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A Review of the Adults and Larvae of the Genus *Pycnopsyche* (Trichoptera: Limnephilidae) with Revision of the *Pycnopsyche scabripennis* (Rambur) and *Pycnopsyche lepida* (Hagen) Complexes

John A. Wojtowicz
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a dissertation written by John A. Wojtowicz entitled "A Review of the Adults and Larvae of the Genus *Pycnopsyche* (Trichoptera: Limnephilidae) with Revision of the *Pycnopsyche scabripennis* (Rambur) and *Pycnopsyche lepida* (Hagen) Complexes." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Animal Science.

D. A. Etnier, Major Professor

We have read this dissertation and recommend its acceptance:

D. L. Bunting, A. C. Echternacht, M. L. Pan, C. D. Pless

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Vice Chancellor
Graduate Studies and Research

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A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

John A. Wojtowicz

June 1982

DEDICATION

TO

Doyne "Dick" Martin

Robert "Bobby" Thompson

AND

Dr. Arthur Jungreis

ALL WHO DIED

BEFORE THEIR TIME

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ABSTRACT

The adults and larvae of the genus Pycnopsyche are reviewed. Nineteen species are recognized for the genus. The males and females of all species are described and illustrated. All species accounts include description, diagnosis, type locality, distribution, variation, notes and material examined sections. The P. scabripennis complex is revised, and three distinct species are recognized (P. scabripennis s.s., P. antica, and P. conspersa). The P. lepida group (P. lepida, P. indiana, P. subfasciata, and P. virginica) is also revised with all species remaining recognized; however, P. virginica is removed from the complex. Two new species are described for the genus but will be named in a separate publication (herein identified as P. sp. A and P. sp. B). Keys are provided for all adults of both sexes. The larvae of sixteen species are described and/or discussed. A number of these were reared for the first time. Because of the conservativeness of larval morphology as a whole, many of the larvae can not be successfully identified below the level of groups of species. Keys to larvae are not included because of this difficulty. Known distributions of the species in the genus are updated utilizing information from published and unpublished sources. Maps plotted by county (U.S. records) or site (Canada records) are included. Finally, a preliminary discussion of phylogenetic relationships in the genus is provided. Based on this discussion the genus is modified from the five species groups of Schmid (1955) to a total of eight groups.

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CHAPTER I

INTRODUCTION

Literature Review

The genus Pycnopsyche with 19 presently recognized species (Table 1) is, next to Limnephilus (95 spp.), the most diverse of the 52 genera of Nearctic Limnephilidae. Members of this genus occur as far west as Alberta, Canada and Texas, as far north as the southern Provinces of Canada and as far south as Florida, with the major concentration of species being in eastern North America. Although basically a "cool lotic" genus, various species inhabit situations as diverse as cool northern lakes, mountain seeps, or even warmer, lower elevation streams and small rivers, and black-water streams of the Coastal Plain. For the most part this range of habitats is restricted to the eastern deciduous forest biome (Ross, 1963; Wiggins, 1977). Certain species are very habitat specific, e.g., P. rossi and P. flavata, while others, e.g., P. guttifer and P. antica, show a great deal more flexibility. Interestingly for a limnephilid genus, Pycnopsyche shows a high diversity of species at both its northern and southern limits, with 11 species known from Tennessee (Etnier & Schuster, 1979; Wojtowicz, unpub. data), 9 reported from South Carolina (Morse et al., 1980; J.C. Morse, pers comm.), 9 from West Virginia (Hill & Tarter, 1978; Tarter & Hill, 1980), 10 from Virginia (Parker & Voshell, 1981; Wojtowicz, unpub. data), 9 from New Hampshire (Morse & Blickle, 1953), 8 from Maine (Blickle & Morse,

TABLE 1

Presently Recognized Species of *Pycnopsyche*

1.	*P. antica* (Walker)
2.	*P. aglona* Ross
3.	*P. circularis* (Provancher)
4.	*P. conspersa* Banks
5.	*P. divergens* (Walker)
6.	*P. flavata* (Banks)
7.	*P. gentilis* (McLachlan)
8.	*P. guttifer* (Walker)
9.	*P. indiana* (Ross)
10.	*P. lepida* (Hagen)
11.	*P. limbata* (McLachlan)
12.	*P. luculenta* (Betten)
13.	*P. rossi* (Betten)
14.	*P. scabripennis* (Rambur)
15.	*P. sonso* (Milne)
16.	*P. subfasciata* (Say)
17.	*P. virginica* (Banks)
18.	*P.* sp. A
19.	*P.* sp. B

1966), 8 from Ontario, Canada (Betten, 1950; Nimmo, 1971; G.B. Wiggins, pers. comm.; Wojtowicz, unpub. data), and 8 from Quebec, Canada (Nimmo, 1966; Mackay, 1972; Roy & Harper, 1975; G.B. Wiggins, pers. comm.). Adult flight periods occur from May thorugh November dependent on latitude, elevation, and species. In general, the flight period of any particular species may span a period of at least one to two months at any given locale.

The genus name for Pycnopsyche origninated with Banks (1905) based on Limnephilus scabripennis Rambur. Betten and Mosely (1940) suggested that certain of the North American species assigned to Stenophylax and Halesus did not fit well into the conception of those European genera and placed Stenophylax divergens and Halesus guttifer into Pycnopsyche. Ross (1944) placed Stenophylax subfasciatus, S. lepidus, S. indiana, S. luculentus, S. circularis, S. flavata, S. gentilis, S. sonso, S. conspersa, and Eustenace limbatus into the genus along with Pycnopsyche aglonus which was originally described in the genus (Ross, 1941). A much needed revision of the genus by Betten (1950) listed 14 species (Table 2) and should be consulted for details of synonymies and reelevations to 1950. Since 1950 little has been done with the systematics of Pycnopsyche except for the addition of P. virginica, formerly Potamorites virginicus, into the genus (Flint, 1966), and the reelevation of P. conspersa from synonymy with P. scabripennis based on differences of peak flight periods between the two species at a locality in SW Pennsylvania (Sykora et al., 1976).

The elucidation of larval systematics in the genus has not kept

TABLE 2

Pycnopsyche Species of Betten (1950)

1.	*P. aglona* Ross
2.	*P. circularis* (Provancher)
3.	*P. divergens* (Walker)
4.	*P. flavata* (Banks)
5.	*P. gentilis* (McLachlan)
6.	*P. guttifer* (Walker)
7.	*P. indiana* (Ross)
8.	*P. lepida* (Hagen)
9.	*P. limbata* (McLachlan)
10.	*P. luculenta* (Betten)
11.	*P. rossi* Betten
12.	*P. scabripennis* (Rambur)
13.	*P. sonso* (Milne)
14.	*P. subfasciata* (Say)

pace with that of the adults. As late as 1960 (Flint, 1960) only eight of the then recognized 14 species had even been reared. Vorhies (1909) provided the first larval description for the genus, describing P. subfasciata. Lloyd (1921) first described the larva of P. gentilis under the name Arctoecia consocia, and, in addition, reared the larvae of P. guttifer and P. scabripennis, but was unable to clearly separate them. Lloyd (1921) also unknowingly figured the case of P. luculenta as a stage in the evolution of case structure in different instars of P. scabripennis. Sibley (1926) provided a description of P. gentilis and, in addition, the first available description for P. lepida. Certain features of the larva of P. luculenta were provided by Betten (1934); however, no description was included. The larva of P. subfasciata was again, in part, described by Elkins (1936). Denning (1937) made available for the first time a list of the then associated larval Trichoptera. The most definitive coverage of the larvae to date was provided by Flint (1960), who described the larva of P. divergens for the first time, made available the first key to larval Pycnopsyche (seven species), and included descriptions and notes on ecology for six of those species.

Further systematic information on certain species has been provided by other workers since Flint (1960), but the larva of only one additional species, P. flavata (Wojtowicz, 1982), has since been described. Cummins (1964) provided additional information on the case structure, systematics, and ecology of various larval instars of P. lepida and P. guttifer. Mackay (1972) produced further information on case structure and ecology of various instars of P. gentilis,

P. luculenta, and P. scabripennis. Additional systematic and ecological information for the larval instars of P. lepida, P. guttifer, and P. scabripennis was made available in Howard (1976). Information of a strictly ecological nature is available for P. guttifer (Neves, 1979) and P. luculenta (Weaver, in press).

Studies of a non-systematic nature on members of the genus Pycnopsyche were provided by Engster (1976 a, b) on the histology, histochemistry, and ultrastructure of the silk glands, and on the structure and amino acid composition of the silk of P. guttifer, and by Duffield et al. (1977) on the chemistry of the defensive secretion of P. scabripennis.

Generalized Description of Pycnopsyche Adults

Betten (1950), Schmid (1955), and Nimmo (1971) all provided generalized descriptions of adults of the genus Pycnopsyche. Much of what is presented here is derived from these sources with many of my own modifications.

Antennae stout and about as long as forewings. Dorsum of head with numerous hairs. Maxillary palps three segmented in male and five segmented in female. Color pale orange to tan. Wings variable in shape, pale orange to tan. Forewing with dark patterns which are often of value in specific identifications, and with corneous spots in the thyridial cell and in the base of cell R4. M-vein on forewing with a bulla just proximal to cord. Hindwings hyaline and with corneous spots in cell R4. Legs with a black spot on the trochanter, a few black spines on the distal end of the femora, and a number of

black spines on the tibia and tarsi. Tibial spurs 1-2-2, 1-3-3, or 1-3-4, and occasionally 1-2-4. Abdomen with scent gland opening on anterolateral portion of the fifth sternite. Genitalia, male: Tergite VIII set with small, dark spines or spinules dorsally, or not so. Tergite VIII often with dorsal, lateral, or ventral, posterior projections, the state of which (rounded, rectangular, sharp) are often of specific value. Segment IX tall and narrow, elliptical or spiniform (narrowed dorsally and ventrally). Segment X consisting of lateral cercal lobes which are rounded, rectangular, tapered posteriorly, or reduced to a triangular patch of setae. Medial projections, massive or not, variously modified, rounded or pointed posteriorly, occasionally reduced to a rectangular patch of setae. Claspers broadly fused to IX with only apices free. Apices of claspers variously shaped, their shape being of taxonomic significance. Aedeagus simple and membranous with ductus deferens opening near apex. Parameres (titillators) of aedeagus with bulbous or cylindrical bases and with variously modified stylets being either simple and elongate, multiple and elongate, short and spinous, or broadly bladelike. Genitalia, female: Posterior border of sternite VII raised and heavily set with setae (a broad v-shaped band in ventral view). Patches of setae present lateral to vulvar scale on venter VIII. Vulvar scale roughly semicircular with posterior border variously lobed or not. A membranous, roughly pentagonal (in ventral view) supragenital area posterior and dorsal to vulvar scale. Genital opening encompassed by vulvar scale ventrally and supragenital area dorsally. Segments IX and X usually fused and tubular, often demarcated to a variable extent by a faint suture line.

Segment IX often with ventral, setose lobes projecting posteriorly beneath X. Segment X variously modified dorsally, and ventrally reduced to an internal sclerite or developed into a scooplike process of variable length. Anal opening of X variously modified and often of specific significance.

Generalized Description of *Pycnopsyche* Larvae

Flint (1960) and Wiggins (1977) provided generalized descriptions of larvae of *Pycnopsyche* from which much of the following has been adapted.

