; 14 males, 36 females, 18-VII-68, B.R.O.; Willow Creek at Hahn's Peak - 1 male, 17-VII-68, B.R.O.

Alloperla lamba Needham and Claassen (Figs. 107, 108, 109)

1925 Alloperla lamba Needham and Claassen, Thomas Say Found., p. 115, description of male and female; male and female genitalia, p. 335, (Figs. 8, 9).

1959 Alloperla (Sweltsa) lamba, Jewett, Oregon St. Monogr., 3:85, (Fig. 31).

Type locality: Fern Lake, Estes Park, Colorado.

Geographic range: Rocky Mountains and out lying ranges from Oregon and Idaho south to Wyoming, Utah, and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 5 males, 7 females, 26-VI-60, A.R.G.; 2 females, 19-VI-61, A.R.G.; 1 female, 26-VI-62, A.R.G.; 1 male, 23-VI-68, B.R.O.; Fish Creek Falls Trickle - 12 males, 1 female, 17-VI-68, B.R.O.; 17 males, 14 females,

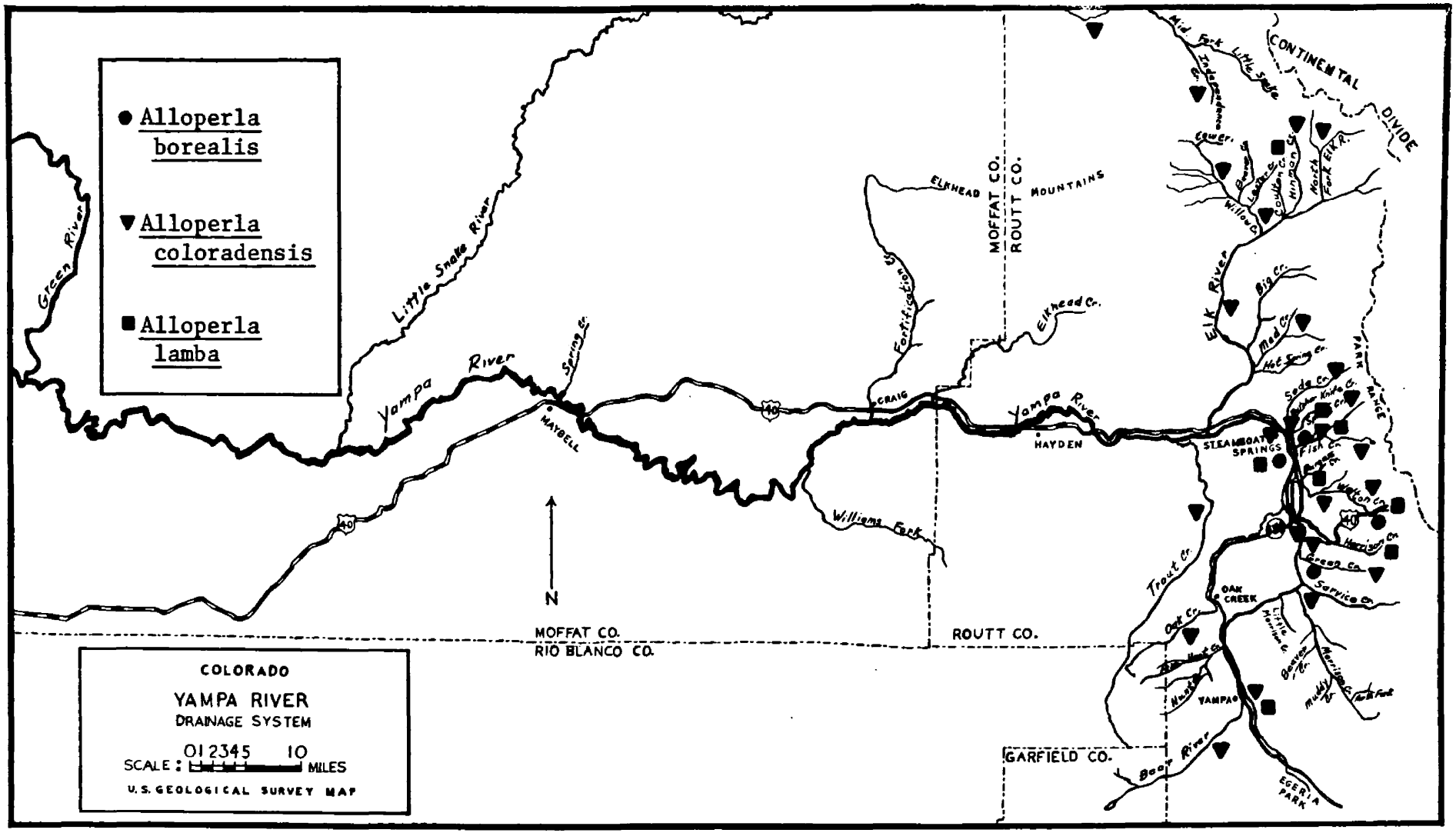


Fig. 16. Distribution map of Alloperla borealis, A. coloradensis, and A. lamba.

25-VI-68, B.R.O.; 4 males, 3 females, 16-VII-68, B.R.O.; Harrison Creek - 3 males, 1 female, 15-VII-68, B.R.O.; Spring Creek - 1 male, 20-VI-68, B.R.O.; Walton Creek at Rabbit Ears Pass - 4 males, 2 females, 15-VII-68, B.R.O.; Burgess Creek - 6 males, 5 females, 28-VI-68, B.R.O.; Coulton Creek - 2 females, 28-VI-68, B.R.O.

Subgenus Triznaka Ricker

Alloperla diversa Frison (Figs. 110, 111, 112)

1935b Alloperla diversa Frison, Trans. Amer. Ent. Soc. 61:333, description of male and female.

Type locality: East Fork of Hood River, Parkdale, Oregon.

Geographic Range: Alaska to California, Utah and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Spring Creek - 1 male, 25-VI-68, B.R.O.

Alloperla pintada Ricker (Figs. 117, 118)

1952 Alloperla pintada Ricker, Syst. Studies Plecop., p. 186.

Type locality: Edloe, Colorado.

Geographic range: Colorado, New Mexico, Oregon, South Dakota, Wyoming.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 1 female, 26-VI-60, A.R.G.; 2 males, 18-VI-61, A.R.G.; 2 males, 2 females, 19-VI-61, A.R.G.; 20 males, 18 females, 26-VI-62, A.R.G.; 1 male, 1 female, 22-VI-68, B.R.O.; 2 males, 23-VI-68, B.R.O.; 2 males, 7 females, 27-VI-68, B.R.O.; 1 female, 15-VII-68, B.R.O.; Yampa River at Phippsburg - 1 female, 27-VI-68, B.R.O.; Yampa River at Little Morrison Junction - 1 male, 24-VI-68, B.R.O.; 1 male, 25-VI-68, B.R.O.; 1 female, 27-VI-68, B.R.O.; Yampa River at Steamboat Springs - 1 male, 2 females, 26-VI-68,

B.R.O.; Little Morrison Creek - 1 male, 1 female, 24-VI-68, B.R.O.; Morrison Creek - 2 females, 24-VI-68, B.R.O.; 1 female, 15-VII-68, B.R.O.; Spring Creek - 1 female, 20-VI-68, B.R.O.; Walton Creek - 4 males, 26-VI-62, A.R.G.; Beaver Creek - 7 males, 6 females, 24-VI-68, B.R.O.; 1 male, 15-VII-68, B.R.O.; Burgess Creek - 1 male, 6 females, 28-VI-68, B.R.O.; Cow Creek - 1 female, 17-VII-68, B.R.O.; 7 males, 3 females, 18-VI-68, B.R.O.; Lester Creek - 1 female, 17-VII-68, B.R.O.; Muddy Creek - 1 female, 24-VI-68, B.R.O.; Willow Creek at Hahn's Peak - 1 male, 17-VII-68, B.R.O.

Alloperla signata (Banks) (Figs. 113, 114, 115, 116)

1895 Chloroperla signata Banks, Trans. Amer. Ent. Soc. 22:314.

1925 Alloperla signata Banks, Needham and Claassen, Thomas Say Found., 2:121-122, description of male and female; male and female genitalia, p. 330, (Figs. 5, 6).

Type locality: Pullman, Washington.

Geographic range: Washington, Montana south to Utah and Colorado.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Yampa - 2 males, 5 females, 23-VII-60, A.R.G.; 29 males, 23 females, 17-VI-61, A.R.G.; 95 males, 88 females, 19-VI-61, A.R.G.; 83 males, 99 females, 26-VI-62, A.R.G.; 12 males, 11 females, 22-VI-68, B.R.O.; 1 male, 4 females, 23-VI-68, B.R.O.; 11 males, 16 females, 27-VI-68, B.R.O.; 2 males, 3 females, 15-VII-68, B.R.O.; Yampa River at Phippsburg - 1 male, 2 females, 27-VI-68, B.R.O.; Yampa River at Little Morrison Junction - 1 male, 7 females, 24-VI-68, B.R.O.; 4 males, 8 females, 25-VI-68, B.R.O.; 2 females, 15-VII-68, B.R.O.; Yampa River at Sarvice Creek Junction - 1 male, 30-VI-67, B.R.O.; 4 males, 1 female, 24-V-68, B.R.O.; 1 female,

27-VI-68, B.R.O.; 1 male, 1 female, 16-VII-68, B.R.O.; Yampa River west of Highway 131 - 13 males, 9 females, 29-VI-67, B.R.O.; 11 males, 1 female, 21-VI-68, B.R.O.; 23 males, 1 female, 22-VI-68, B.R.O.; Yampa River east of Highway 131 - 15 males, 19 females, 1-VII-67, B.R.O.; 3 males, 4 females, 25-VI-68, B.R.O.; 3 males, 14 females, 26-VI-68, B.R.O.; Yampa River at Milner - 1 male, 1 female, 26-VI-68, B.R.O.; Yampa River at Steamboat Springs - 126 males, 170 females, 25-VI-62, A.R.G.; 1 female, 28-VI-67, B.R.O.; 1 male, 18-VI-68, B.R.O.; 2 males, 21-VI-68, B.R.O.; 78 males, 59 females, 26-VI-68, B.R.O.; 1 male, 4 females, 28-VI-68, B.R.O.; 4 males, 3 females, 16-VII-68, B.R.O.; 1 male, 17-VII-68, B.R.O.; Yampa River west of Steamboat Springs - 67 males, 55 females, 25- VI-62, A.R.G.; Yampa River 2 miles west of Hayden - 9 males, 2 females, 18-VII-68, B.R.O.; 91 males, 25 females, 20-VI-68, B.R.O.; Yampa River at Craig - 1 male, 2 females, 18-VI-61, A.R.G.; 1 male, 1 female, 25-VI-62, A.R.G.; Butcher Knife Creek - 2 females, 21-VI-68, B.R.O.; East Fork of Elk River - 27 males, 7 females, 20-VI-68, B.R.O.; 1 male, 3 females, 29-VI-68, B.R.O.; Elk River at Clark - 1 male, 28-VI-68, B.R.O.; 19 males, 21 females, 17-VII-68, B.R.O.; Fish Creek - 6 males, 4 females, 25-VI-62, A.R.G.; 4 males, 6 females, 15-VII-68, B.R.O.; 1 female, 16-VII-68, B.R.O.; Harrison Creek - 1 male, 1 female, 28-VI-68, B.R.O.; Little Snake River at Focus Ranch - 4 males, 4 females, 17-VII-68, B.R.O.; Oak Creek - 2 males, 1 female, 22-VI-68, B.R.O.; Sarvice Creek - 10 males, 30-VI-67, B.R.O.; 1 female, 24-VI-68, B.R.O.; 1 male, 1 female, 16-VII-68, B.R.O.; Soda Creek - 4 males, 4 females, 19-VI-61, A.R.G.; 8 males, 9 females, 25-VI-62, A.R.G.; 44 males, 28 females, 1-VII-67, B.R.O.; 3 males, 1 female, 21-VI-68,