Base color of head yellowish brown with darker, discrete spots and splotches. All 18 major head setae present. Setae 13 and 16 hairlike or modified as broad blades. Prosternal horn present. Pro- and mesonotum covered by paired sclerotized plates with hairlike setae, spinelike setae, or both, and occasionally with bladelike setae. Coloration as on head. Metanotum consisting of Sa1, Sa2 and Sa3 sclerites. Sa1 sclerites unfused though often closely opposed. Basal setae of tarsal claws extending far short of claws. Major setae on ventral femora of hind legs two or more. First abdominal segment with lateral and dorsal spacing humps (except in *P. gentilis* where dorsal hump is absent). Lateral humps with single, long, thin sclerite posteriorly. Dorsum of first abdominal segment without sclerites. Venter of first abdominal segment with Sa2 lightly sclerotized and one or more sclerites in Sa3 area. Abdominal segment II sternite lacking chloride epithelium. Abdominal gills single. Segment IX usually with a single seta laterad of dorsal sclerite

(Wiggins, 1977). Cases variable, of stone, sand, bark and plant pieces, leaves, twigs or a combination thereof. Case shapes, cylindrical or dorsoventrally flattened.

Diagnosis of Adults

The genus Pycnopsyche is a member of the tribe Stenophylacini. Within this tribe the closest relative is Hydatophylax. Betten (1950) and Schmid (1955) provide a brief diagnosis for the genus including the following.

Pycnopsyche differs from Hydatophylax mainly in that Hydatophylax has the line of fusion of the clasper less well marked, the clasper less flatly joined to segment IX and the base of the claspers without a conspicuous covering of setae. Other differences include the area of setae on the posterior border of the head being more slender in Hydatophylax (at least in H. argus), and a difference in the division of M in the forewing into M1+2 and M3. In Pycnopsyche M divides at the level of the middle of the discal cell, in Hydatophylax the division is near the distal end of that cell. The species of Hydatophylax often possess a sc-r crossvein which is lacking in Pycnopsyche. In the females of Hydatophylax the anal tube is more strongly developed than in Pycnopsyche.

Diagnosis of Larvae

Wiggins (1977) provided the most recent and inclusive diagnosis for the genus including the following.

As in the adults, Hydatophylax is the most similar genus. The

major differences are that Hydatophylax possesses fused Sa1 sclerites whereas in Pycnopsyche these may be close but are not fused. Pycnopsyche lacks chloride epithelium on venter II and possesses usually only one seta lateral to the dorsal sclerite on abdominal segment IX. Hydatophylax argus larvae possess chloride epithelium on venter II and have only one seta laterad to dorsal sclerite IX. The other known larva of Hydatophylax lacks chloride epithelium on venter II, but has 3-6 setae laterad to dorsal sclerite IX.

Purpose and Scope of Project

Even with the availability of a revision by Betten (1950) and additional papers (Flint, 1966; Sykora et al., 1976) the systematics of the adults of Pycnopsyche still presents some difficult problems. Few studies have noted expected or extant variability either within or among localities of particular species. In spite of the reelevation of P. conspersa to specific status by Sykora et al. (1976), there is still a great void concerning the true composition of the P. scabripennis complex. Another complex in need of consideration is that of P. lepida (including P. lepida, P. indiana, P. subfasciata, and P. virginica). A number of recognized species in the genus (males and especially females) have been poorly described and/or figured. In addition, several of the females in the genus have either not been described or have only been tentatively described. Two new species have been discovered and are in need of description. At present there are no all inclusive keys to either males or females of the genus. Since Betten (1950) no definitive work has dealt with the

known distribution of the species of Pycnopsyche. Finally, concerning the adults, since Schmid (1955) no serious effort has been made to address the issue of phylogenetic relationships in the genus.

As mentioned previously, larval work in the genus has lagged far behind work on the adults. Since work by Flint (1960) only one additional species has been reared and described (Wojtowicz, in press). Much additional work on the larvae will be necessary to aid in a more complete understanding of the systematics and evolution in the genus.

In this paper an attempt has been made to seriously address all of the aforementioned difficulties.

CHAPTER II

MATERIALS AND METHODS

General

Adults utilized in this study were either collected in light traps and preserved in 80% ethyl alcohol, or were borrowed from museums and personal collections. All species in the genus were studied, with emphasis placed on the P. scabripennis and P. lepida complexes. The characters emphasized in this study included total length, length of forewing, wing coloration pattern, tibial spur formula, and the structure of abdominal segments VIII, IX, and X of both males and females. Characteristics of diagnostic value varied from species to species. Most significant in females proved to be wing coloration pattern, tibial spur formula, shape of the posterior border of the vulvar scale, shape as well as degree of sclerotization and ornamentation of the usually fused segments IX and X, and to some extent the shape and degree of sclerotization of the anal opening. In males the most useful diagnostic characters were wing coloration pattern, tibial spur formula, the shape and ornamentation of tergite VIII, the shape and orientation of the lateral and mesal processes of X, the shape and modification of especially the tips of the claspers (in both lateral and posterior view), the shape and especially the morphology of the parameres of the aedeagus, and occasionally the shape of the structure containing the scent gland opening on the anterolateral portion of sternite V.

Each species account contains separate description sections for the male and female, separate diagnoses for each sex, a statement of type locality, distribution, separate variation and notes sections for each sex, and a materials examined section. In the notes section where reference is made to the northern and southern parts of a species range the south is considered to include the States of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, West Virginia, and the District of Columbia. Each material examined section is organized with States alphabetically arranged. Canadian localities are listed alphabetically by Province following United States citations. Following State or Province the county (if known), specific locality, date of collection, collector, and number and sex of specimens are listed. Collections from the same county follow each other separated by a semicolon. In instances where only a date and number and sex of specimens (occasionally also collector) follows a semicolon, it is understood that the record is from the immediately preceding locale.

The majority of the specimens in this study were preserved in alcohol and studied without clearing. In addition, a number of pinned and alcohol specimens with the genitalia cleared were examined. Total and forewing length measurements were made at 9X with the aid of a 15 cm. rule marked with mm. graduations. Measurements were made to the nearest .5 mm. Specimens used for illustrations had the abdomen removed at the fourth segment and were cleared in an approximately 10% KOH solution as described by Ross (1944), Nimmo (1971) and

others. Cleared genitalia were held in position in a watchglass of ethyl alcohol by insect pins placed in the anterior opening of the abdomen and were drawn with the aid of a camera lucida mounted on a Wild model #M-5 stereomicroscope. Drawings of a particular structure were made at the same magnification for all species. All measurements of genitalic structures were made using a calibrated ocular micrometer and are recorded in mm. units. Wings were wet mounted between two microscope slides and drawn with the aid of a camera lucida.

For the larval portion of this study specimens were usually collected as late fifth instar diapausing larvae or pupae, and transported in plastic Ziploc® bags placed in an ice chest. Whenever possible, other specimens were collected concurrently and immediately preserved in a solution of 80% ethyl alcohol for later study. On occasions when the live specimens could not be returned and processed the same day, it was necessary to aerate each of the bags at least once a day to insure the viability of the specimens. Once returned the specimens were usually placed in individual, wire, window-screen envelopes and partially submerged in a spring seep at the University of Tennessee woodlot in south Knox county. When available, incubators set at 15°C were used for the rearing of some specimens. Cages were checked at intervals of two to three days and specimens which had emerged were placed in individual two-dram homeopathic vials along with their cases, sclerites, and pupal exuviae, and preserved in 80% ethyl alcohol. In addition to the reared specimens, metamorphotype (MMT) pupae preserved at the time of collection were also utilized. Larvae were associated with the adults by comparison of the larval

sclerites with those of the concurrently collected and preserved larvae from the site of collection. This was not always an easy task. Larvae were described using the format of Flint (1960). Larval drawings were done using the same technique as for the adults.

Larval collections for study and rearing were made in Tennessee and adjacent North Carolina throughout late 1977, 1978, 1979, and early 1980. In addition, two extensive collecting trips were made during the summers of 1978 and 1979. The 1978 trip included much of the eastern United States as far north as New York State. The 1979 trip included the same and also a part of Vermont and a portion of southern Ontario, Canada. Additional larvae were collected on trips to Arkansas, Oklahoma, and Missouri as part of the University of Tennessee Regional Faunas Class during 1979. Collecting trips were also made to South Carolina and Georgia during the term of this study.

Characters used in the identification and separation of larval Pycnopsyche included the morphology and position of major head setae, the presence or absence of a dorsal spacing hump on the first abdominal segment, the number of setae on the ventral surface of the metafemora (two or more than two), the morphology and composition of the larval case, and to some extent the number of setae on the venter and dorsum of the first abdominal segment. Parameters such as stream size and species range were also utilized in differentiating certain problem specimens.

The distributions of Pycnopsyche species were determined by utilizing both published and unpublished sources. Only adult records were used except where larval identifications were considered reliable.

Distribution maps were plotted using county localities for United States records, placing a solid circle in the approximate center of each county where the collection of a particular species had been recorded. In cases where the county of a particular collection site could not be ascertained an asterisk has been used to indicate the presence of unplotted records in the text. A solid square indicates a record given as an area of a State. A solid triangle has been used where no specific locales or sites have been cited, although the species in question has been reported from that State. Canadian localities have been plotted by site (unlocatable sites are treated as per problem U.S. locales). Counties or sites from which I have seen specimens are enclosed in brackets in the text. A list of published and unpublished sources examined in this study is included in the appendix (Appendix A).

Ideally, phylogenetic relationships in a taxa should be elucidated using all life stages, as well as the ecology of the involved organisms. In this paper, proposed phylogenetic relationships have been based heavily on the genitalic characters of the adults, with larval characters and ecological data being utilized where available. Unfortunately, because of the lack of knowledge of certain life stages of some of the species and the extreme conservativeness of the larvae and pupae in this genus the ideal is unobtainable.

Terminology

Wings: (Fig. 1, Appendix B). The terminology used in this paper is a blend of the Comstock system, that used by Ross (1944), and that used by Nimmo (1971). Longitudinal veins are named according to

the Comstock system except for the cubital veins which are named following Ross (1944). According to Comstock, the cubital vein is two branched (Cu1 and Cu2), the remainder of the veins being anal veins. Ross (1944) and others consider the first two branches of Cu as Cu1a and Cu1b with the next longitudinal vein being Cu2. This change in terminology for the cubitus also affects the identity of the subsequent anal veins. Apical cells of the wing are named after the vein forming the anterior margin of that cell. In cases where the anterior margin of the cell is formed by a fused wing vein (e.g. M3+4), the cell is named after the posterior component of that vein (i.e. M4). The more basal cells of the wing have been named according to the system in Nimmo (1971) (discoidal = 1st R3; subradial = R; thyridial = M) to avoid confusion with the apical wing cells. The cord is that series of cross-veins forming the distal border of the discoidal, subradial, and thyridial cells.

Genitalia, male: (Fig. 8, Appendix B). The terminology used here is that of Ross (1944), Wiggins (1973), and Schmid (1980). The genital segments of the male consist of abdominal segments VIII to X. Segment VIII consists of a distinct tergite and sternite, the tergite often displaying various modifications of taxonomic significance. Segment IX consists of a tall, narrow, elliptical or spindle shaped, sclerotized structure with no distinct tergum or sternum. To the posterior border of IX are fused the claspers with the apical portions free and the bases delimited from IX by a distinct suture line. Segment IX consists of lateral cercal lobes and medial sclerotized projections perched as a horizontal platform on the posterodorsal

surface of IX. X also encloses the anal opening. The retractile aedeagus is simple and membranous with the ductus deferens ending apically and with the parameres (titillators) possessing membranous, tubular or bulbous bases and variously modified stylets.