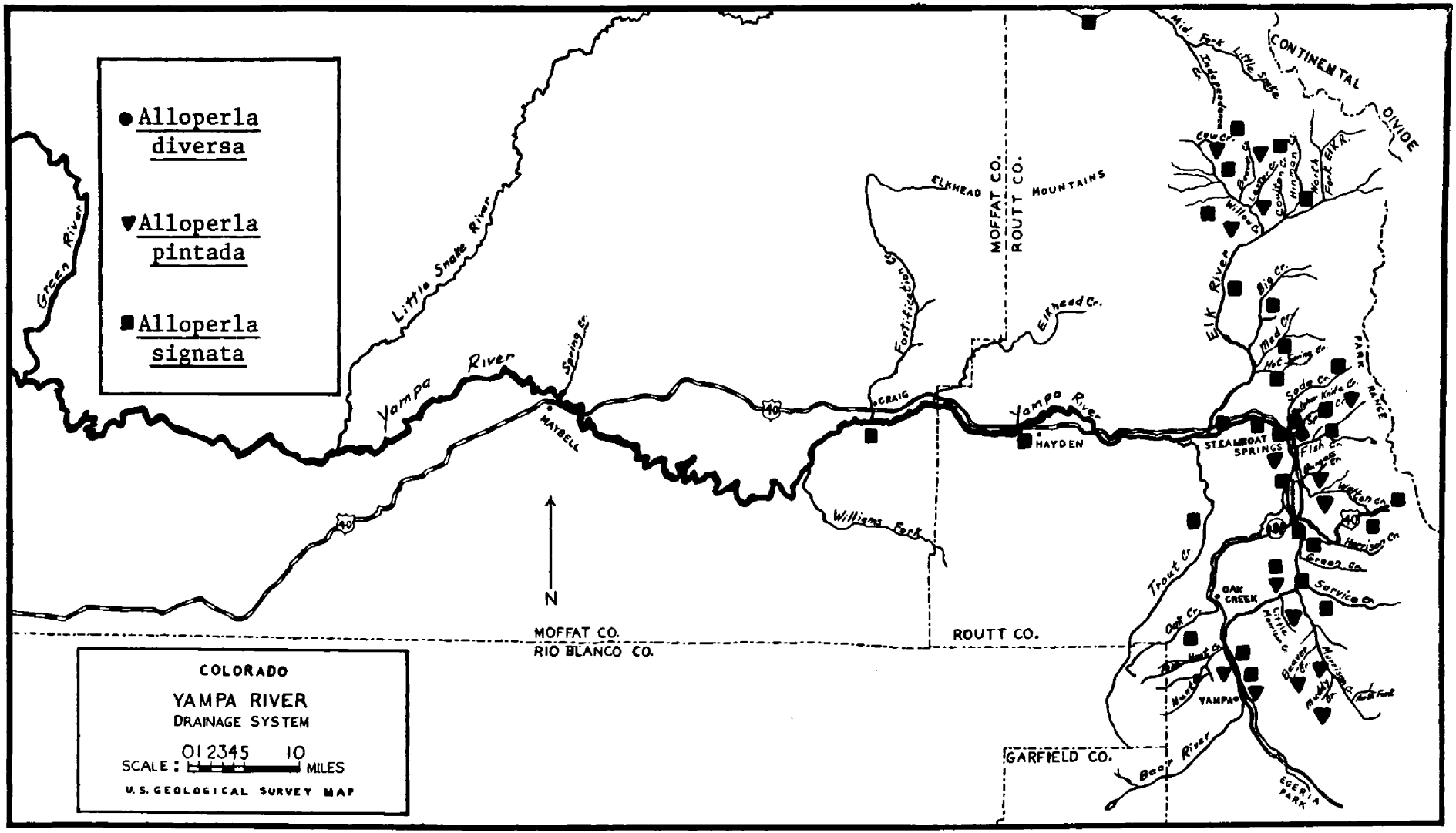


Fig. 17. Distribution map of Alloperla diversa, A. pintada, and A. signata.

B.R.O.; 10 males, 21 females, 16-VII-68, B.R.O.; Spring Creek - 30 males, 14 females, 25-VI-68, B.R.O.; 3 males, 2 females, 16-VII-68, B.R.O.; Trout Creek - 16 males, 14 females, 22-VI-68, B.R.O.; 2 males, 9 females, 15-VII-68, B.R.O.; Walton Creek - 3 females, 26-VI-62, A.R.G.; 1 male, 1 female, 30-VI-67, B.R.O.; Walton Creek at Rabbit Ears Pass - 1 female, 28-VI-68, B.R.O.; Big Creek - 1 male, 4 females, 17-VII-68, B.R.O.; Coulton Creek - 1 male, 28-VI-68, B.R.O.; 1 male, 2 females, 18-VII-68, B.R.O.; Cow Creek - 2 females, 19-VI-68, B.R.O.; Hinman Creek - 2 males, 28-VI-68, B.R.O.; 1 female, 18-VII-68, B.R.O.; Hot Springs Creek - 4 males, 8 females, 17-VII-68, B.R.O.; Mad Creek - 9 males, 7 females, 17-VII-68, B.R.O.; Lester Creek - 2 males, 6 females, 19-VI-68, B.R.O.; 3 females, 17-VII-68, B.R.O.; Willow Creek south of Hahn's Peak - 4 females, 19-VI-68, B.R.O.; 4 females, 17-VII-68, B.R.O.; Willow Creek northwest of Hahn's Peak - 1 male, 3 females, 17-VII-68, B.R.O.

Family PERLIDAE

Subfamily ACRONEURINAE

Males

1. Grooves of the mesosternum widely divergent; anal gills absent . . . . (Subgenus Calineuria). . . . . A. californica

   Grooves of the mesosternum short and nearly parallel; anal gills present . . . . . .(Subgenus Hesperoperla) . . . . . A. pacifica

Females

1. Grooves of mesosternum widely divergent; anal gills

absent . . . . . (Subgenus Calineirua) . . . . A. californica

Grooves of the mesosternum short and nearly parallel;

anal gills present . . . . . .

. . . . . .(Subgenus Hesperoperla). . . . . A. pacifica

Subgenus Calineuria

Acroneuria californica (Banks) (Figs. 119, 120, 121)

1905 Perla californica Banks, Invert. Pac., 1:87, description of male and female.

1925 Acroneuria californica, Needham and Claassen, Thomas Say Found., 2:192-193, description of male and female; male and female genitalia, p. 347.

1931 Acroneuria californica, Claassen, Thomas Say Found., 3:85; description of nymph.

1954 Acroneuria californica, Ricker, Proc. Ent. Soc., B.C., 51:39; placed in new subgenus Calineuria.

Type locality: California.

Geographic range: British Columbia to California.

Distribution, Yampa River Drainage, Moffat Co.: Yampa River at Craig - Naiad, 18-VI-61, A.R.G.; Yampa River, Green River Junction, at Dinosaur National Park - Naiad, 24-VII-62, D.Q.A

Subgenus Hesperoperla

Acroneuria pacifica Banks (Figs. 122, 123, 124, 125)

1900 Acroneuria pacifica Banks, Trans. Amer. Ent. Soc. 26:242.

1906a Acroneuria pumila Banks, Can. Ent. 38:335.

1925 Acroneuria pacifica, Needham and Claassen, Monog. Plecop., pp. 187-188.

1925 Acroneuria pumila, Needham and Claassen, ibid., p. 188.

1931 Acroneuria pacifica, Claassen, Plecop. Nymphs, pp. 88-89.

1937b Acroneuria delta, Claassen, Jour. Kansas Ent. Soc. 10:42.

1942b Acroneuria pacifica, Frison, Pan-Pac. Ent. 18:72-73.

Type locality: Washington.

Geographic range: British Columbia to Montana, Utah, Colorado and California.

Distribution, Yampa River Drainage, Routt Co.: Elk River at Hinman Creek - Exuviae, 18-VII-68, B.R.O.; Fish Creek Falls - Exuviae, naiads, 23-VIII-67, B.R.O.; Fish Creek - Exuviae, 15-VII-68, B.R.O.; naiad, 24-XI-67, B.R.O.; Little Snake River at Focus Ranch - Exuviae, 17-VII-68, B.R.O.; Hot Springs Creek - 1 female, 17-VII-68, B.R.O.; exuviae, 17-VII-68, B.R.O.; Mad Creek - Exuviae, 17-VII-68, B.R.O.

Genus Claassenia (Banks)

Claassenia sabulosa (Banks) (Figs. 126, 127)

1900 Perla sabulosa Banks, Trans. Amer. Ent. Soc. 26:242, description of female.

1916 Adelungia artica Klapalek, Casopis Ceske Spolei. Ent. 13:59.

1925 Perla sabulosa, Needham and Claassen, Thomas Say Found., 2:101, description of female; wing, p. 317, (Fig. 4).

1925 Perla languida Needham and Claassen, ibid., p. 100, description and figure of female, wing and genitalia.

1938 Claassenia arctica, Ricker, Trans. Royal Can. Inst., 22:140;

male and female genitalia, p. 154.

1942a Claassenia arctica, Frison, Bull. Ill. Nat. Hist. Sur. 22:286; Nymph.

1952 Claassenia sabulosa, Ricker, Syst. Studies Plecop., pp. 190-191, above synonymy, indicated.

Type locality: Yakima, Washington.

Geographic range: British Columbia, southern Montana south through the Cascade and Rocky Mountains to New Mexico.

Distribution, Yampa River Drainage, Routt Co.: Yampa River at Sarvice Creek Junction - Naiads, 30-VI-67, B.R.O.; exuviae, naiad, 16-VII-68, B.R.O.; Yampa River 2 miles west of Hayden - 1 female, exuviae, naiads, 22-VII-67, B.R.O.; naiads, 24-XI-67, B.R.O.; East Fork of Elk River - 2 males, 4 females, 3 naiads, 22-VIII-67, B.R.O.; West Fork of Elk River - Naiads, 20-II-68, B.R.O.; Elk River 3 miles south of Clark - Naiads, 18-III-68, B.R.O.; Fish Creek Falls - Exuviae, 23-VIII-67, B.R.O.; Fish Creek - Naiads, 29-VI-67, B.R.O.; naiads, 24-XI-67, B.R.O.; Soda Creek - Naiad, 20-III-68, B.R.O.; Trout Creek - Naiads, 19-III-68, B.R.O.; naiads, 15-VII-68, B.R.O.; Big Creek - Naiad, 18-III-68, B.R.O.; Mad Creek - Naiads, 18-III-68, B.R.O.; Moffat Co.: Yampa River at Maybell - Exuviae, 1-VII-67, B.R.O.; naiads, exuviae, 18-VII-68, B.R.O.; Yampa River, Highway 318 Sunbeam - Exuviae, 18-VII-68, B.R.O.

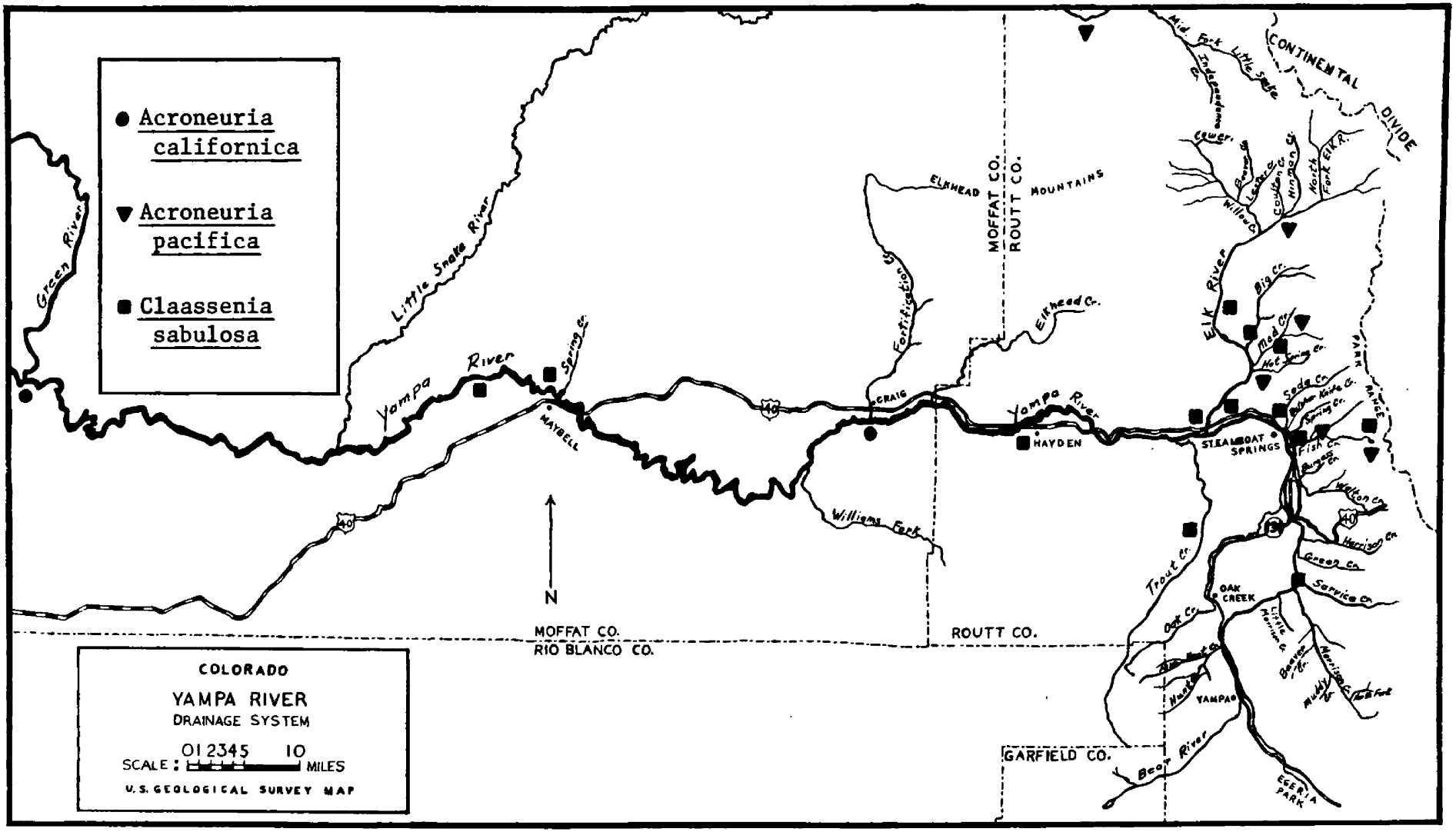


Fig. 18. Distribution map of Acroneuria californica, A. pacifica, and Claassenia sabulosa.

IV. KEY TO THE ABBREVIATION OF COLLECTORS

D. Q. A. . . . . Dean Q. Anderson

R. W. B. . . . . Richard W. Baumann

A. R. G. . . . . Arden R. Gaufin

G. F. K. . . . . George F. Knowlton

C. K. . . . . Cathy Knudsen

A. V. N. . . . . Allen V. Nebeker

B. R. O. . . . . Briant R. Oblad

J. L. O. . . . . James L. Oblad

J. N. O. . . . . John N. Oblad

Male and Female Genitalia

Fig. 19a. Nemoura coloradensis, male, dorsal view.

Fig. 19b. Nemoura coloradensis, male, lateral view.

Fig. 20. Nemoura californica, male, dorsal view.

Fig. 21a. Nemoura venusta, male, dorsal view.

Fig. 21b. Nemoura venusta, male, subanal lobe.

Fig. 22. Nemoura venusta, male, lateral view.

Fig. 23. Nemoura besametsa, male, dorsal view.

Fig. 24. Nemoura besametsa, male, lateral view.

Fig. 25. Nemoura coloradensis, female, ventral view.

Fig. 26. Nemoura californica, female, ventral view.

Fig. 27. Nemoura venusta, female, ventral view.

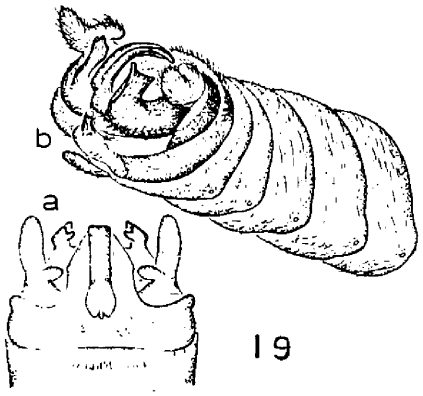
Fig. 28. Nemoura besametsa, female, ventral view.

Fig. 29. Nemoura decepta, male, dorsal view.

Fig. 30. Nemoura delicatula, male, dorsal view.

Fig. 31. Nemoura decepta, female, ventral view.

Fig. 32. Nemoura delicatula, female, ventral view.



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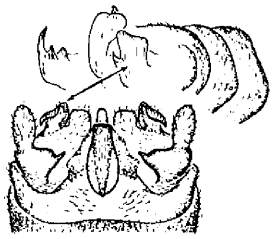

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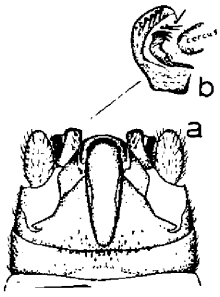

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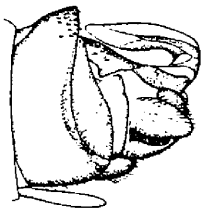

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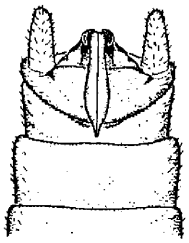

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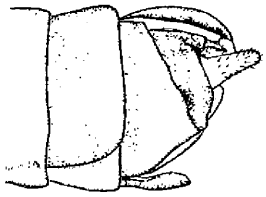

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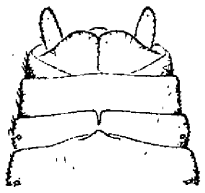

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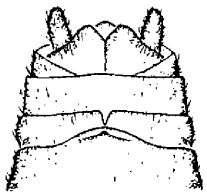

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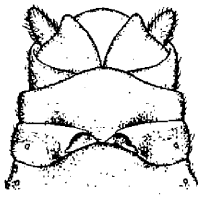

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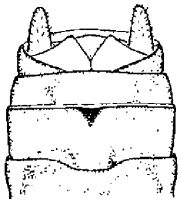

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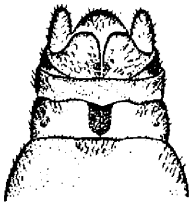

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Male and Female Genitalia

Fig. 33. Nemoura cinctipes, male, dorsal view.

Fig. 34. Nemoura cinctipes, male, lateral view.

Fig. 35. Nemoura haysi, male, dorsal view.

Fig. 36. Nemoura haysi, male, lateral view.

Fig. 37. Nemoura oregonensis, male, dorsal view.

Fig. 38. Nemoura oregonensis, male, lateral view.

Fig. 39. Nemoura cinctipes, female, ventral view.

Fig. 40. Nemoura haysi, female, ventral view.

Fig. 41. Nemoura oregonensis, female, ventral view.

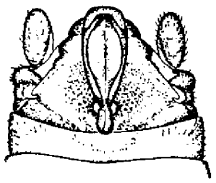
Fig. 42. Pteronarcella badia, male, dorsal view.

Fig. 43. Pteronarcella badia, male, lateral view.

Fig. 44. Pteronarcella badia, female, ventral view.

Fig. 45. Pteronarcys californica, male, dorsal view.

Fig. 46. Pteronarcys californica, female, ventral view.



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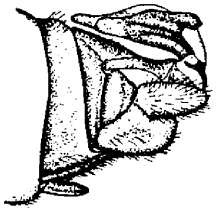

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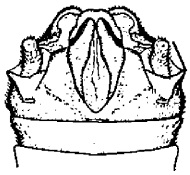

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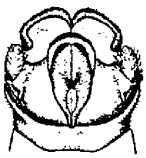

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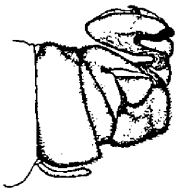

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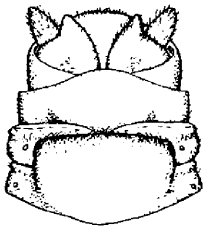

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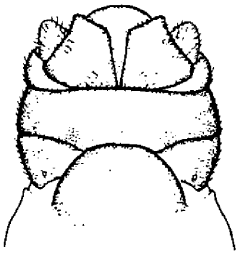

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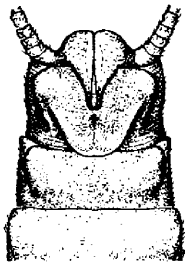

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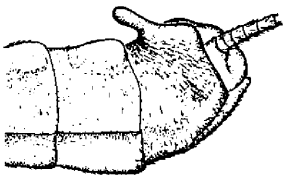

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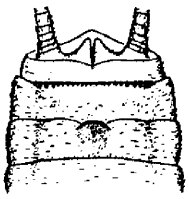

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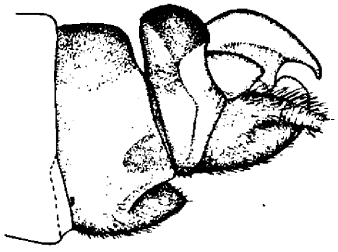

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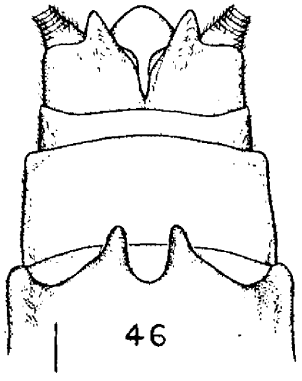

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Male and Female Genitalia

Fig. 47. *Paraleuctra occidentalis*, male, dorsal view.