Genitalia, female: (Fig. 15, Appendix B). The terminology used here is that used by Wiggins (1973), Nielsen (1977), and Schmid (1980). The genital segments are here defined as segments VIII to X. The posterior border of VIII bears the vulvar scale (partly VIII and partly IX?). Immediately posterior and dorsal to the vulvar scale is a membranous area referred to as the supragenital area. The genital opening is enclosed by the vulvar scale ventrally and the supragenital area dorsally. The remaining two segments, IX and X, are often fused and form a blunt posterior, tubular structure. Segment IX is defined as that area immediately posterior to VIII and dorsal to the supragenital area. The posterior border of IX is often defined, at least in part, by a faint suture line. Segment X is defined, at the least, as that area surrounding the anal opening.

Larva: Wiggins (1977) and Flint (1960) both described the generalized external morphology of trichopterous larvae. Their works should be consulted for greater detail. Characters used in this work include morphology and relative position of the head setae, number of major ventral femoral setae on the hind femora, setal counts on the venter and dorsum of the 1st abdominal segment, presence or absence of a dorsal spacing hump, and case morphology and components. Head setae: (Fig. 2, Appendix B). There are generally considered to be 18 major head setae. All are paired, with one of each present on each half of

the head. All setae except 8 and 18 are either dorsally or laterally positioned. Setae 1 to 3 are located on the anterior portion of the frons and are numbered from lateral to medial. Seta 4 is on the frons just posterior to the first three setae. Seta 5 is on the frons near its constriction. Seta 6 is posterior to 5 on the frons. Seta 7 lies lateral to the frons and just anterior of the antenna. Seta 8 is ventral and lies near the anterolateral edge of the gena. Nine is dorsal to and near the anterior limit of the eye. Ten is at the anterior border of the eye, is short, and often seems to arise from the eye. Eleven is short, dorsal to, and near the posterior limit of the eye. Twelve is lateral on the head and placed slightly posterior to the eye. Thirteen and 14 are posterior and dorsal to 12, 13 being shorter, slightly ventral, and lateral to 14. Fifteen and 16 are slightly posterior to 13 and 14, with 15 being slightly lateral and ventral to 16, a generally short and pale seta. Seventeen is on the posterior margin of the gena near the median ecdysial line. Eighteen is ventral on the gena near the anteriormost edge of the occipital foramen. Setae 1 and 4 are pale and appressed. Seta 6 is often short or absent. Setae 13 and 16 may be modified into bladelike structures in certain species. Femoral setae: (Fig. 3, Appendix B). The major ventral femoral setae are those setae on or close to the ventral ridge of the femora. First abdominal segment: (Fig. 5, Appendix B). Three setal areas are generally recognized. The Sa1 area is that area of setae near the anterior border and midline of the segment, both dorsally and ventrally. The dorsal Sa2 area is that setal area on the posterior portion of the segment near the

midline. Ventrally, the Sa2 area consists of a sclerite on either side of the midline. The Sa3 area is on the dorsal portion of the lateral spacing humps dorsally, and slightly ventral and medial to the lateral spacing humps ventrally. Dorsal Sa1 and Sa2 counts have been combined because of inherent difficulties in distinguishing between the two areas in most specimens. In counting setae all visible setae are enumerated for each area. Dorsal spacing hump: The dorsal spacing hump may be present (Fig. 5D, Appendix B) or absent (Fig. 5E, Appendix B). Gills: Single filament gills are present on a number of abdominal segments in dorsal, dorsolateral, ventrolateral, and ventral positions. Case morphology: Final instar cases may be constructed primarily of stone, plant fragments, sand, or sticks, and may be cylindrical or dorsoventrally flattened.

CHAPTER III

REDESCRIPTIONS AND REILLUSTRATIONS

The following are descriptions of species in the genus Pycnopsyche whose identities have for the most part been little in contention. Two minor exceptions are the females of P. aglona and P. divergens. The female of P. aglona as described by Betten (1950) is essentially identical to the female of P. sonso. The females I have studied which had been associated with P. aglona males differ considerably from the specimen of Betten (1950) (which I have also seen). For further discussion kindly consult the text. The female of P. divergens described by Betten (1950) with some question as to its correctness has, indeed, proved to be the correct female.

Pycnopsyche aglona Ross. (Pycnopsyche aglonus Ross, 1941. Canad. Ent. 73: 18, Fig. 6)

Description. Male--Total length 14-15.5 mm. Length of forewing 12-14 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 8A, Appendix B) with darkening in discoidal, subradial, and thyridial cells, extending basally along M vein. Pattern on cord from cell R3 to cell M2 on both sides, and also extending basally along veins R4+5 and M1+2. Pattern along wing apex from cell R3 to anal margin. Tibial spurs 1-3-4. Genitalia: Lateral-(Fig. 8B, Appendix B). VIII with rounded posterolateral projections medially on tergite. Posterior VIII lightly set with

fine spicules. IX tall and roughly elliptical. X with cercal lobes large, setose, and with posterior borders rounded, oriented somewhat obliquely upward. Central processes of X massive and bladelike, extended far posteriorly, tapered suddenly distally to a sharp, slightly downcurved apex. Claspers moderately wide at base, tapering to bulbous tip, with bases setose. Tips of claspers with a medially projecting conical point occasionally partly visible in lateral view. Dorsal-(Fig. 8C, Appendix B). VIII with posterolateral projections. Posterior borders of VIII lightly set with short spicules. Membranous area present between posterior VIII and dorsal arch of IX. Lateral cercal lobes of X setose, narrow, vertical, and set at a slightly oblique angle to the longitudinal axis of the body. Central processes of X massive, slightly raised, each bladelike and broadly rounded posteriorly. Clasper with only apices visible. Apices nearly circular, set with setae and with a conical projection arising centrally with its apex directed medially. Dorsal X continuous with subanal sclerite. Posterior-(Fig. 8D, Appendix B). Clasper bases moderately wide and set with setae, tapering ventrally. Tips sclerotized with oblique apices, with centrally arising conical points directed medially. Distinctly sclerotized band visible below anus. Anus apparently obliquely oriented. Aedeagus-(Fig. 8E, F, Appendix B). In lateral view constricted prior to base of parameres, deepened distal to end of paramere bases, then tapering to a slightly upturned tip. Paramere bases nearly spherical. Blades multiple, extending distally short of aedeagal tip. In dorsal view widest at base, tapering gradually to tip with lateral borders somewhat sinuate. Distal portion of aedeagus with medial portion slightly raised and lateral borders distinctly

raised with concavities between. Paramere bases short and tubular, blades multiple.

Female--Total length 15.5-16 mm. Length of forewing 14-15 mm. Wing and body color pale orange to tan. Wing coloration pattern and tibial spur formula as in male. Genitalia: Lateral-(Fig. 9A, Appendix B). IX and X fused, separation barely indicated by a suture line. IX roughly rectangular, ventrally abutting supragenital plate. X roughly triangular produced posteriorly to blunt apex. Lateral membranous wall of X partly visible. Supragenital plate membranous and triangular with apex posterior. Vulvar scale roughly triangular with posterior border broadly rounded. Ventral-(Fig. 9B, Appendix B). Vulvar scale semicircular with broad, v-shaped indentation in posterior border. Supragenital plate membranous, roughly pentagonal. Ventral IX continuous beneath. Ventral X surrounding anus ventrally and laterally, with roughly v-shaped anal notch. Dorsal X lateral and posterior to ventral X. Posterior X produced into two broadly rounded points laterally, with a broad u-shaped notch between. Ventral and dorsal X with setae. Dorsal-(Fig. 9C, Appendix B). IX roughly trapezoidal and with a few setae. X demarcated by a suture line, produced into two broadly rounded lateral lobes, with broad u-shaped notch between.

Diagnosis. Male--This species shows distinct affinities with P. limbata from which it may be differentiated by the more massive medial processes of X, clasper apices with medial conical projections, and aedeagal parameres with multiple stylets.

Female--This species bears greatest resemblance to P. limbata. It differs in that the posterior projection of X (lateral view) is rounded and not pointed, ventral IX is less distinctly developed, the posterior lobes of X (ventral and dorsal view) are more rounded and less distinctly pointed, and the posterior border of the vulvar scale has a distinctly rounded emargination medially.

Type locality. Costello Lake, Algonquin Park, Ontario, Canada.

Distribution. See chapter IX and Fig. 47 (Appendix B).

Variation. Male--I have noted no great amount of variation in any of the described characters. Study of a more extensive series would undoubtedly uncover slight variations in wing coloration pattern and genital characters.

Female--See notes below.

Notes. Male--I have seen relatively few specimens (including a paratype) of this species and have not reared its larva though others have (M. Rief, pers. comm.). I suspect that its habitat requirements are similar to those of P. limbata. Records indicate it to be a strictly northern species whose distribution closely resembles that of P. limbata. There are relatively few specimens in any collections. According to available records, the flight period of this species appears to extend from early August to late September.

Female--I have seen very few specimens assumed to be of this species. I have also seen the specimen which Betten (1950) described

as a likely P. aglona female. The specimen which Betten (1950) examined and discussed was pinned and the abdomen was cleared and placed in a microvial attached to the pin. The genitalia were identical to those of the female of P. sonso. Examination of the cleared abdomen showed it consisted of segments VI to X. The pinned female agrees with P. aglona in size and color; however, the abdomen appears to have been removed past segment III (segments IV and V are not accounted for). A male specimen in the same series shows perfect agreement of segments between pinned specimen and cleared abdomen. The absence of two abdominal segments along with the fact that the males of P. aglona and P. sonso do not appear to be closely related leads me to suspect that the abdomen was placed in error with the female of P. aglona. I believe the specimen I have described here to be the true female of P. aglona. However, some doubt remains in my mind as to its correct association. Examination of more specimens and rearing of several males and females will be necessary to clarify this situation.

Material examined. Maine-Oxford Co., Norway, date?, S.J. Smith, 4 males, 1 female? New Hampshire-Strafford Co., Barrington, B.L.T., 23 Sept. 1966, Morse & Blickle, 2 males, 2 females. Wisconsin-Forest Co., Pine R., 13 Sept. 1968, J. Longridge, 2 males, 1 female. CANADA: Ontario-Costello Lake, Algonquin Pk., Ont. Fish. Res. Lab., Cage no. 5, 20 Aug. 1939, W.M. Sprules, 1 male (PARATYPE, INHS).

Pycnopsyche circularis (Provancher). (Platyphylax circularis Provancher, 1877. Nat. Canad. 9: 260)

Description. Male--Total length 15.5-20 mm. Length of forewing 14-18 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 10A, Appendix B) with darkening in discoidal, subradial, thyridial, and Cu1 cells, and continuing to hind margin of wing, also extending basally along Cu1. Darkening on cord from cells R3 to M1, often on both sides. Apical cells from R3 to hind wing margin darkened. Entirety of wing surface speckled with even sized brown spots. Tibial spur formula 1-3-3. Genitalia: Lateral-(Fig. 10B, Appendix B). VIII with dorsal portion produced to a blunt point posteriorly. Medial portion of posterior VIII slightly elevated. Posterior border of VIII set with black spines dorsally. IX tall and broadly elliptical. X with central sclerotized portion massive and curved to a ventral point. Lateral cercal lobes rectangular with obliquely cut posterior borders. Claspers narrow and set with a number of setae. Tips of claspers with posterior border notched and anterior border pointed and extending upward beyond posterior border. Dorsal-(Fig. 10C, Appendix B). Posterior border of VIII with three distinct lobes set with black setae. Lateral lobes extending considerably caudad of medial. Lateral borders of medial lobe slightly depressed giving medial lobe a raised appearance. Cercal lobes of X set at slight oblique angle to longitudinal axis of body. Medial X raised, each half triangular with posterior border truncate. Medial X with setae. Cercal lobes of X with setae. Claspers easily visible with lateral tips produced upward. Subanal sclerite visible. Posterior-

(Fig. 10D, Appendix B). Claspers relatively narrow, bases set with setae. Tips with medial borders raised slightly and blackened. Lateral tips produced upward. Subanal sclerite a broad, glabrous band. Aedeagus-(Fig. 10E, F, Appendix B). In lateral view base not stocky, tapering posteriorly with slight upcurve at apex. Base of parameres short with simple blades. Blades extending to tip of aedeagus and only gently upturned at tips. Shallow notch present at base of parameres. In dorsal view roughly parallel sided with slight tapering to tip. Slight narrowing at tip of paramere bases. Base of parameres short. Blades of parameres single, extending to aedeagal tip. Medial and lateral borders of apical half of aedeagus raised, creating a depression between.