Fig. 48. *Paraleuctra occidentalis*, male, lateral view.

Fig. 49. *Paraleuctra occidentalis*, female, ventral view.

Fig. 50a. *Paraleuctra sara*, male, cercus.

Fig. 50b. *Paraleuctra sara*, male, dorsal view.

Fig. 51. *Paraleuctra sara*, female, ventral view.

Fig. 52. *Eucapnopsis brevicauda*, male, dorsal view.

Fig. 53. *Eucapnopsis brevicauda*, male, lateral view.

Fig. 54. *Eucapnopsis brevicauda*, female, ventral view.

Fig. 55a. *Paracapnia angulata*, male, dorsal view.

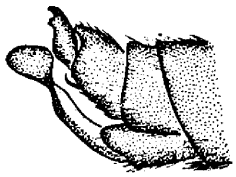
Fig. 55b. *Paracapnia angulata*, male, lateral view.

Fig. 56. *Paracapnia angulata*, female, ventral view.

Fig. 57. *Brachyptera fosketti*, male, dorsal view.

Fig. 58. *Brachyptera fosketti*, female, ventral view.

47



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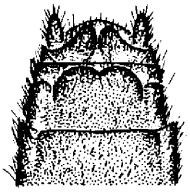

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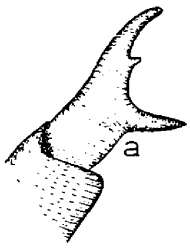

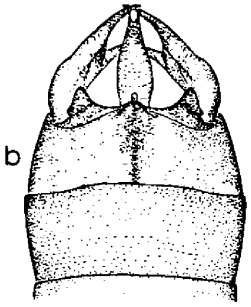

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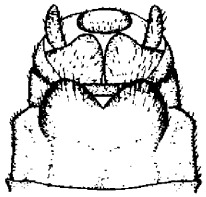

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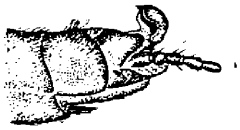

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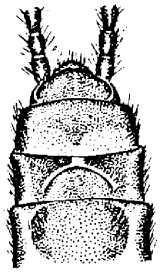

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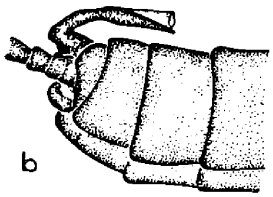

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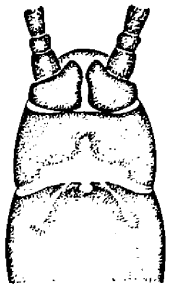

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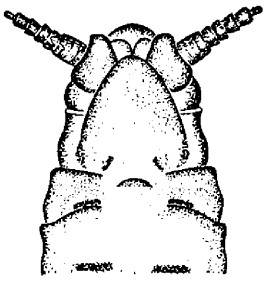


58

Male and Female Genitalia

Fig. 59. Brachyptera pacifica, male, dorsal view.

Fig. 60. Brachyptera pacifica, male, lateral view.

Fig. 61. Brachyptera pacifica, female, ventral view.

Fig. 62. Brachyptera nigripennis, male, dorsal view.

Fig. 63. Brachyptera nigripennis, male, lateral view.

Fig. 64. Brachyptera nigripennis, female, ventral view.

Fig. 65. Arcynopteryx parallela, male, dorsal view.

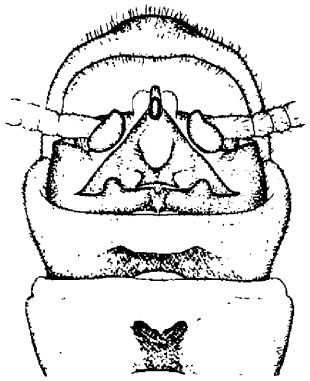
Fig. 66. Arcynopteryx parallela, female, ventral view.

Fig. 67. Arcynopteryx signata, male, dorsal view.

Fig. 68. Arcynopteryx signata, female, ventral view.

Fig. 69. Isogenus aestivalis, male, supra-anal apparatus and lateral stylets.

Fig. 70. Isogenus aestivalis, female, ventral view.



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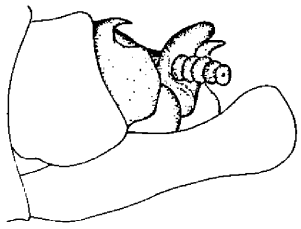

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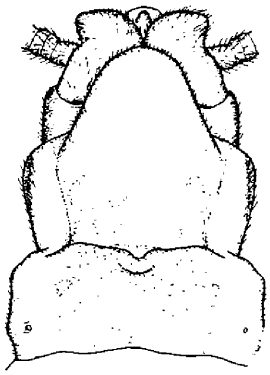

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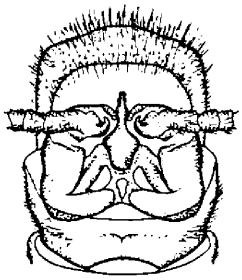

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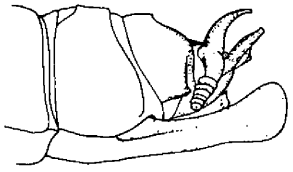

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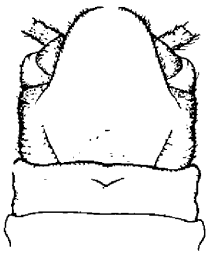

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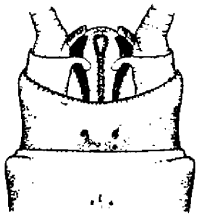

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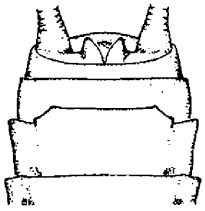

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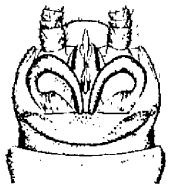

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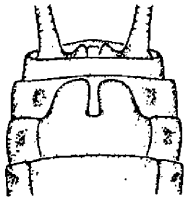

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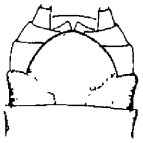

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One Head Pattern, Male and Female Genitalia

Fig. 71. Isogenus colubrinus, male, dorsal view.

Fig. 72. Isogenus colubrinus, female, ventral view.

Fig. 73. Isogenus elongatus, male, dorsal view.

Fig. 74. Isogenus elongatus, female, ventral view.

Fig. 75. Isogenus modestus, male, lateral view.

Fig. 76. Isogenus modestus, female, ventral view.

Fig. 77. Isoperla ebria, male, head and pronotal pattern.

Fig. 78. Isoperla ebria, male, dorsal view.

Fig. 79. Isoperla ebria, female, ventral view.

Fig. 80. Isoperla fulva, male, dorsal view.

Fig. 81. Isoperla fulva, female, ventral view.

Fig. 82. Isoperla longiseta, male, lateral view.

Fig. 83a. Isoperla longiseta, twelth cercal segment.

Fig. 83b. Isoperla longiseta, male, dorsal view.

Fig. 84. Isoperla longiseta, female, ventral view.

Fig. 85a. Isoperla patricia, male, dorsal view.

Fig. 85b. Isoperla patricia, male, lateral view.

Fig. 86. Isoperla patricia, female, ventral view.

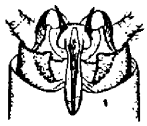
Fig. 87a. Isoperla pinta, male, dorsal view.

Fig. 87b. Isoperla pinta, male, lateral view.

Fig. 88. Isoperla pinta, female, ventral view.

Fig. 89. Isoperla 5-punctata, male, dorsal view.

Fig. 90. Isoperla 5-punctata, female, ventral view.



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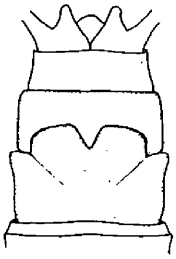

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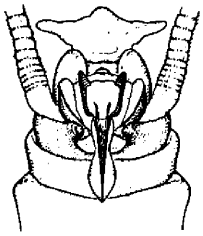

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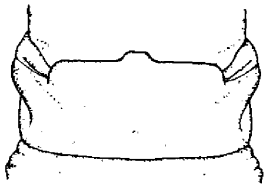

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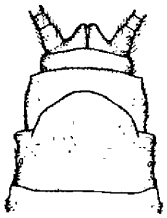

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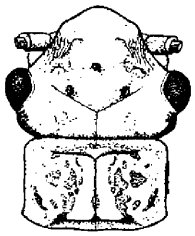

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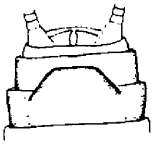

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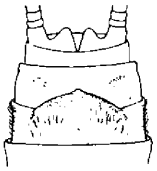

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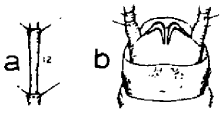

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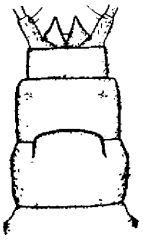

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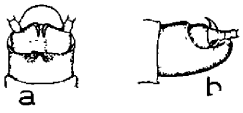

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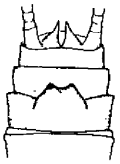

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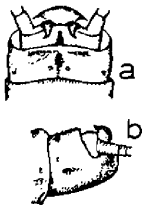

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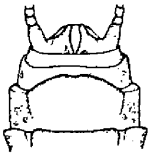

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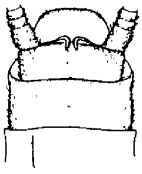

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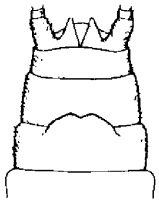


90

Male and Female Genitalia

Fig. 91. Diura knowltoni, male, dorsal view.

Fig. 92. Diura knowltoni, female, ventral view.

Fig. 93. Paraperla frontalis, male, dorsal view.

Fig. 94. Paraperla frontalis, female, ventral view.

Fig. 95. Alloperla severa, male, dorsal view.

Fig. 96. Alloperla severa, female, ventral view.

Fig. 97. Alloperla pallidula, male, dorsal view.

Fig. 98. Alloperla pallidula, female, ventral view.

Fig. 99. Alloperla pallidula, male, ventral view of aedeagus.

Fig. 100. Alloperla lineosa, male, ventral view of aedeagus.

Fig. 101. Alloperla lineosa, female, ventral view.

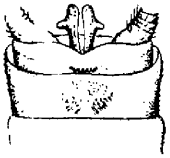
Fig. 102. Alloperla borealis, male, dorsal view.

Fig. 103. Alloperla borealis, female, ventral view.

Fig. 104. Alloperla coloradensis, male, dorsal view.

Fig. 105. Alloperla coloradensis, male, lateral view.

Fig. 106. Alloperla coloradensis, female, ventral view.