Female--Total length 19.5-20.5 mm. Length of forewing 17.5-18.5 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-3. Genitalia: (Fig. 11A, Appendix B). IX rapidly declivitous to X. IX and X demarcated by vertical suture lines. IX very roughly rectangular. X dorsally (dorsal roof of anus) with setae, ventrally produced into a flat, sclerotized plate pointed posteriorly. Ventral IX and X with setae. Supragenital plate membranous, produced posteriorly to a bluntly rounded tip. Vulvar scale with central and lateral lobe visible. Central lobe a blunt ventral point produced farther caudad than lateral lobe. Ventral-(Fig. 11B, Appendix B). Posterior VII bordered by a broad v-notched band of setae. Vulvar scale with three posterior lobes. Central lobe bluntly rounded and raised from general plane of scale. Supragenital plate membranous, produced posteriorly

to a rounded point. Ventral IX with triangular setal patches laterally. Ventral X with setae laterally and medially and with posterior border produced into flat, sclerotized plate with two posterolateral lobes. Dorsal anal opening projecting to a finely bifid, sharp point. Dorsal X visible as two lateral lobes above dorsal anal point. Dorsal-(Fig. 11C, Appendix B). IX roughly rectangular, raised above X and without setae. X inferior to IX and roughly triangular. Dorsal X setose, posterior edge with two rounded shoulders and centrally with slightly bifid dorsum of anal tube. Lobes of ventral X plate visible inferiorly.

Diagnosis. Male--This species is most closely allied to P. divergens, P. flavata, and P. gentilis. It may be easily differentiated from P. gentilis and P. flavata by the simple stylets of the aedeagus, the three-lobed, emarginate posterior border of tergite VIII, the extensive wing coloration pattern, the reduced complexity of the apices of the claspers, and by the 1-3-3 tibial spur formula as opposed to 1-3-4. It may be differentiated from P. divergens by the three-lobed posterior border of tergite VIII (two-lobed in P. divergens) and by the claspers with a sharp lateral and blunter medial point (P. divergens claspers are simple and accuminate).

Female--This species may possibly be confused with P. luculenta, P. divergens, P. guttifer, P. sp. A, and P. rossi. It may be easily distinguished from P. luculenta and P. sp. A by its tibial spur formula (1-3-3 vs. 1-3-4) and by its more extensive wing coloration pattern. It can most easily be distinguished from the others by the development of ventral X into a distinctly flattened, heavily sclerotized plate.

Type locality. Quebec, Canada.

Distribution. See chapter IX Fig. 49 (Appendix B).

Variation. Male--The extent of the wing coloration pattern may vary somewhat. Basal cell coloration may extend slightly into cell R1. Cord coloration occasionally extends slightly into cells R2 and M2. On the apical wing edge an occasional specimen may show an extension of the coloration pattern slightly into cell R2. The genitalia of this species are relatively non-variable. There may, however, be some variation in the extent of development of the medial lobe on the posterior margin of tergite VIII viewed dorsally.

Female--See male account for wing coloration variation. I have seen little variation in the genitalia of this species.

Notes. Male--I have seen relatively few specimens of this species. From collection records it would seem that the species is widespread but localized and fairly broad in ecological tolerance. The flight period of this species in the northern portion of its range extends from late August to late October. In the southern portion of its range records indicate an early September to mid-October flight period.

Female--I have seen very few specimens of this species. Characters seem fairly stable in the specimens which I have studied. See also notes on male.

Material examined. New Hampshire-? Co., Dolly Copp Camp, White Mtns., 1400', 31 Aug. 1940, J. Hanson, 1 male (L.J. Milne Coll.);

1 Sept. 1940, 1 male (L.J. Milne Coll.). Pennsylvania-Erie Co., W. Springfield, 5 Sept. 1977, E.C. Masteller, 1 male. Forest Co., Pigeon Spr. Cr., Marienville Rod and Gun Club, 28-29 Aug. 1976, J.S. Weaver, III, 1 male. Westmoreland Co., Spruce Run, 25-26 Sept. 1976, J.S. Weaver, III, 2 males. Tennessee-Cumberland Co., Plateau Experiment Station, nr. Crossville, 21-30 Sept. 1972, W. VanLandingham, 6 males; 14 Oct. 1972, 1 male, 1 female. Madison Co., Univ. of Tenn, Dept. of Economic Entomol., light trap at Jackson, 3 Oct. 1966, Coll.?, 4 males, 3 females. Morgan Co., Trib. to Clear Cr., N of Catoosa, off Hwy. 62W, 30 Sept. 1978, A. Cady and M. Post, 1 male; Fall 1980, A. Cady, 1 male; Dry Branch, trib. to Emory R., off Rt. 62W, west of Wartburg, Fall 1980, J.A. Wojtowicz & E.B. Williams, 1 female. Virginia-Giles Co., light trap approx. 4 mi. NW Mtn. Lake Hotel, 2 Sept. 1973, B. Strickler, 1 male. West Virginia-Hardy Co., Lost R. St. Pk., 9-13 Oct. 1950, B.D. Burks, 1 male. United States: No data, 1 male (L.J. Milne Coll.). CANADA: Nova Scotia-Lunenburg Co., Petite R., New Cumberland Rd., 9 Sept. 1956, D.C. Ferguson, 6 males; Green Bay, 5 Sept. 1956, D.C. Ferguson, 16 males.

Pycnopsyche divergens (Walker). (Limnephilus divergens Walker, 1852. Cat. Neur. Brit. Mus.: 30)

Description. Male--Total length 16-20 mm. Length of forewing 14-18.5 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 12A, Appendix B) with darkening in discoidal, subradial, thyridial, and Cu1 cells, continuing to posterior wing edge. Darkening on cord from cell R3 to M2. Also darkening basally

along veins M and Cu proximal to cord. Apical cells R4 to posterior wing margin darkened. Wing lightly speckled throughout with even sized brown spots. Tibial spur formula 1-3-3, rarely 1-3-4 (?). Genitalia: Lateral-(Fig. 12B, Appendix B). Posterior border of VIII produced dorsally with a distinct lobe, heavily set with black spines. Medial portion of dorsal, posterior VIII raised. Lighter band anterior to posterior border of VIII. IX tall and narrowly elliptical. Cercal lobes of X setose and set perpendicular to the longitudinal axis of body, tips rounded and slightly curved posteriorly. Medial projections of X setose, short, deep and with posterior border rounded. Clasper bases moderately wide and setose. Tips dramatically reduced, sclerotized, tapered to a slightly caudad directed, blackened point, and with few setae. Dorsal-(Fig. 12C, Appendix B). Dorsum of posterior VIII projecting as two rounded, lateral lobes heavily set with black spines, enclosing a u-shaped indentation. A slightly raised area present between the two lobes. A distinct lighter area anterior to and continuous with raised area between the lobes. Cercal lobes of X setose, rounded distally, and set at an oblique angle to longitudinal axis of the body. Central processes of X massive and fused basally with distal tips distinct and somewhat truncate, set with setae. Clasper bases rounded posteriorly and setose. Tips not visible. Posterior-(Fig. 12D, Appendix B). Clasper bases widest dorsally, tapering ventrally and setose. Tips sclerotized, tapering to blackened dorsal point, with few setae. Sclerotized band present along ventral border of anus. Anus situated vertically. Aedeagus-(Fig. 12E, F, Appendix B). In lateral view

deepest basally, slightly indented past bases of parameres, slightly deepened and gradually tapered to an abruptly upturned tip. Parameres with bases long and thin, approximately one-third length. Blades simple, extending to near aedeagal tip, points sharp and abruptly upcurved. In dorsal view widest basally, very slightly constricted past base of parameres, slightly widened beyond, then tapered, parallel sided, and abruptly tapered to tip. Distal portion of aedeagus with medial and lateral edges raised, with concavities between. Paramere bases long, tubular, and thin. Blades simple, extending to near tip of aedeagus.

Female--Total length 17-19.5 mm. Length of forewing 15-17.5 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula typically 1-3-3, rarely 1-3-4. Genitalia: Lateral-(Fig. 13A, Appendix B). IX and X fused and tubular. IX narrow dorsally and somewhat broadened ventrally. Ventral IX produced posteriorly into bulbous, setose lobe. Dorsal X semicircular, set with setae dorsally, separated from IX by a faint suture line. Ventral X composed of a sclerite lining the ventral and lateral portions of the anal opening, visible interiorly. Supragenital plate membranous and triangular, its apex projecting posteriad. Vulvar scale triangular with apex posteriad, and with slight medial lobe detectable. Ventral-(Fig. 13B, Appendix B). Vulvar scale semicircular, posterior border with a small, rounded medial lobe. Supragenital plate membranous and pentagonal. Ventral IX forming a distinctly raised, setose bulbous area ventral to anal opening. Ventral X visible as an internal ventral plate with lateral, dorsally oriented

extension forming the ventral and lateral rims of the anal opening. Dorsal X consisting of two setose, rounded, posterior lobes forming a v-notch between them. Dorsal-(Fig. 13C, Appendix B). Fused segment IX and X distinctly narrower than VIII. IX roughly rectangular with a posteromedial triangular projection. X with two semicircular, setose lobes projecting posteriad and forming a v-notch between.

Diagnosis. Male--This species is most likely confused with P. gentilis, P. flavata, and P. circularis. It may be separated from P. gentilis and P. flavata by the more extensive wing coloration pattern, simpler clasper apices, emarginate posterior border of tergite VIII, simple paramere stylets, and by its 1-3-3 tibial spur formula (1-3-4 in the others). The presence of only two spinate lobes on posterior tergite VIII, and the simple, accuminate clasper apices will also differentiate it from P. circularis.

Female--This species is most likely to be confused with P. luculenta, P. circularis, P. rossi, P. sp. A, and P. guttifer. It may be distinguished from P. luculenta and P. sp. A by the much more extensive wing coloration pattern and by its 1-3-3 tibial spur formula. It can be distinguished from P. circularis by the lack of flattened, heavily sclerotized ventral X. It differs from P. guttifer in having a more bulbous and heavily setose ventral IX, by the shape of the dorsum of the anal opening which is less acute, and in the reduction of ventral X to a mostly internal, sclerotized area.

Type locality. North America.

Distribution. See chapter IX and Fig. 51 (Appendix B).