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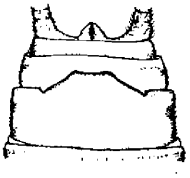

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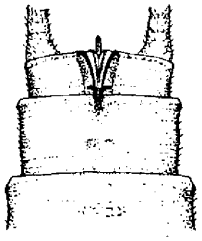

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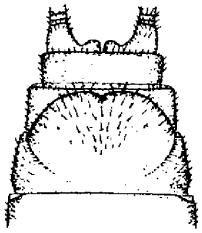

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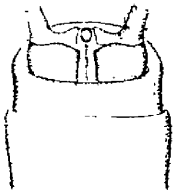

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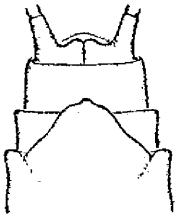

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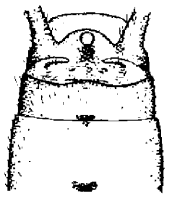

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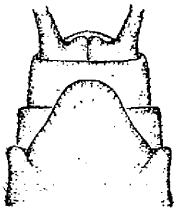

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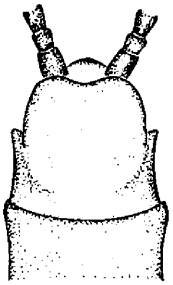

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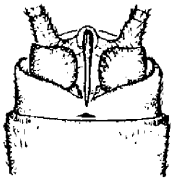

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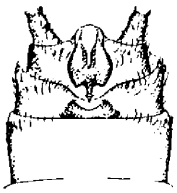

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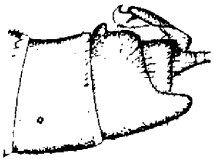

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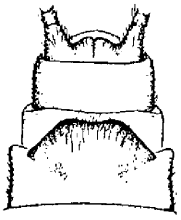

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Two Head Patterns, Male and Female Genitalia

Fig. 107. Alloperla lamba, male, dorsal view.

Fig. 108. Alloperla lamba, male, lateral view.

Fig. 109. Alloperla lamba, female, ventral view.

Fig. 110. Alloperla diversa, male, dorsal view.

Fig. 111. Alloperla diversa, male, lateral view.

Fig. 112. Alloperla diversa, female, ventral view.

Fig. 113. Alloperla signata, male, dorsal view.

Fig. 114. Alloperla signata, male, lateral view.

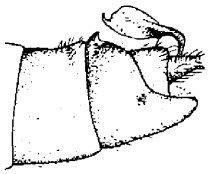
Fig. 115. Alloperla signata, female, ventral view.

Fig. 116. Alloperla signata, head and pronotal pattern.

Fig. 117. Alloperla pintada, head and pronotal pattern.

Fig. 118. Alloperla pintada, female, ventral view.

107



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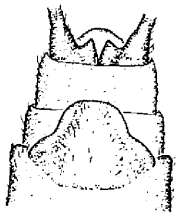

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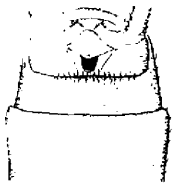

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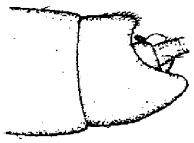

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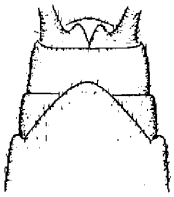

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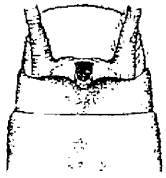

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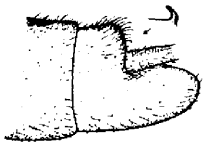

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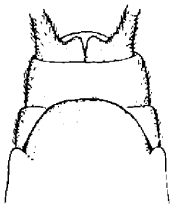

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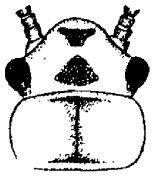

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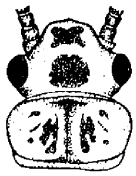

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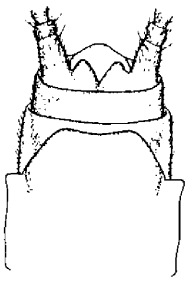


118

Male and Female Genitalia

Fig. 119. Acroneuria californica, male, dorsal view.

Fig. 120. Acroneuria californica, male, lateral view.

Fig. 121. Acroneuria californica, female, ventral view.

Fig. 122. Acroneuria pacifica, male, dorsal view.

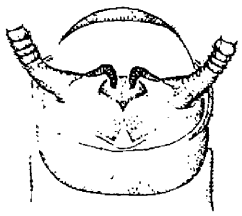
Fig. 123. Acroneuria pacifica, male, lateral view.

Fig. 124. Acroneuria pacifica, male, ventral view.

Fig. 125. Acroneuria pacifica, female, ventral view.

Fig. 126. Claassenia sabulosa, male, dorsal view.

Fig. 127. Claassenia sabulosa, female, ventral view.



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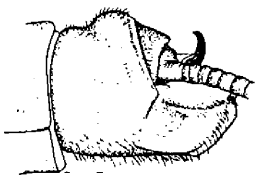

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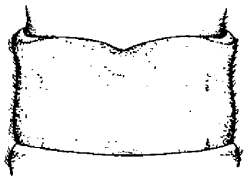

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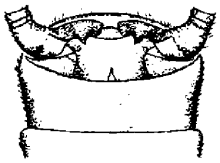

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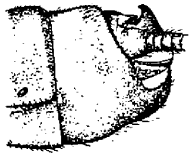

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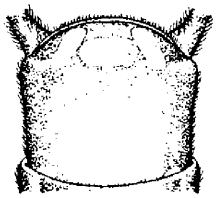

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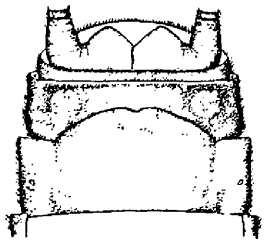

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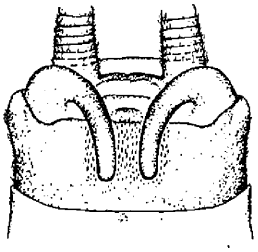

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CHAPTER IV

DISCUSSION

I. EMERGENCE

When a stonefly nymph is mature it crawls to the stream's edge, and climbs out on some emergent object, or clings to the vegetation. The larger Setipalpia may migrate two to three meters, while the Filipalpia and smaller Setipalpia stay nearer the stream's bank. To exuviate, the stonefly attaches itself to the desired substrate with its tarsal claws. Its skin then splits along the epicranial suture down the thorax. Upon emergence, the adult is white or light colored, and the wings, not yet dry, are held vertically. One to several hours is required for the color to darken, the cuticle to harden, and the wings to dry.

The seasonal emergence period for each species is presented in Table I. Rare species which have been collected on only one date are marked with a plus sign. For a comparison the stonefly emergence patterns of the Western United States are also included (Gaufin, et. al., 1966). From this table it can be seen that the majority of the species emerge in the spring and summer period. This is due to the type of nymphal growth the stonefly exhibits. Per Brinck (1949) calls these the early and late hiemal species. Growth of the nymph occurs during autumn and winter and emergence commences in early spring or summer. Those species in which the major growth occurs during the late spring and summer are called estival species (Brinck, 1949). These begin emerging in late summer and fall. Nemoura californica is an example of an estival species.

In the study area, the Setipalpia, with the exception of Arcynopteryx

TABLE I

SEASONAL EMERGENCE DISTRIBUTION

——— Yampa River Drainage
------ Western United States

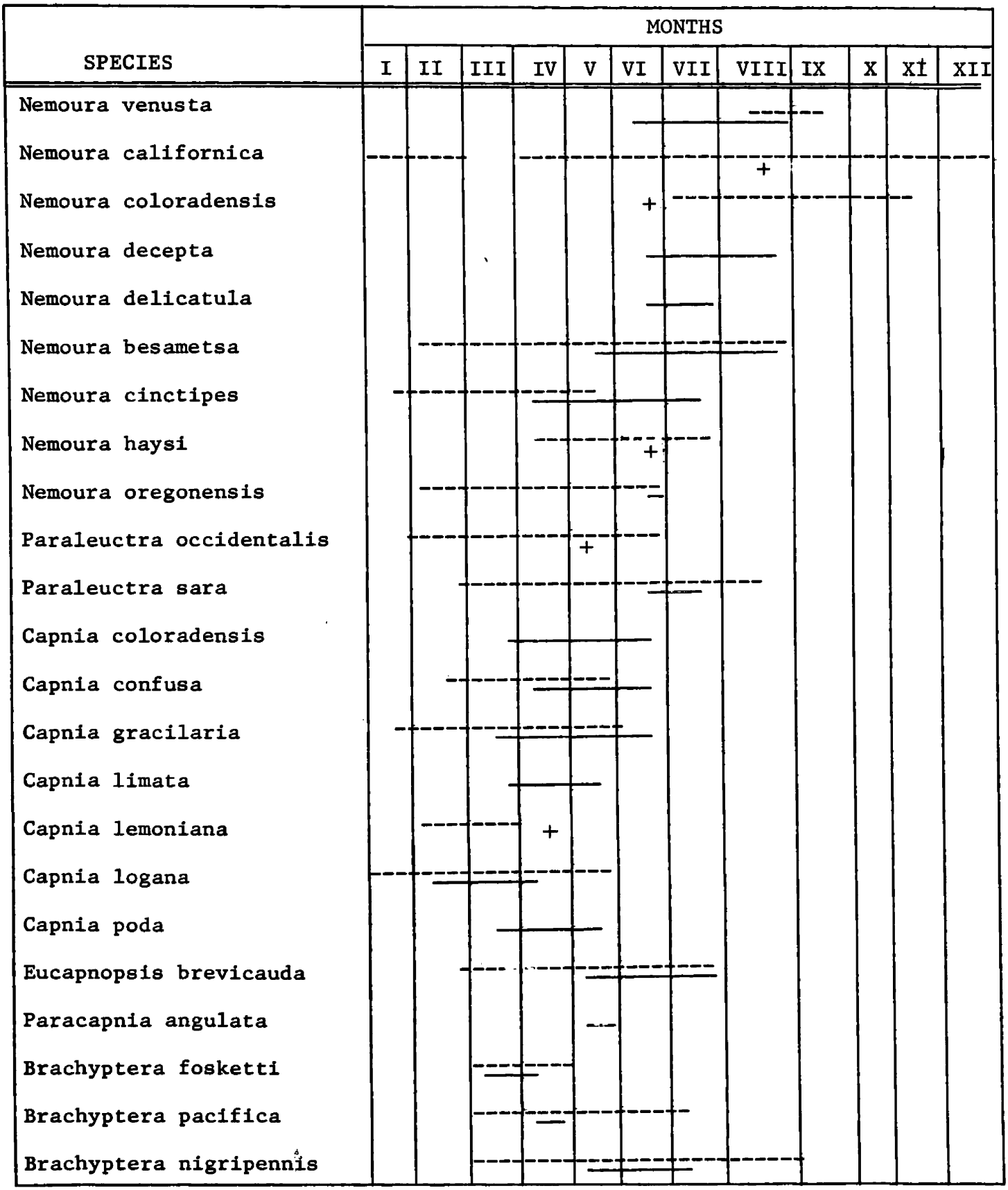
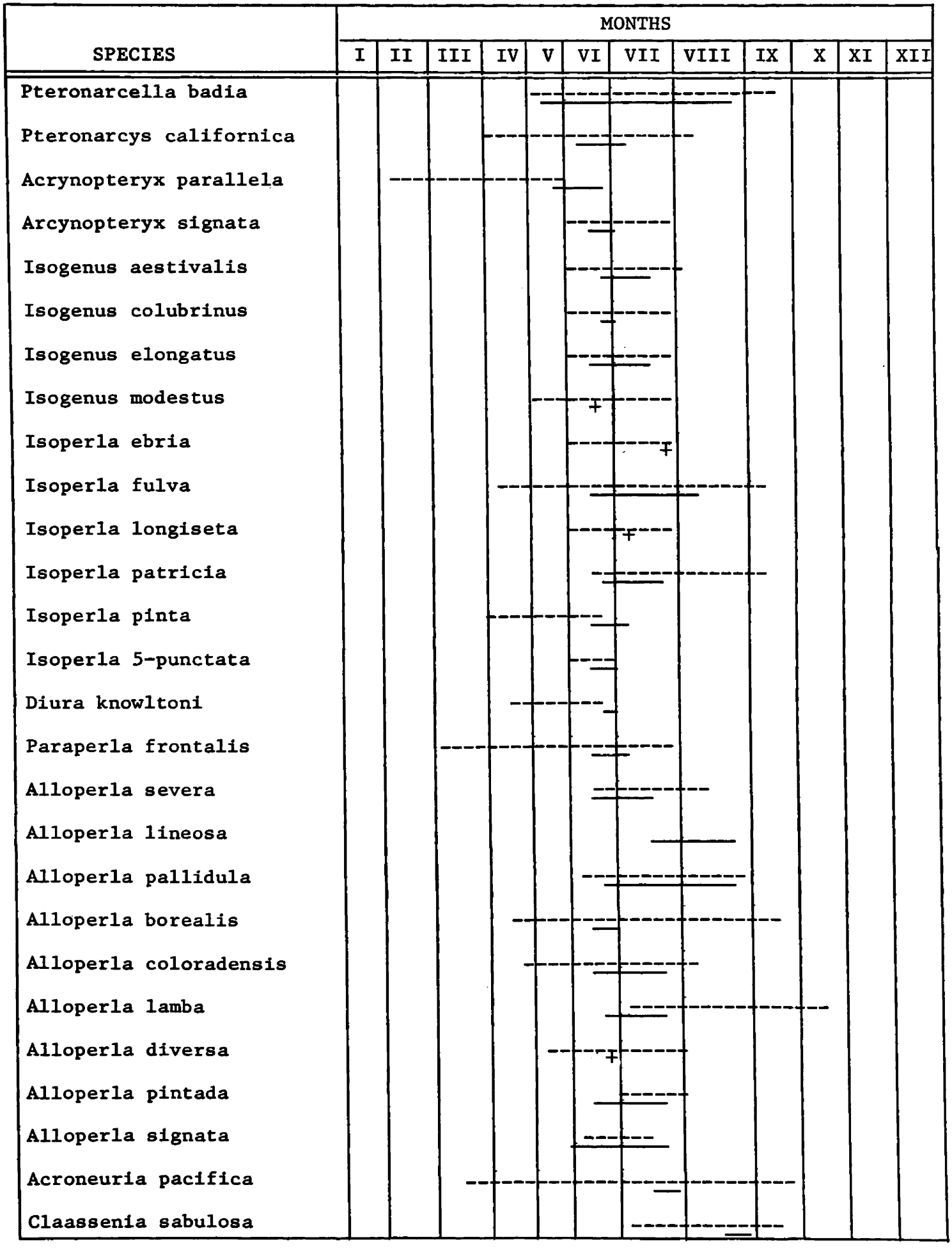


TABLE I (continued)



parallela and Alloperla signata, start emerging in the middle of June or later. The Filipalpia can be found emerging in the winter, spring, summer, and fall.

II. ADULT BEHAVIOR

Although the adult stonefly is secretive in its activities, observations are still possible. The adult stays near the vicinity where it lived as a naiad. Thus there is a great overlap in the terrestrial habitat for the various stonefly species, but certain preferences have been observed. Paraleuctra adults were found only along streams where there was abundant vegetation overhanging the stream bed. They were often found on alder tree limbs and on the undersides of the leaves. Specimens of the genus Nemoura frequented the shallow margins of streams, crawling on rock piles and dead stumps. Their small size and coloration make them difficult to see. One species, Nemoura delicatula, was found by the hundreds in a conduit in Walton Creek. Isoperla congregated in tall grasses near the rivers as did some Alloperla. Most Alloperla seemed to prefer densely vegetated and shaded areas. The large forms of Isogenus were found hiding in the cracks and crevices underneath concrete bridges. Arcynopteryx signata, positively thigmotrophic, was found in crevices of wooden bridges, log jams, or under the bark of fallen logs. A. parallela crawled the stony shores and hid in the spaces between boulders and rocks. Capnia were usually observed in the winter crawling along the banks of snow.

The adult lives from two to three weeks generally, and mates during this time. Mating always occurs with the male in apposition. The male attaches itself to the thorax and wings of the female with its legs, then bends the abdomen to either the right or left side of the female's abdomen,

and under to the subgenital plate where copulation occurs. Mating may occur several times (Brinck, 1949), but once is sufficient for fertilization of the ova.

In the Filipalpia, the males emerge slightly earlier than the females (Wu, 1923, Brinck, 1949). While awaiting the females the males become sexually mature. When the females emerge they are immediately mounted and fertilized. The eggs of the Filipalpia, spherical in shape, are not immediately deposited into the water, because the female must eat to provide nourishment for the development of the eggs.

The Setipalpian males and females emerge at approximately the same time, but copulation doesn't occur until the females are mature. As soon as the non-spherical ova have been fertilized, they are ready to be deposited in the water. Oviposition may occur in several different ways. The small Setipalpia and all Filipalpia oviposit in flight. The female will descend to the water and dip the abdominal apex where the eggs are in a ball. The larger Setipalpian females deposit their eggs by crawling into the water at the shore or by the above method when favorable environmental conditions prevail.

Filipalpian eggs in the water have a sticky coat and this insures attachment to the nearby substrate. The Setipalpian eggs do not have a sticky coat, but have an anchor plate which serves a similar purpose (Brinck, 1949).

III. CLASSIFICATION OF HABITATS

Within the Yampa River drainage there are many different types of streams, and this affords the Plecoptera a wide variety of habitats. Although it is difficult to divide the streams into various types

because of the problem of overlapping, it is nevertheless of some value to do so. Most authors agree that stonefly habitats can be primarily classified as flowing water and still water, with both of these being subdivided. This study concerns only the flowing water and its subdivisions. The classification used for the Yampa drainage is a modification of earlier studies by Hynes (1941), Muttkowski (1929), and Brinck (1949).

In the study area six stream types have been determined. They are: trickles, temporary streams, small oligotrophic stony streams subdivided into streams 7,000 feet in elevation and above, and those under 7,000 feet elevation, stony rivers, constant rivers, and sluggish rivers. The following criteria have been used when possible to make these classifications: substrate, altitude, volume, width and depth, source, current, and chemical datum. Each of the stream classifications will be discussed in detail, and Table II presents the stream types for each species of stonefly found.

Trickles. A trickle is spring fed. Its dimensions range from one to ten centimeters in depth and not more than one and a half meters in width. Because a trickle is so shallow, extreme fluctuations in temperature may occur. In the study area only one such habitat was observed. This is the Fish Creek Falls trickle. The substratum was predominately gravel with occasional stones from two to eight centimeters in diameter. The chemical parameters showed the water to be saturated with dissolved oxygen and a small amount of carbon dioxide was found. The water was soft, the bicarbonate alkalinity being 22 ppm. A pH of 7.1 was recorded. (See Table III, Chemical Data).

In this habitat six species of stoneflies were collected. They

TABLE II

STREAM TYPES OF THE DIFFERENT STONEFLY SPECIES

SPECIES \ STREAM TYPES	Trickles	Temporary	Small Stony Over 7,000	Small Stony Under 7,000	Stony River	Constant River	Sluggish River
Nemoura venusta		x	x	x	x	x	
Nemoura californica			x				
Nemoura coloradensis						x	
Nemoura decepta	x	x	x	x			
Nemoura delicatula	x	x	x	x	x	x	
Nemoura besametsa			x	x	x	x	
Nemoura cinctipes			x	x		x	
Nemoura haysi			x				
Nemoura oregonensis			x	x		x	
Paraleuctra occidentalis						x	
Paraleuctra sara	x	x	x	x	x	x	
Capnia coloradensis			x	x	x	x	
Capnia confusa			x	x		x	
Capnia gracilaria		x		x		x	
Capnia limata			x	x	x	x	x
Capnia lemoniana			x				
Capnia logana		x		x		x	
Capnia poda		x	x	x		x	x
Eucapnopsis brevicauda			x	x	x	x	
Paracapnia angulata			x	x			
Brachyptera fosketti						x	
Brachyptera pacifica					x	x	
Brachyptera nigripennis			x	x	x		
Pteronarcella badia			x	x	x	x	x
Pteronarcys californica				x	x	x	
Arcynopteryx parallela			x	x	x	x	x
Arcynopteryx signata			x	x	x	x	
Isogenus aestivalis				x	x	x	
Isogenus colubrinus						x	
Isogenus elongatus						x	
Isogenus modestus			x				
Isoperla ebria			x				
Isoperla fulva		x	x	x	x	x	x
Isoperla longiseta						x	
Isoperla patricia				x	x	x	
Isoperla pinta						x	
Isoperla 5-punctata						x	
Diura knowltoni			x	x	x	x	
Paraperla frontalis				x	x	x	
Alloperla severa			x	x	x	x	
Alloperla lineosa	x	x	x	x	x	x	
Alloperla pallidula	x	x	x	x	x	x	
Alloperla borealis			x	x		x	
Alloperla coloradensis		x	x	x	x	x	
Alloperla lamba	x	x	x	x		x	
Alloperla diversa				x			
Alloperla pintada		x	x	x		x	
		x	x	x	x	x	
ıica						x	
ə			x	x	x		
ə			x	x	x	x	

TABLE III

CHEMICAL DATA

Location	Date and Time	Air/Water C. Temperatures	D. O. ppm	CO_2 ppm	HCO_3 ppm	CO_3	pH
Yampa R. at Yampa	19-III-68 12:10	-3/1	10.5	0.0	60	0.0	7.5
	10-V-68 10:00	9/8	9.9	0.0	66	0.0	7.4
	21-VI-68 15:15	24/15	8.9	0.0	58	0.0	7.4
	15-VII-68 13:00	20/14	8.6	0.0	52	0.0	7.3
Yampa R. at Sarvice Cr. Junct.	16-VI-68 13:10	26/21	9.5	0.0	165	0.0	7.6
	15-VII-68 16:30	19/19	9.0	0.0	175	0.0	7.8
Yampa R. W. of Hwy 131	20-VI-68 15:00	24/15	9.3	2	38	0.0	7.1
Yampa R. at St. Sps.	24-XI-67 16:20	1/2	11.5	2	3	0.0	7.0
	18-III-68 16:00	-2/1	10.5	2.5	15	0.0	6.8
	11-V-68 13:00	9/7	9.4	2	21	0.0	7.2
	20-V-68 13:00	22/10	9.5	2.5	20	0.0	7.1
	16-VII-68 18:30	21/18	8.5	0.0	40	0.0	7.3
Yampa R. 2 miles W. of Hayden	19-VI-68 14:20	27/8	9.4	2	17	0.0	7.1
Yampa R. 3 miles East of Hayden	19-VI-68 15:30	27/12	9.2	1.4	26	0.0	7.1