Variation. Male--As in other species in the genus, the wing coloration pattern may vary somewhat in extent. The pattern along the cord may be broader and more intense, occasionally on both sides. Occasional specimens may show a vague connection between the cord and wing edge in cell R4. Genitalic characters have not been noted to vary to any appreciable extent. Rare specimens with aberrant tibial spur formula 1-3-4 may be found.

Female--The wing coloration pattern and tibial spur formula variation is as described for males. I have noted little variation in the genitalia of this species.

Notes. Male--This species appears to be quite widespread but localized. It occurs in the mountains of the south, but occurs much more commonly further north. It may be abundant locally. All indications are that it is a resident of small, slow flowing, springfed waters. Flight periods in the northern portion of its range are reported for as early as May, but more typically from late July to late September or mid-October. In the southern portion of its range flight occurs from late July to late October.

Female--I have seen relatively few female specimens of this species. See also notes for male.

Material examined. Massachusetts-Franklin Co., from F.H., Sunderland, Fall 1954, O.S. Flint, Jr., 2 female MMT (reared); 27 Aug. 1954, 1 female MMT (reared). New Hampshire-? Co., Dolly Copp Camp, White Mtns., 1400', 1 Sept. 1940, J. Hanson, 1 male (L.J. Milne Coll.).

New York-Essex Co., light trap nr. John's Brook Lodge, on trail to Mt. Marcy from Keene Valley, 30 Aug. 1978, J.A. Wojtowicz, 5 males. North Carolina-? Co., Black Mtns., N.C. Exped., 1 Sept. 1911, Coll.?, 1 male (L.J. Milne Coll.). Pennsylvania-Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 Aug. 1976, J.S. Weaver, III, 11 males, 6 females; 28-29 July 1976, 27 males, 6 females. Somerset Co., Laurel Hill St. Pk., Jones Mill Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 1 male; Kooser St. Pk., Kooser Run, 25-26 Sept. 1976, J.L. Sykora & J.S. Weaver, III, 1 male. Washington Co., Amity, sm. spr. nr. Ten Mile Run, 2 Sept. 1976, B. Owens, 5 males. Westmoreland Co., Spruce Run, 25-26 Sept. 1976, J.S. Weaver, III, 1 male. Virginia-Carroll Co., New R. at Fries, low water bridge, 26 Aug. 1976, C.R. Parker, 1 male. Tazewell Co., sm. spr. base of Sta. Spr. Cr. at Moor Ranch, Burkes Garden, 1 Sept. 1979, B. Kondratieff, 1 female.

Pycnopsyche flavata (Banks). (Stenophylax flavata Banks, 1914. Can. Ent. 46: 154, pl. 10, figs. 32,33)

Description. Male--Total length 18-24 mm. Length of forewing 16-22 mm. Wing and body coloration pale orange to tan. Wing coloration pattern (Fig. 14A, Appendix B) with darkening on cord in cells R5 and M1, and often in cells M3 to posterior border of wing, usually slightly on both sides. Wing edge with slight darkening from cells R5 to M3 and around to posterior wing margin. Cu cell somewhat darkened basally (not illustrated). Genitalia: Lateral-(Fig. 14B, Appendix B). Segment VIII without posterolateral projections. IX

tall and narrowly elliptical. Cercal lobes of segment X narrowed proximally, broadened and truncate distally, and oriented obliquely upward. Central projections of X massive and bladelike, flexed slightly upward at base, and sloping gently downward to a broadly rounded distal tip. Claspers thick basally and set with setae. Tips massive, with three distinct points, two produced dorsally and one subapical and projecting obliquely backward. Distinct concavity visible laterally at base of clasper tip. Dorsal-(Fig. 14C, Appendix B). VIII with no lateral projections. X with setose cercal lobes oriented vertically and produced upward, nearly parallel to the longitudinal axis of the body. Central processes of X massive, parallel sided, elongate, setose processes with blackened tips, projecting beyond tip of cercal lobes. Anus nearly horizontally oriented with straplike sclerite below. Claspers massive, bases setose. Tips massive and blackened, with posterior directed points distinct. Posterior-(Fig. 14D, Appendix B). Claspers with bases wide, tapered ventrally, and set with setae. Tips blackened with usually three distinct lobes visible. The more cephalad lobe (sometimes not visible) appearing slightly medial to the slightly posteriad, broadest lobe. The caudad lobe more ventral and mesad of the previous lobes with the apex oriented medially. A large distinct concavity visible at the bases of the clasper tips. A straplike sclerite present below the anus. Aedeagus-(Fig. 14E, F, Appendix B). In lateral view deep at the base, tapering past the base of the parameres to a fine, sharply upcurved point. Parameres massive, bases long, tips heavily spinose. Tip of aedeagus beyond base of parameres only vaguely flaired. In dorsal view wide

basally, distinctly narrowed past the bases of the parameres and tapering to a distinct point. Parameres massive with tips heavily spinose.

Female--Total length 20.5-25 mm. Length of forewing 18.5-23 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 15A, Appendix B). IX and X separated by a faint suture line. IX narrow dorsally, and ventrally expanded into cercuslike lobes. Dorsal X with central concavity when viewed obliquely and produced to points distally. Ventral X produced posteriorly into long, sclerotized scoop. Supragenital plate somewhat triangular with a rounded apex posteriorly. Vulvar scale triangular with apex posterior and produced to a sharp point. Ventral-(Fig. 15B, Appendix B). Ventral IX produced into cercuslike lobes laterally. Ventral X produced posteriorly into long, sclerotized scoop, extending far posteriad of dorsal X. Supragenital plate roughly pentagonal, nearly truncate posteriorly. Vulvar scale roughly v-shaped with posterior border nearly truncate and with a distinct posteromedial projection. Dorsal-(Fig. 15C, Appendix B). Dorsal IX roughly trapezoidal. Dorsal X setose, separated from IX by only a faint suture line, and tapered posteriorly with medial notch distally. Ventral IX produced into two setose, rounded lateral lobes. Ventral X tubular and produced far distally of IX and dorsal X.

Diagnosis. Male--This species is most closely allied to P. gentilis. It differs in that it lacks a dense patch of spines on the posterior border of tergite VIII. The apices of the claspers of P. flavata are more complex and possess a larger lateral concavity

ventral to the apex. The cercal lobes of X of P. flavata differ from those of P. gentilis in extending nearly parallel to the longitudinal axis of the body (oblique to the long axis in P. gentilis). The medial processes of X are narrower and more extended in P. flavata (dorsal view).

Female--This species is not easily confused with any other member of the genus. Although its wing coloration pattern is virtually identical to that of P. gentilis, the peculiar form of ventral X and the fact that it extends well posterior of any other portion of the abdomen, separate it with ease.

Type locality. Pisgah Forest, North Carolina.

Distribution. See chapter IX and Fig. 52 (Appendix B).

Variation. Male--The wing coloration pattern may be extremely vague. Coloration on the cord may extend slightly above cell R5 and below M1. The darkening along the wing edge may be restricted to the apical portion of the veins. The shape and massiveness of the tip of the claspers may vary somewhat. The most anterior lobe may not be visible in posterior view, and the posteriormost lobe may be more or less well delineated than in the figure. The tip, as a whole, may be short and broad as pictured or may be more expanded in a vertical direction. Certain specimens may show a development of sparse spines on the posterior border of tergite VIII, but never does it approach a patch of spines as in P. gentilis.

Female--Variation in wing coloration pattern is as in males. I have noted only minor variations in the genitalia of this species.

Notes. Male--This species is restricted to high mountain seeps and headwater streams in a five state area of the southern Appalachians (Fig. 52, Appendix B). I have evidence that it occurs sympatrically with P. gentilis, P. luculenta, P. sonso, and possibly with P. sp. B. Pycnopsyche flavata may be locally common. The flight period of this species extends from as early as mid-May, but more typically from mid-June to late September or early October.

Female--This female has only recently been described (Wojtowicz, 1982), although it has been in collections since at least 1953. See notes for male.

Material examined. Georgia-? Co., Neel Gap, Wolf Cr., 3.6 mi. N, 20 Sept. 1945, P.W. Fattig, 1 male; Wolf Cr., 3.5 mi. N, 10 Sept. 1945, 1 male. North Carolina-Jackson Co., Whitewater Falls, 14 July 1979, J.C. Morse, 1 male. Macon Co., Coweeta Exper. For., sm. spr., 20 July 1953, L.B. Tebo, 1 female (reared). Yancey Co., Spivey Gap Rec. Area, just off St. Rt. 19W, ca. 1 mi. from N.C.-TN. border, 29 June 1978, N. Burkhead & J. Beets, 2 males (1 abd. missing); Black Mtns., Hemphill Spr., elev. 4760', 2-3 Sept. 1978, J.S. Weaver, III, 6 males; 1-2 July 1979, 32 males, 2 females. Tennessee-Monroe Co., headwaters of Mill Cr., Citico Cr. area, Cherokee Natl. Forest, 5 July 1978, J.A. Wojtowicz & R.C. Stone, Jr., 16 males, 2 females; Falls Branch Parking Area, Laurel Branch, along new Robinsville Hwy. above Tellico Plains, 22 Aug. 1979, J.A. Wojtowicz, 17 males, 1 female; Seep along F.S. rd. 217, 1.8 rd. mi. E of Sugar Cove Branch along Meadow Branch, ca. 3440' elev., 12 July 1979, R.L. Jones, 4 males, 1 female; Sugar Cove Branch seep, along F.S. rd. 217 above North R.

on the way to Stratton Meadow, 15 June 1980, E.B. Williams & J.A. Wojtowicz, 2 male, 1 female adults, 1 male, 1 female MMT. Sevier Co., Great Smoky Mtns. Natl. Pk., Walker Prong, West Prong Pigeon R., elev. 4500', nr. spr., 4 July 1979, J.S. Weaver, III, 1 male. Virginia-Grayson Co., lrg. spr. fed str. into Fox Cr., 13 Aug. 1979, B. Kondratieff, 1 male. Patrick Co., Mouth of Dan, 18 May 1963, F. Harris, 1 male. Smyth Co., spr. seeps nr. Grindstone Campground, 14 Aug. 1979, B. Kondratieff, 2 males; Grindstone Br. and spr. fed trib., Grindstone Campground, 19 Apr. 1981, B. Kondratieff, 3 male adults, 1 male MMT. Washington Co., Beartree Campground, trib. of Straight Br., 26 July 1979, J.R. Voshell, Jr., 4 males; 27 July 1979, 1 male; 28 July 1979, 5 males.

Pycnopsyche gentilis (McLachlan). (Stenophylax gentilis McLachlan, Linn. Soc. London 11: 108)

Description. Male--Total length 18-23 mm. Length of forewing 16-21 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 16A, Appendix B) with slight darkening on cord in cells R5 and M1, usually both sides. Tibial spur formula typically 1-3-4, occasionally 1-2-4. Genitalia: Lateral-(Fig. 16B, Appendix B). Dorsal portion of tergite VIII produced distinctly distal of remainder. Posterior tergite VIII heavily set with patch of black spines dorsally. IX tall and narrowly elliptical. Cercal lobes of X setose, slightly widened distally and truncate. Central projections of X sloping downward from base and with slightly upturned, broadly rounded apex. Claspers fairly massive with bases setose, with tips blackened, and with

three distinct points (variable). Distinct concavity visible slightly lateral and ventral of tip of clasper. Dorsal-(Fig. 16C, Appendix B). Posterior VIII with a distinct rectangular shaped border of black spines. Cercal lobes of X setose and set nearly perpendicular to the longitudinal axis of the body. Central processes of X short, stout and cylindrical with rounded, blackened tips. Tips of claspers triangular and blackened. Bases of claspers setose. Posterior-(Fig. 16D, Appendix B). Clasper bases broad dorsally, tapering sharply ventrally, and setose. Tips blackened and appearing bilobed, the second lobe directly caudad of the first (often difficult to see due to the darkening of the tips). Concavity evident in upper base lateral of tip. Subanal sclerite distinct, pushed outward like lower lip, making anus somewhat oblique. Aedeagus-(Fig. 16E, F, Appendix B). In lateral view broad at bases and gradually tapering past bases of parameres to a thin, slightly upslanted tip. Parameres massive with tips heavily spinose. In dorsal view broadest at base. Distal portion past base of parameres distinctly narrower, slightly flaired, and tapering to distinct point. Bases of parameres massive. Distal ends of parameres heavily spinose.

Female--Total length 19.5-26 mm. Length of forewing 17.5-22 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula typically 1-3-4, occasionally 1-2-4. Genitalia: Lateral-(Fig. 17A, Appendix B). Segments IX and X distinct, separated by a suture line. IX narrow dorsally and broadly expanded ventrally, projecting slightly below X, set with setae laterally and ventrally. X setose dorsally, ventral portion short

and scooplike, projecting no further than equal to dorsal X. Supragenital plate compressed anteroposteriorly. Vulvar scale triangular with long, distinct, rounded medial lobe projecting posteriad. Ventral-(Fig. 17B, Appendix B). Vulvar scale semicircular with distinctly extended, mucronate lobe medially. Supragenital plate vaguely pentagonal. Venter of IX distinctly rectangular and setose. Ventral X reduced to short, sclerotized scoop. Dorsal X semicircular with slightly rounded indentation posteriorly. Dorsal-(Fig. 17C, Appendix B). IX and X separated by a vague suture line. IX narrow and glabrous. X somewhat carbuncular, set with setae, with somewhat rounded indentation posteriorly. Ventral IX visible laterally. Ventral X slightly visible depending on angle (illustration not so, Fig. 17C, Appendix B).

Diagnosis. Male--This species is most easily confused with P. flavata from which it differs in the less complex apices of the claspers, the less pronounced concavity ventral to the apex of the clasper, the briefer and thicker (in dorsal view) medial processes of X, and the presence of a rectangular patch of spines along the posterior border of dorsal tergite VIII.

Female--This species is most closely allied to P. flavata. It is easily distinguished from P. flavata by the shortness of the ventral scoop of X, which extends posteriorly, short of or equal to the remainder of the caudal segments.

Type locality. White Mountains, New Hampshire.

Distribution. See chapter IX and Fig. 53 (Appendix B).

Variation. The cord coloration may extend into cell R4 and M2. This coloration may be vaguely continued from M2 to the posterior wing margin. The apical wing edge coloration which is often vague may extend from cell R5 to the posterior wing margin, or may be limited to the vicinity of the wing veins. Tibial spur formulas are usually 1-3-4, but may be notably variable. Cumberland Mountain populations in Tennessee and Kentucky have a 1-2-4 formula (rarely 1-3-4). Appalachian and Blue Ridge populations typically possess a 1-3-4, but occasionally a 1-2-4 pattern. Spur formulas in some individuals are mixed (1-3-4, 1-2-4). Claspers are quite variable. The tips often have a variable shape especially in lateral view. Clasper shoulders are occasionally sclerotized and somewhat modified from their typical rounded form. The medial processes of X are sometimes curved and produced to a ventral point in lateral view (instead of broad and bladelike) and the setal patch of VIII is nearly pentagonal (dorsal view) in a South Carolina and a Pennsylvania population (Fig. 18A, B, Appendix B). Aedeagal parameres may be modified (D.A. Etnier, pers. comm.), with one or two spines reaching near to the tip of the aedeagus, in all Cumberland Mountains specimens and occasionally in Appalachian and Blue Ridge specimens.

Female--The wing and tibial spur formula variation is as in the male. Genitalia are relatively non-variable except in certain populations (e.g., South Carolina) where segments IX and X are considerably dorsoventrally compressed and produced distad (Fig. 19A, Appendix B). In the South Carolina population studied there is also a difference in the shapes of IX and X in ventral view (Fig. 19B, Appendix B).

Notes. Male--This is one of the most variable species of Pycnopsyche and is also one of the most widespread in the east, occurring from Nova Scotia to northern South Carolina, Georgia, and Alabama. There may be some justification for separating certain populations (e.g., the South Carolina and Pennsylvania populations mentioned) as distinct species; however, variability within these populations leads me to believe that a conservative approach to this issue is warranted at least until such time as better evidence is available. Although typically a high elevation, cold water insect, P. gentilis occurs in somewhat less likely and unexpected habitats in some locales. In the Cumberland Mountains of Tennessee, for example, it inhabits lower elevation seeps and streams commonly associating with P. luculenta, P. antica, and P. sp. A. Nowhere is P. gentilis restricted to specific size streams and seeps. It can be found in small seeps to large streams and even raging mountain torrents with small quiet areas. It is a locally common species. The flight period of this species in the northern part of its range extends from late May or early June to mid-October. In the southern part of its range it typically flies from mid-August to late October (with one isolated record from mid-March).

Female--Females of this species are among the largest in the genus, some approaching and even surpassing the females of P. guttifer. See also notes on the male.

Material examined. Kentucky-Bell Co., Pine Mtn. Settlement School, Pine Mtn., 31 Oct. 1961, J.S. Ayars, 2 females. New York-Essex Co., light trap nr. John's Brook Lodge on Mt. Marcy trail from

Keene Valley, 5 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 2 males; 30 Aug. 1978, J.A. Wojtowicz, 7 males. Herkimer Co., Seep area along trail to Cedar Pond nr. Old Forge, 2 Sept. 1978, J.A. Wojtowicz, 2 females. North Carolina-Swain Co., Little Tennessee R., Co. Rd. 1125, light trap, 30 Sept. 1977, D.A. Etnier, S. DeKozlowski, J. Beets, N. Burkhead, 3 males. Yancey Co., Black Mtns., Hemphill Spr., 4760' elev., 2-3 Sept. 1978, J.S. Weaver, III, 22 males, 2 females. Pennsylvania-Carbon Co., Hickory Run St. Pk., seep trib. to Hickory Run, 29 Aug. 1978, J.A. Wojtowicz, 1 male MMT (coll. and preserved). Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 Aug. 1976, J.S. Weaver, III, 1 male. Lancaster Co., Welsh Mtn., New Holland Watershed Area, 5-6 Oct. 1977, J.S. Weaver, III, 3 males, 2 females. Somerset Co., Kooser St. Pk., Kooser Run, 25-26 Sept. 1976, J.L. Sykora & J.S. Weaver, III, 4 males, 1 female. Washington Co., Amity, sm. spr. nr. Ten Mile Run, 2 Sept. 1976, B. Owens, 23 males. Westmoreland Co., Laughington, Furnace Run, 25-26 Sept. 1976, J.S. Weaver, III, 7 males; Linn Run St. Pk., Linn Run, 20-21 Aug. 1976, J.S. Weaver, III, 1 male; Rector, Powdermill Run Nature Reserve, Maul Spr., 20-21 May 1977, J.S. Weaver, III, 1 female; 26-27 July 1977, J.S. Weaver, III & J.L. Sykora, 1 male, 1 female; 16 Aug. 1978, J.A. Wojtowicz & G.W. Wolfe, 4 males, 3 females; 27 July 1979, J.A. Wojtowicz & E.B. Williams, 4 males; Spruce Run, 25-26 Sept. 1976, J.S. Weaver, III, 4 males. South Carolina-Oconee Co., Walhalla Fish Hatchery, 1 Oct. 1970, Coll.? 1 female. Pickens Co., Wildcat Cr., Clemson Univ. Forest, 22-23 Oct. 1978, J.S. Weaver, III, 2 males; 9 km. NW of Clemson, 21-22 Oct. 1979, 8 males, 7 females. Tennessee-

Carter Co., Watauga R., ca. 1.5 River mi. below TN.-N.C. border, 24 Sept. 1977, N.M. Burkhead, J. Beets, & D. Nieland, 5 males, 1 female. Cumberland Co., Plateau Exper. Sta., 5 Oct. 1972, W. VanLandingham, 2 males, 2 females; 14 Oct. 1972, 2 males. Monroe Co., Jake Best Branch, trib. to Citico Cr., Cherokee Natl. Forest, 21 Oct. 1978, J.A. Wojtowicz & E.B. Williams, 2 males. Morgan Co., trib. to Clear Cr., N of Catoosa, off Hwy. 62W, 30 Sept. 1978, A. Cady & M. Post, 2 males; 10 Oct. 1978, J.A. Wojtowicz, 4 males, 1 female. Vermont-Bennington Co., Woodford, Br. on Grn. Mtn. Natl. For., .3 mi. from Rt. 9, on dirt rd. just east of Woodford, past sign to Redmill Brook Rec. Area, 9 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 3 male, 3 female MMT (reared). Virginia-Franklin Co., 11 Oct. 1977, C.A. Hopkins, 1 male. Giles Co., Mtn. Lake Biological Sta., 12 Aug. 1977, P.K. Powell, 1 male; Stoney Cr., Rt. 613 nr. Rt. 635, 28 Sept. 1977, C.R. Parker, 1 male; White Rocks Branch, White Rocks Campground, 2 Oct. 1980, B. Kondratieff, 3 males. Highland Co., Beaver Ponds on Back Cr., Locust Sprs. Run, 12 Sept. 1979, B. Kondratieff, 1 male; Locust Sprs. Run, Locust Sprs., 8 Aug. 1978, reared, emerged 23 Aug. 1978, B. Kondratieff, 2 male adults, 1 male MMT, 1 male pupa. Madison Co., Whiteoak Canyon Parking Area, Rockface Strms., Shenandoah Natl. Pk., 28 Aug. 1978, J.A. Wojtowicz, 11 male adults, 4 male, 2 female MMT. Montgomery Co., Brush Mtn., 17 Sept. 1976, K. Cannon, 1 male; Tom's Cr. Area, 8 Sept. 1976, F. Carle, 1 male; Oct. 1966, Strayley, 1 male; Radford Environs, 30 Oct. 1969, R.C. Entomol. Class, 1 male; c/o Mr. McBath, 30 Oct. 1969, R.C. Entomol. Class, 1 male. Rockbridge Co., light trap, G.R. 39, 14 Sept. 1977, M. Meschter, 1

male. Smyth Co., sm. str. into Grindstone Branch, 14 Aug. 1979, B. Kondratieff, 2 females. Tazewell Co., sm. spr., base of Station Spr. Cr. at Moor Ranch, Burkes Garden, 1 Sept. 1979, B. Kondratieff, 1 female. ? Co., Dark Hollow Falls, Shenandoah Natl. Pk., 28 Aug. 1978, J.A. Wojtowicz, 2 male adults, 1 male MMT (reared?). ? Co., Yankee Horse Ridge, Blue Ridge Parkway, 28 Aug. 1978, J.A. Wojtowicz, 1 male (reared). CANADA: Nova Scotia-Baddeck, Cape Breton, 60, 4 Sept. 1928, Coll.?, 1 male.