TABLE III (continued)

Location	Date and Time	Air/Water C. Temperatures	D.O. ppm	CO_2 ppm	HCO_3 ppm	CO_3	pH
Yampa R. at Maybell	24-XI-67 14:00	-2/1	11	0.0	195	0.0	8.1
	20-III-68 17:00	-3/1	12	0.0	175	0.0	7.8
	29-VI-68	30/12	9.5	0.0	65	0.0	7.5
	18-VII-68 16:00	27/22	8.0	0.0	127	0.0	7.7
Primary Trib.							
Bear River	15-VII-68 13:40	19/13	9.5	0.5	50	0.0	7.3
Trout Creek	19-III-68 13:15	-5/5	12.5	0.0	7	0.0	7.1
	15-VI-68 11:45	24/17	9.1	0.0	114	0.0	7.6
	21-VI-68 12:30	25/13	10	3	39	0.0	7.3
Oak Creek	20-VI-68 14:20	26/15	8.6	2	68	0.0	7.4
	15-VII-68 11:00	20/14	9.1	0.0	123	0.0	7.5
Morrison Creek	15-VII-68 18:00	18/19	8.0	0.0	50	0.0	7.3
Sarvice Creek	16-VII-68 13:35	33/18	9.0	0.0	14	0.0	7.0
Green Creek	16-VI-68 12:20	24/13	9.2	1.0	16	0.0	7.0
Harrison Creek	16-VI-68 11:00	21/11	9.4	1.0	24	0.0	7.1
Walton Creek (9,200')	15-VII-68 17:35	17/14	8.7	0.5	15	0.0	7.1

TABLE III (continued)

Location	Date and Time	Air/Water C. Temperatures	D. O. ppm	CO_2 ppm	HCO_3 ppm	CO_3	pH
Walton Creek (6,750')	16-VII-68 18:37	30/21	7.5	4.0	48	0.0	6.8
Fish Creek Falls	17-VI-68 14:00	12/17	9.5	2.0	7	0.0	7.1
	14-VI-68 20:40	18/16	9.0	0.0	10	0.0	7.0
Fish Creek Falls Trickle	16-VII-68 19:10	21/15	9.2	1.0	22	0.0	7.1
Fish Creek	15-VII-68 9:45	21/14	10.0	1.0	10	0.0	6.5
Spring Creek	18-III-68 16:40	-4/1	11.5	1.0	29	0.0	7.2
	20-VI-68 14:00	26/11	10.1	2	11	0.0	7.1
	16-VII-68 19:30	22/18	9.0	1.5	18	0.0	7.1
	17-VII-68 8:30	17/18	8.9	1.0	59	0.0	7.2
Soda Creek	20-VI-68 11:30	22/8	9.4	1.0	8	0.0	7.1
	16-VII-68 8:05	19/17	9.3	1.0	24	0.0	7.0
East Fk. of Elk R.	20-III-68 10:50	-1/1	12.1	0.0	35	0.0	7.1
	19-VI-68 18:15	27/12	9.6	0.5	120	0.0	7.1
	18-VII-68 15:15	27/19	8.8	0.0	42	0.0	7.3
Little Snake R.	17-VII-68 13:50	22/20	7.8	0.0	49	0.0	7.3

TABLE III (continued)

Location	Date and Time	Air/Water C. Temperatures	D. O. ppm	CO_2 ppm	HCO_3 ppm	CO_3	pH
Secondary Trib.							
Hot Springs Creek	18-VI-68 12:05	15/11	9.4	0.5	15	0.0	7.0
Mad Creek	18-III-68 18:00	-5/1	11.9	1.5	20	0.0	7.0
	18-VI-68 12:48	23/8	9.5	2.0	15	0.0	6.9
	17-VII-68 19:45	19/17	8.5	1.0	14	0.0	7.0
Big Creek	17-VII-68 19:26	21/18	8.0	1.0	73	0.0	7.4
Willow Creek	18-VI-68 15:15	27/17	8.1	0.0	48	0.0	7.4
	17-VII-68 17:45	24/18	7.5	0.0	50	0.0	7.6
Lester Creek	18-VI-68 16:45	25/14	8.2	1.0	37	0.0	7.1
	17-VII-68 17:15	29/19	7.5	2.0	47	0.0	7.1
North Fk. of Elk R.	18-VII-68 11:45	28/11	9.2	1.0	22	0.0	6.9

included Nemoura decepta, N. delicatula, Paraleuctra sara, Alloperla lineosa, A. pallidula, and A. lamba. All six species are small forms with a one year life cycle. The larger species are not found in the trickle. There are several probable reasons for this. First, the substrate is not suitable for the large Setipalpia, which prefer a substrate of large stones or boulders and they also need a more rapid current. Secondly, the trickle habitat has a limited area and does not have a large amount of primary production available to the herbiverous forms. This in turn cuts down the available food for the carnivorous forms of Setipalpia. According to Hynes (1941), "Small bodies of water are often not large enough to support a sufficient number of specimens of a given species to allow it to maintain itself there". All of the species found in the trickle are found in at least three other stream types. This shows these species to be tolerant to a variety of stream types. While Alloperla lamba was also found in three other stream types, 56 per cent of the specimens were taken from the trickle. This habitat offers less competition with the larger species. Baumann (1967) found the majority of Alloperla lamba to inhabit the spring areas also.

Temporary streams. The temporary stream arises largely from melting snows. It may carry large amounts of water for a time, but tends to become intermittent in the late summer. The substrate ranges from two to twelve centimeters in diameter. Collections were made along six temporary streams. They are: Beaver Creek, Cow Creek, Independence Creek, Burgess Creek, Little Morrison Creek, and Muddy Creek. Spring Creek at Maybell was dry throughout the year 1968.

A temporary stream is a poor habitat for Plecoptera. While fourteen species were collected from these streams, thirteen species were very

scarce in numbers and were found more abundantly in some other stream type. Only Alloperla pintada was found in five of the six temporary streams in large numbers. It seems to be well adapted to the fluctuations that occur in intermittent stream situations.

Small stony oligotrophic streams. These are small rapid streams found in mountainous regions. Because of the altitudinal range in the study area the habitat is divided into the high small stony oligotrophic streams (over 7,000 feet in elevation) and low small stony oligotrophic streams (under 7,000 feet in elevation). Due to the swift current the water in these streams is always well saturated with dissolved oxygen. Stones of the substratum are from five to twenty-five centimeters in diameter. The width of the stream may vary from 30 centimeters up to 4 1/2 meters. Bicarbonate alkalinity ranged from 7 to 50 ppm. There was no measurable phenolphthalein alkalinity.

Thirteen small stony streams above 7,000 feet were studied. They are: Green Creek, Harrison Creek, Sarvice Creek, Hinman Creek, Coulton Creek, Walton Creek at Rabbit Ears Pass, Fish Creek Falls, Lester Creek, Willow Creek, North Fork of the Elk River, North Fork of Morrison Creek, Morrison Creek, and Oak Creek. From these collectively a total of thirty-four species were found. Most of these were Filipalpia and small Setipalpia. There are many reasons for this diverse fauna. These streams are protected by the dense forest shade from warming by solar radiation. According to Brinck (1949), the shading effect of trees and bushes is advantageous to the development of stonefly naiads. While the current velocity prevents sedimentation, slight amounts of detritus and leaf packets collect between the cracks of rocks. This is an important food source for the herbivorous Filipalpia, and small omnivorous Setipalpia.

Nine small stony streams below the altitude of 7,000 feet were investigated. These include: Spring Creek at Steamboat Springs, Butcher Knife Creek, Soda Creek, Hot Springs Creek, Mad Creek, Big Creek, Fish Creek, Walton Creek, and Trout Creek.

The lower stony streams are very similar to the higher stony streams. However, the stream is wider and the current is slower. Because of these factors, plus the limited vegetative cover, the stream may become several degrees warmer in the summer than the upper stony streams.

Chemical analysis showed the water to be quite soft and the bicarbonate alkalinity ranged from 8 to 114 ppm. The pH range was from 6.5 to 7.6. Thirty-six species were collected from these streams. While there were eighteen species of Filipalpia in both the upper and the lower stony streams more Setipalpia were found in the lower stony streams. The warmer temperatures helped increase the primary productivity in the stream making more food available to the herbivorous forms and in turn to the omnivorous and carnivorous Setipalpia. Also there is more space available in the lower stony streams. Hynes (1941), also found more species in the lower stony streams than in the higher stony streams. Representatives of all the species of the family Chloroperlidae were collected from this habitat.

Stony rivers. Stony rivers are from ten to twenty meters wide. The substratum consists of rocks and boulders from two to sixty centimeters in diameter and the current is very swift. For a short time these carry a large amount of water due to runoff. Bear River, the Little Snake River at Focus Ranch, and the Elk River are examples. Water temperatures in the spring and summer varied from 1 to 22^{o} C. The dissolved oxygen content of the water varied from 7.8 to 10.5 ppm. This is from

108 per cent saturation to 129 per cent saturation. No carbonate alkalinity was detected, but the bicarbonate maximum was 120 ppm in the Elk River. The pH range was 7.1 to 7.3. Twenty-five species were found in the stony rivers. Frison (1935a) states that medium sized streams usually offer the best variety of stoneflies because both the large as well as the small forms can develop in this situation.

The Elk River has an abundant number of certain species because the carbon source is sufficient for a moderate algal growth which is used as food by prey of the carnivorous Setipalpia and to some extent by most stoneflies (Richardson, 1965). The substrate of rock and boulders is excellent as a hiding place from common predators.

The Little Snake River at the Yampa River junction (elevation 5,200 feet) is not productive because the substrate is of mud and silt and there is no place that a stonefly naiad can attach itself or find refuge from predators. The average mean temperature during July, 1967, was 23° C. while the maximum temperature was 26° C. (Dept. of Interior, 1967). Such high temperatures may be a limiting factor for stoneflies.

The Little Snake River near Focus Ranch (elevation 6,700 feet) is an excellent stonefly habitat. However, because of the distance and inaccessibility over the Columbine Road a major portion of the year, this location was visited only once. Thus the winter and spring fauna are unknown.

Constant rivers. Constant rivers carry large amounts of water and this volume is not greatly diminished throughout the summer or fall. These are from twenty to fifty-five meters wide. The substratum ranges from silt and sand to boulders over one meter in diameter. The Yampa River itself is considered the only constant river in the Yampa River drainage. However,

there are many microhabitats found within the river. Because of this and the extensive collecting done along the main river more species were taken from this habitat than any of the others. Forty-one species were collected from this river representing eighty-three per cent of the total diversity of species found in the study.

In order to determine habitat preferences the river was divided into four sections. The first section includes the portion of the Yampa River at Yampa. The second section is very different and stretches from near Phippsburg to the Sarvice Creek junction. The third is in the vicinity of Steamboat Springs, and the fourth section is from 6,500 feet in elevation to the mouth of the river at 5,080 feet in elevation.