Pycnopsyche guttifer (Walker). (Halesus guttifer Walker, 1852. Cat. Neur. Brit. Mus. 1: 16)

Description. Male--Total length 18-23 mm. Length of forewing 16-21 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 20A, Appendix B) with darkening in the subradial, thyridial, and slightly in Cu1 cell. Darkening on cord from cells R3 to M1, often both sides. Darkening on wing apex from cells R4 to the posterior margin. Wing with a number of equally sized light brown speckles throughout. Tibial spur formula typically 1-3-3, rarely 1-3-4. Genitalia: Lateral-(Fig. 20 B, Appendix B). VIII with posterolateral projections arising near ventral border of tergite, elongate and with distal end rounded. Patch of black spines centrally on dorsum VIII and densely covering caudal portions of posterolateral projections. Area posteriad of VIII membranous. IX tall and narrowly elliptical. Lateral cercal lobes of X setose with posterior tapered to distinct rounded point. Medial projections of X arising dorsally, short, curved points with ventrally directed, acute tips. Clasper

bases thin and setose, apices tapered to point dorsally (not easily visible due to black spines on posterolateral processes). Dorsal-(Fig. 20C, Appendix B). Posterior VIII with small rectangular patch of spines medially. Posterolateral lobes present on VIII large, with ends rounded and densely set with heavy black spines. Lighter area on VIII surrounding posteromedial spines. A membranous area posterior to VIII. Cercal lobes of X elongate, narrow, rounded distally, and set with setae, set at slight oblique angle to longitudinal axis of body, and oriented near vertical. Medial processes of X short, relatively narrow, and produced to a point posteriorly. Clasper bases not distinctly visible. Tips tapered to points laterally. Posterior-(Fig. 20D, Appendix B). Clasper narrow, widest near base, gradually tapering to sharp, distinct, laterally set point, setose throughout. Distinct sclerotized band ventral to anus. Anus nearly vertical. Aedeagus-(Fig. 20E, F, Appendix B). In lateral view deepest at base, constricted past bases of parameres, little changed beyond until tapering to broad tip. Paramere bases short and globular, less than one-third total length. Blades multiple and reaching near to tip of aedeagus. In dorsal view wide basally, constricted slightly past bases of parameres, widened distally, then tapered to a broad tip. Distal portions with medial and lateral areas slightly raised with concavities between. Paramere bases short and cylindrical, less than one-fifth total length. Blades multiple and reaching close to aedeagal tip.

Female--Total length 20-24.5 mm. Length of forewing 18-22 mm. Wing and body color pale orange to tan. Wing coloration pattern as

in male. Tibial spur formula typically 1-3-3, rarely 1-3-4. Genitalia: Lateral-(Fig. 21A, Appendix B). IX and X fused, differentiated by a vague suture line. Combined segment tubular. IX vaguely rectangular. Ventral IX produced posteriorly beneath venter of X. X widest dorsally, tapered ventrally with a raised circular area set with setae on the lateral surface. Ventral X predominantly an internal, sclerotized plate. Supragenital area membranous and narrowly triangular, produced to a posterior apex. Vulvar scale triangular, produced to a posterior apex. Ventral-(Fig. 21B, Appendix B). Vulvar scale semicircular, posterior border with a slight medial lobe discernable. Supragenital plate membranous and pentagonal. Ventral IX produced medially beneath X, slightly raised, and setose. This projection rounded distally. Ventral X a sclerotized plate visible internally, forming floor of anus. Lateral raised, setose area of X visible. Dorsal X acutely pointed posteriorly and very slightly bifid. Dorsal-(Fig. 21C, Appendix B). IX and X fused, differentiated only by a vague suture line. Combined segment conical. IX roughly trapezoidal with sharp, medial, posterior projection. X laterad of projection of IX setose. Raised setose area visible on X laterally. Posterior X slightly bifid. Ventral X slightly visible posteriorly.

Diagnosis. Male--This species is most easily confused with P. rossi, P. scabripennis, P. antica, P. conspersa, and P. sp. A. Pycnopsyche guttifer differs from P. scabripennis, P. conspersa, and P. antica in the coloration pattern of the wings by having only small even sized spots, by tibial spur formula usually 1-3-3 (1-3-4 in

others), by the shape of the apices of the claspers, by the vertical position of the posterolateral projections of VIII, and by the multiple stylets of the parameres of the aedeagus. It differs from P. sp. A by the shape of the clasper apices, by tibial spur formula (1-3-4 in P. sp. A), by aedeagal parameres (simple in P. sp. A), and by the more pronounced coloration pattern of the wing. It differs from P. rossi mainly in the more ventral position of the posterolateral projections, and in the multiple stylets of the aedeagal parameres (vs. simple in P. rossi).

Female--This species is most likely to be confused with P. luculenta, P. circualris, P. divergens, P. sp. A, or P. rossi. It can be distinguished from P. luculenta and P. sp. A by its tibial spur formula of 1-3-3 and by its more extensive wing coloration pattern. It can be distinguished from P. circualris by lacking a distinctly flattened, heavily sclerotized plate for ventral X. It can be distinguished from P. divergens by the more accuminate nature of segments IX and X caudally (dorsal view) and by the less bulbous shaped and less heavily setose ventral IX. It can be differentiated from P. rossi by combined segments IX and X not being curved sharply downward (lateral view) and by the greater width of ventral IX.

Type locality. Georgia.

Distribution. See chapter IX and Fig. 54 (Appendix B).

Variation. Male--The extent of wing coloration pattern is somewhat variable. A number of specimens have a pattern in the discoidal cell, a cord pattern in cell M2, and the wing apex with the pattern

starting in cell R3 and continuing to the posterior wing edge. Occasional specimens have a mixed 1-3-3, 1-3-4 (same individual) tibial spur formula. I have noted no significant variation in the male genitalia.

Female--The wing coloration pattern and tibial spur formulas are as in the male. I have noted no significant variation in the female genitalia.

Notes. Male--This species is the most widespread in the genus. Locally common, it occurs from small woodland streams and even lakes in the north (Flint, 1960) to moderate to large sized rivers in both the north and south. Pycnopsyche guttifer is also one of the largest species in the genus. The flight period of the northern populations of this species extends from early or mid-July to early November. Karl and Hilsenhoff (1979) even record this species as being captured on the snow in November in Wisconsin. Southern populations of this species are reported typically from mid-September to mid-October or mid to late November (with an isolated record for 30 July).

Female--See notes under male description. The females are among the largest in the genus.

Material examined. Georgia-White Co., Cleveland, Chestatee R., 11 mi. N, 29 Sept. 1945, P.W. Fattig, 1 male. Indiana-LaGrange Co., Pigeon R. at 1100 E, 8 Sept. 1973, Coll.?, 1 male. LaPorte Co., light trap, 15 July 1959, D.L. Schuder, 1 male; Light trap, 4 Oct. 1960, Coll.?, 1 female. Maine-? Co., Gilead, at light, 15 Sept. 1934, W.H. Anderson, 5 males, 2 females. Maryland-Garrett Co., Savage R. at light, 1 Oct. 1978, J. McFarland, 1 male, 1 female. Michigan-Alger Co., Au

Train at light, 13 Sept. 1955, M.W. Sanderson, 5 males. Benzie Co., Honor, Platte R., 16 Sept. 1936, Ross & Burks, 2 females; 24 Aug. 1936, C.O. Mohr, 4 female pupae. Crawford Co., N Br. of Au Sable R., 3 Sept. 1935, J.W. Leonard, 1 male, 1 female. Lake Co., Pine River nr. Walker Br. Camp, 5-6 Sept. 1938, J.W. Leonard, 2 males. Montmorency Co., Hunt Cr., Sect. "C", T29N, R2E, Sec. 35, 3 Sept. 1940, J.W. Leonard, 2 males. Van Buren Co., Paw Paw at light, 12 Oct. 1940, J.S. Ayars, 1 male. ? Co., Str. S of Almena, 8 Oct. 1939, J.S. Ayars, 1 male. Minnesota-? Co., Marcel, 22 Aug. 1942, T.H. Frison, 1 male pupa. ? Co., Two Inlet, Indian Cr., 23 Aug. 1952, H.T. Spieth, 2 male MMT. New Hampshire-? Co., Cherry Mtn., Mill Brook, 18 Aug. 1934, W.H. Anderson, 1 male MMT. New York-Warren Co., Charles Lanthrop Pack Demonstration Forest, nr. Warrensburg, 2 Sept. 1978, J.A. Wojtowicz, 2 males (emerged after collection). North Carolina-Swain Co., Little Tenn. R., Co. Rd. 1125, light trap, 30 Sept. 1977, D.A. Etnier, S. DeKozlowski, J. Beets, & N.M. Burkhead, 1 male. Pennsylvania-Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 July 1976, J.S. Weaver, III, 6 males, 2 females; 28-29 Aug. 1976, 2 males, 1 female; 28-29 Aug. 1977, 1 female. Somerset Co., Kooser St. Pk., Kooser Run, 25-26 Sept. 1976, J.L. Sykora & J.S. Weaver, III, 1 male. Westmoreland Co., Ligonier, Loyalhanna Cr., 24 Sept. 1976, J.S. Weaver, III, 1 male. Tennessee-Cumberland Co., Plateau Exper. Sta. nr. Crossville, light trap, 25 Sept. 1972, Coll.?, 1 male; Rest stop before Cumberland St. Pk. exit on I-40W, at lights, 21 Sept. 1978, J.A. Wojtowicz, G.W. Wolfe, & D. A. Etnier, 1 male, 2 females; Catoosa Wildlife Management Area at

Potter Ford on the Obed R., 4.2 river mi. E of Adams Bridge, co. rd. 4252, 18 Oct. 1979, R. McKitrick, 18 males. Morgan Co., North of Catoosa off Hwy 62W, trib. to Clear Cr., light trap, 10 Oct. 1978, J.A. Wojtowicz, 1 male. Virginia-Bath Co., Back Cr. at St. Rt. 43, 8 Oct. 1972, B. Strickler, 1 male. Craig Co., Potts Cr., Steel Bridge Campground, off Rt. 18, 29 Sept. 1977, C.R. Parker, 2 males. Montgomery Co., New R., Radford Park, 27 Sept. 1976, B. Kondratieff, 1 male. Wythe Co., 17 Sept. 1976, W.A. Allen, 1 male; Black light trap, 1 Oct. 1976, 2 males, 1 female. Wisconsin-Door Co., Ephriam, exterior light globe, 1957, C.O. Mohr, 1 male. Vilas Co., Sayner, Plum Cr., 25 Aug. 1937, H.H. Ross, 3 male MMT and pupae. CANADA: Alberta-Blindman R., Hwy 2, 23 Aug. 1967, A.P. Nimmo, 5 females; 1 Sept. 1975, 2 females (coll. dead). Nova Scotia-Springhill Jct., 21 Aug. 1939, T.H. Frison & T.H. Frison, Jr., 1 male MMT. Ontario-Lake Huron, West Bay Manitoulin Island, Sept. 1939, C.H.K., 1 male, 1 female. Saskatchewan, LaRange, 25 Aug. 1952, Oliver, 1 male (abd. only) adult on pin.