The first section of the Yampa River might be classified as a stony river. The dissolved oxygen here ranged from 8.6 to 10.5 ppm which is 98 to 116 per cent saturation. No traces of free carbon dioxide were found, and the water here is more alkaline than at Steamboat Springs. There was no carbonate alkalinity, but bicarbonate alkalinity varied from 52 to 66 ppm. The pH range was from 7.3 to 7.5. The maximum recorded temperature in the area was 15^{o} C. Twenty-one species were found in this section. With exception of the rare species, each species was abundant. There is sufficient algal growth and diatoms here to support large numbers of Plecoptera. Bicarbonates and nutrients used in agriculture processes, which are washed into the stream during runoff, contribute to this productivity. Alloperla severa, A. pallidula, A. pintada, Isoperla fulva, Pteronarcella badia, Capnia logana and C. gracilaria, were found in greatest abundance in this section of the Yampa. Alloperla signata, and Alloperla coloradensis were very abundant also.

The second section is quite different from the first and could be

considered a sluggish river. The rocky bottom has been covered by silt and mud from erosion of soil along the banks, and because of agricultural practices the stream is more eutrophic in this area. Macrophytes grow here causing a great fluctuation in the dissolved oxygen content. However, no twenty-four hour tests were taken to determine whether this is a limiting factor. The maximum temperature recorded in this section was 21° C. which might be limiting. The pH range was 7.6 to 7.8. This section of the stream produced fourteen species. Isoperla 5-punctata was found in no other section of the river. Isogenus aestivalis was abundant in this section.

The third region of the Yampa River supports the most diverse fauna. The bottom is rubble ranging from sand and small pebbles to small boulders two-thirds of a meter in diameter. The water is extremely soft with bicarbonate alkalinity ranging from 3.0 to 40.0 ppm. The dissolved oxygen ranges from 8.5 to 11.5 ppm correlated with the temperature of 18 to 1° C. Traces of free carbon dioxide were found and the pH range was 6.8 to 7.3. Eleven of the sixteen genera were collected in this section including a total of twenty-six species. The number of specimens collected from the Yampa at Steamboat Springs is deceiving. Actually, the Yampa River is highly oligotrophic in this section, being almost devoid of any primary production, and this limits the abundance of the species. Because the primary purpose of the study was to find what species are found in the Yampa River drainage, more time was spent in areas such as this where great diversity occurs. This is the only section of the Yampa where Nemoura delicatula, N. besametsa, N. oregonensis, Eucapnopsis brevicauda, Paraperla frontalis, and Alloperla borealis were found. Paraleuctra occidentalis was found nowhere else in the entire drainage system.

The fourth portion of the river includes the lower section of the stream, which is the plains area. The water in this section is very turbid, because of the mud banks. The water is more alkaline here, ranging from 65 to 195 ppm of bicarbonate. The maximum temperature obtained during July, 1968 was 22° C. The dissolved oxygen was near saturation in all cases. The pH ranged from 7.5 to 8.1. Of the ten species collected in this section, four were found only in this area. These are Brachyptera fosketti, Isogenus colubrinus, Isoperla longiseta, and Acroneuria californica. It is of interest that the only species of the suborder Filipalpia which were found in this area are Capnia confusa, C. limata, C. poda and Brachyptera fosketti. They are winter and early spring emergers. During the summer no Filipalpia were collected which could be due to the warmer water temperatures at this lower altitude. Kamler (1965) found that together with increases in temperature and temperature fluctuation there is a decrease in the number of Plecoptera species. However, the large Setipalpia prefer or need the warmer temperatures for development as they are found in this section in greater numbers than any where else.

Sluggish Rivers. Sluggish rivers can be large or small, but have a muddy bottom and rooted aquatic plants. Substratum ranges from sand to small rocks, ten centimeters in diameter. Three streams of this type were found in the Yampa River drainage. They are Middle Hunt Creek, Fortification Creek, and Elkhead Creek. Only five species occurred in this habitat. These five, Capnia limata, C. poda, Pteronarcella badia, Isoperla fulva, and Arcynopteryx parallela are found in a wide range of habitats as shown by Table II and seem to have a high tolerance to conditions which other species cannot withstand. The dissolved oxygen fluctuation may be the limiting factor, because the dissolved oxygen is

reduced during the night by respiration and lack of photosynthesis of the aquatic plants. Also the substrate is not desirable for most species which prefer a rubble type substrate with medium sized stones to boulders.

IV. ALTITUDINAL DISTRIBUTION

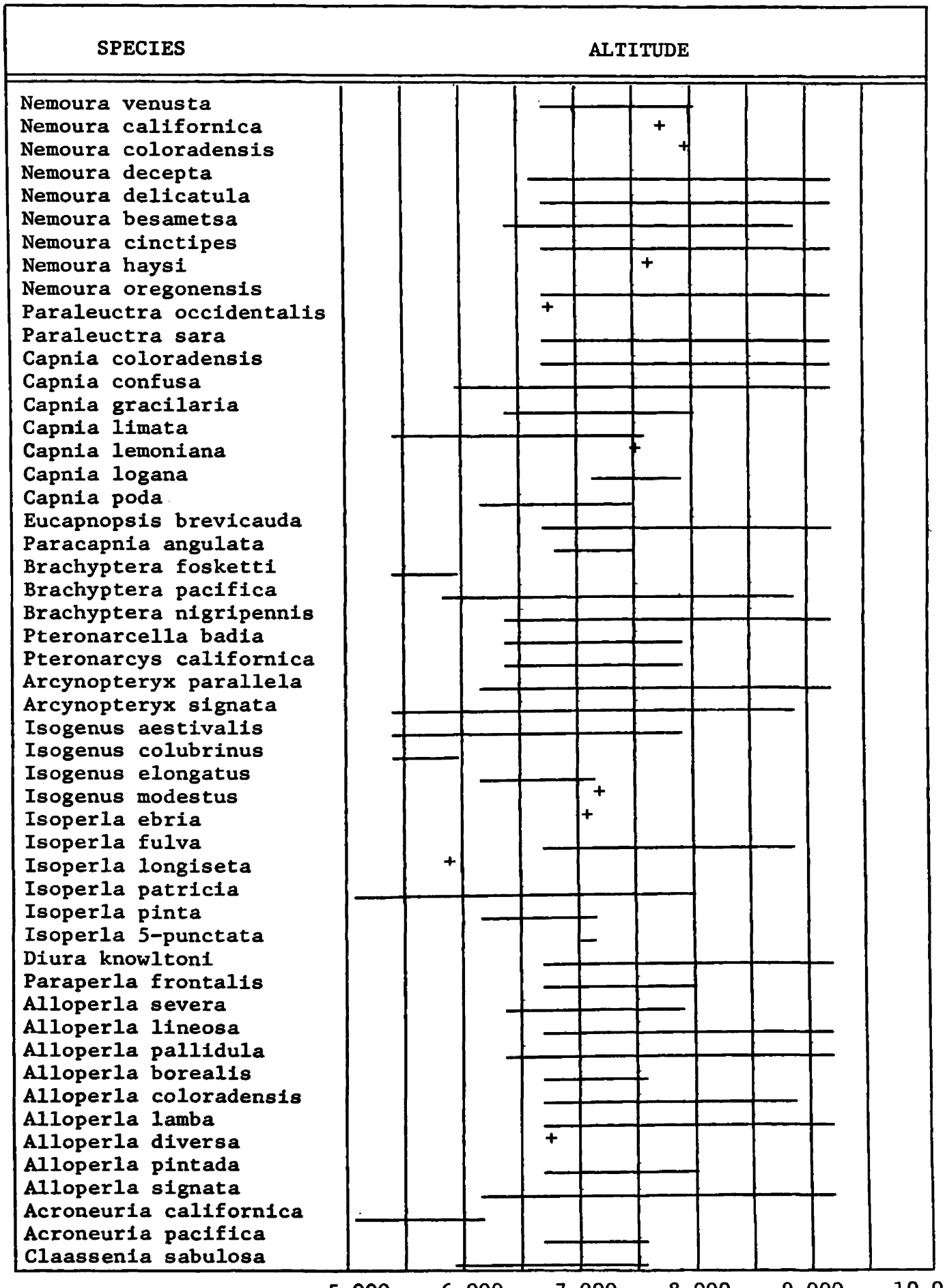
The study area presented an excellent opportunity for altitudinal investigations of the fauna. The altitude varies from 5,080 feet to 9,200 feet above sea level. Table IV presents the altitudinal range through which each species has been collected. This range includes both adults and naiads.

Many authors recognize temperature to be the prime factor in determining altitudinal zonation (Dodds and Hisaw, 1925, Knight and Gaufin, 1966, and Baumann, 1967). For comparative reasons those species which have an altitudinal range of 1,000 feet or more will be considered euthermic (Dodds and Hisaw, 1925). Accordingly these species are not limited by temperature conditions and have a wide altitudinal distribution. Those species which are limited to an altitudinal distribution less than 1,000 feet are stenothermic (Dodds and Hisaw, 1925). In this study thirty-three species, or a majority, were found to be euthermic and eighteen species were stenothermic. More extensive collecting in this drainage however, may reveal that some rare species now considered stenothermic are actually euthermic.

Another interesting factor dealing with altitude and the mean water temperature is the emergence time of the stoneflies. In a study along the Wasatch Front in Utah (Baumann, 1967), it was found that hiemal species begin their emergence first at lower elevations and progressively later at higher elevations. Baumann states "In some cases the earliest

TABLE IV

ALTITUDINAL DISTRIBUTION IN THE YAMPA RIVER DRAINAGE



collection dates for the higher elevations are similar to those of the lower but in all cases the emergence peaks are staggered according to increase in elevation". The genera Capnia, Eucapnopsis, Brachyptera, and Nemoura in the Yampa River drainage seem to follow this pattern.

Table IV shows that the smaller stoneflies prefer the smaller streams at higher elevations, while the large Setipalpia prefer the larger rivers at the lower altitudes. The only exceptions are Arcynopteryx parallela, and Diura knowltoni, which were found occasionally at the higher altitudes.

CHAPTER V

SUMMARY

The Yampa River Drainage System proved to have a very abundant stonefly fauna. Sixteen genera and fifty-one species were collected from this area. Six new state records were found, namely, Nemoura californica Capnia lemoniana, Alloperla severa, Acroneuria californica, Brachyptera fosketti, and Paracapnia angulata. Paracapnia angulata has been known only from the Eastern United States. This is the first record of it west of the continental divide. The most abundant species in the area were Alloperla signata, Nemoura delicatula, Alloperla coloradensis, and Capnia poda.

Taxonomic keys are provided for all the species. Distributional records and distributional maps for each species are also presented. Illustrations of male and female genitalia are included to aid in the identification of species. Illustrations of the genus Capnia are not included because they are illustrated in the publications by Nebeker and Gaufin (1965, 1967 and 1968).

The drainage was divided into six types of habitats, based upon the substrate type, altitude, water volume, current, size, and chemical datum. It was found that the constant river habitat of the Yampa River was the most productive area. Eighty-three per cent of the total diversity of species found in the drainage was represented along some section of this river. This is thought to be due to the diversity of habitat and the extensive collecting which has been done along the Yampa River.

The adult emergence patterns showed the Setipalpia to emerge some-

what later than the Filipalpia in general.

The altitudinal distribution information showed that the smaller forms of stoneflies frequent the higher altitudes while the larger Setipalpia prefer lower altitudes and larger rivers. Certain species were found to be stenothermic, but the majority were euthermic.

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