Pycnopsyche limbata (McLachlan). (Stenophylax limbatus McLachlan, 1871. Jour. Linn. Soc. London, Zool. 11: 108)

Description. Male--Total length 13-17 mm. Length of forewing 11-15 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 22A, Appendix B) with darkening in subradial, thyridial, and Cu1 cells. Darkening on cord from cells R3 to M2. Wing apex darkened from cell R3 to the posterior margin. Pattern extending basally along Cu vein. Wing edge and cord color patterns may nearly

fused in cell R4. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 22B, Appendix B). VIII with a large hook shaped posterolateral projection slightly above the ventral surface of the tergite. Posterior border of VIII and projection lightly peppered with black spines. Posterior border of VIII except for spines, lightly colored. IX tall and broadly elliptical. Membranous dorsal area between VIII and IX. Cercal lobes of X roughly rectangular with posterior border truncate, setose, and oriented slightly obliquely upward. Medial processes of X elongate, bladelike, tapering to downward points distally, and setose. Claspers narrow with bases setose. Tips of claspers tapered slightly posteriorly to caudal, rounded point. Dorsal-(Fig. 22C, Appendix B). VIII with distinct posterolateral projections. Posterior VIII set with small, black spicules especially on dorsolateral lobes. Light band on posterior VIII. Cercal lobes of X setose, rounded posteriorly, vertically set, and at a slight oblique angle to the longitudinal axis of the body. Medial projections of X long, setose, tapering slightly posteriorly to rounded, outcurved apices. Bases of claspers slightly visible laterad, set with setae. Tips of claspers setose, flat, and paddlelike. Posterior-(Fig. 22D, Appendix B). Claspers widest on dorsal portion of base. Bases setose and tapering ventrally. Tips of claspers wide and paddlelike with some setae. Sclerotized band ventral to anus. Anus oriented roughly vertically. Aedeagus-(Fig. 22E, F, Appendix B). In lateral view short and stocky. Deepest at base, gradually tapering to tip. Distal portion past base of parameres somewhat sinuate. No noticeable indentation past paramere bases. Bases of parameres

heavy and long, comprising nearly three-quarters of total length. Blades broadened and flattened with two major points, these being finely bifid. In dorsal view fairly parallel sided along length except slightly constricted past bases of parameres, widening slightly distally, and tapering to tip. Distal portion of aedeagus with medial and lateral edges slightly raised with concavities between. Paramere bases thick and long, tapering distally, produced to a sharp point medially. Blades broadly flattened. Tip two pointed, these finely bifid.

Female--Total length 15.5 mm. Length of forewing 14 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 23A, Appendix B). IX and X fused, only slightly demarcated by a dorsal suture. IX roughly rectangular. Dorsal posterior lobe of IX appearing as slight rise in dorsal surface, caudad. Dorsal X produced into distinct point posteriorly. Lateral X produced to distinct point. Ventral X (?) a rounded lip beneath anus. Supragenital plate triangular and membranous with a rounded apex posteriorly. Vulvar scale triangular, pointed posteriorly. Ventral-(Fig. 23B, Appendix B). Vulvar scale semicircular, posterior border with two lateral lobes and small, rounded, slightly projecting central lobe. Supragenital plate membranous and roughly pentagonal. Ventral X (?) setose and forming lower border of anus. Lateral portion of X (possibly IX?) projecting backward as lateral points. Dorsal X produced into two sharp lateral points with v-shaped notch between. Dorsal X setose. Dorsal-(Fig. 23C, Appendix B). IX and X demarcated by vague suture line. Median

lobe of IX rounded. X consisting of two lateral, setose, sharp points with v-notch between.

Diagnosis. Male--This species is most easily confused with P. aglona from which it differs in the less massive and more tapered mesal processes of X, simple paddlelike clasper apices, and wide bladelike aedeagal paramere stylets.

Female--This species is most similar to P. aglona (see notes under P. aglona description). It differs in that dorsal X is produced into a sharp, posteriorly directed point (rounded in P. aglona) in lateral view, lateral X (possibly IX?) is produced into two distinct lobes (ventral view), the two posterior lobes of X are more distinctly pointed (dorsal and ventral view), and the posterior border of the vulvar scale possesses a medial subapical lobe and not just a mesal indentation as in P. aglona.

Type locality. Canada, Newfoundland, St. John's.

Distribution. See chapter IX and Fig. 58 (Appendix B).

Variation. Male--The wing coloration pattern may vary somewhat in extent. Basal cell darkening may include the discoidal cell. The cord coloration may be limited to cells R4 to M1 with darkening in cell R5 very slight, and may also be on both sides. Wing edge coloration may begin in cells R1 or R2. There may also be a slight darkening basally along vein M. The genitalic characters appear quite constant in form.

Female--Wing coloration variation is as in the male. See also notes below.

Notes. Male--I have seen relatively few specimens of this species. Some collections indicate, however, that it may be locally common, though restricted somewhat in overall distribution. Pycnopsyche limbata is strictly northern in distribution and inhabits higher elevation small streams and smaller, marshy streams. The flight period of this species extends from as early as the beginning of July to late October and early November.

Female--See also notes on male. I have seen very few specimens, but have reared it and am certain of its identification.

Material examined. New York-Essex Co., light trap nr. John's Brook Lodge on trail to Mt. Marcy from Keene Valley, 30 Aug. 1978, J.A. Wojtowicz, 2 males. Hamilton Co., two seep areas from mtn. marsh nr. North Placid Trail, on trail ca. 2 mi. from Hwy 30, ca. 5 mi. N of Indian Lake, 2 Sept. 1978, J.A. Wojtowicz, 1 male. Vermont-Windham Co., Halifax Gorge, sweeping foilage along sides of gorge, 13-20 Sept. 1974, G.K. Pratt, 1 male. Wisconsin-Bayfield Co., 25 Aug. 1970, J. Longridge, 1 male. CANADA: Nova Scotia-Lunenburg Co., Petite R., New Cumberland Rd., 4 Sept. 1956, D.C. Ferguson, 2 males; Green Bay, 5 Sept. 1956, D.C. Ferguson, 1 male. ? Co., Baddeck, Cape Breton, 104, 16 Sept. 1930, Coll.?, 1 male.

Pycnopsyche luculenta (Betten). (Stenophylax luculentus Betten, 1934. N.Y. State Mus. Bull. 292: 345, pl. 48, figs. 7-12, pl. 49, figs. 1-4)

Description. Male--Total length 16-23 mm. Length of forewing 15-20 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 24A, Appendix B) with darkening in subradial and

thyridial cells. Darkening along cord in cells R4, M1, and sometimes R5. Wing apex with darkening from cell R4 to the posterior margin. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 24B, Appendix B). Posterior VIII with sharp, slightly hooked posterior extension medially. This extension lightly set with black spines. IX tall and elliptical. Cercal lobes of X wide basally and rapidly tapering posteriad. Central processes of X long, slightly flexed, and pointed posteriorly. Base of clasper set with setae. Clasper tips bifid and pointed. Anterior lobe of clasper taller and bent anteriorly. Posterior lobe oriented slightly posteriad. Dorsal-(Fig. 24C, Appendix B). Posterior border of VIII truncate. Lateral VIII extended posteriorly in hooklike processes. Cercal lobes of X setose, obliquely set to longitudinal axis of body. Central projections of X raised and extended to blunt points posteriorly. Posterior border of X angulate laterally with semicircular indentation beneath cnetral projections. Straplike sclerite visible ventral to anal area. Anal opening obliquely set. Clasper bases setose. Tips mittenlike with thumbs posterior and slightly more medial. Posterior-(Fig. 24D, Appendix B). Clasper bases fairly parallel sided, tapering only slightly toward bases, set with setae. Tips bifid. Smaller lobe slightly medial to larger lobe. Straplike sclerite ventral to anus, glabrous. Anus obliquely set. Aedeagus-(Fig. 24E, F, Appendix B). In lateral view base deepest, generally tapered posteriorly with tip suddenly upturned. Bases of parameres short, less than one-fourth total length. Blades of parameres single, extending to tip of aedeagus, and curved upward. Slight indentation in aedeagus distal to paramere

bases, broadened and then tapered posteriad. In dorsal view parallel sided and then suddenly tapered to tip. Distal one-third or so with medial and lateral ridges and slight concavity between. Paramere bases short and stocky. Blades extending to aedeagal tip, gently curved medially, posteriad.

Female--Total length 19-23 mm. Length of forewing 16-21 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 25A, Appendix B). IX and X fused dorsally, separated only by a vague suture line. IX wide dorsally, narrowed medially, and expanded ventrally. Ventral IX forming setose mounds set with setae, just anterior and slightly inferior to X. Ventral X somewhat scooplike, projecting posteriorly no further than the dorsum. Posterior portion of dorsum IX and X set with setae. Supragenital area projecting backward in triangular membranous lobe. Vulvar scale triangular with posterior portion brought to a fine point. Ventral-(Fig. 25B, Appendix B). Vulvar scale half-moon shaped with mucronate lobe medially on posterior border. Supragenital area membranous and somewhat pentagonal with apex posteriad. Posterior IX with oblong protuberences set with setae. Ventral X sclerotized, scoop-shaped, with posterior border bilobed, and with setae anteriorly. Dorsal X visible with small, broad, v-notch medially. Dorsal-(Fig. 25C, Appendix B). IX and X fused. Entire segment (IX & X) triangular, tapering rapidly distally. IX pentagonal. Dorsal X setose and consisting of a half-moon-shaped lobe on either side. Apex of segment forming a broad, v-notch. Lateral posterior lobes of ventral X slightly visible.

Diagnosis. Male--This species is most closely allied to P. sonso and P. sp. B, from which it may be distinguished by the more tapered and unfused medial processes of X, the slightly less extensive wing coloration pattern, and the shape of the apices of the claspers.

Female--This species is similar to P. circularis, P. divergens, P. sp. A, P. guttifer, and P. rossi. It differs from P. circularis, P. divergens, P. guttifer, and P. rossi in its much reduced wing coloration pattern, its 1-3-4 tiibal spur formula, and in the form and extent of sclerotization and flatness of ventral X (ie. not extremely flattened as in P. circularis). It differs from P. sp. A in the shape of ventral X and in the shape of the posterior border of the vulvar scale (medial, mucronate lobe in P. luculenta vs. three subequal lobes in P. sp. A).

Type locality. Ithaca or Old Forge, New York.

Distribution. See chapter IX and Fig. 59 (Appendix B).

Variation. Male--The wing coloration pattern may include a darkening in cord cell R5. The coloration of the wing apex may begin in cell R4 or R5. The genitalia of this species seem remarkably constant. A slight difference in the acuteness of the apical points of the claspers may exist but does not seem of significance.

Female--For wing coloration pattern variation see male description. I have noted no variation of any consequence in genitalic characters.

Notes. Male--This species is widespread throughout the

eastern United States and appears to be quite diverse in habitat preferences, occurring from spring heads and high elevation streams to low elevation, small to moderate sized streams. Despite its diverse habitats there appears to be only slight differences in adult morphology. It is probably one of the most commonly collected species in the genus in eastern North America. The flight period in northern populations of this species ranges from early June to early October. In the southern populations the flight period extends typically from mid-August (reported as June in one source) through late October or even mid to late November.

Female--See notes under male description.

Material examined. Georgia-? Co., Neel Gap, Wolf Cr., 20 Sept. 1945, P.W. Fattig, 2 males. Harris Co., Pine Mtn. Valley, Beaver Cr. at light, 18 Oct. 1969, J.B. Wallace & H.H. Ross, 2 females; Blue Sprs. at light, Rt. 116, 18 Oct. 1969, J.B. Wallace & H.H. Ross, 1 female. Indiana-Montgomery Co., Shades St. Pk., trail 2, spr. below 1st bridge, 2 Aug. 1980, R.D. & N. Waltz (reared in lab), 3 males. New York-Essex Co., John's Brook Lodge on Mt. Marcy nr. Keene Valley, 5 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 5 males, 2 females; 30 Aug. 1978, J.A. Wojtowicz, 3 males, 3 females; 6 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male. St. Lawrence Co., trib. to Oswegatchie R., xing Rt. 3 N.Y., west of Wanakena Ranger School in Adirondak Preserve, 5 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 6 males (reared). Tompkins Co., McLean Reserve, 8 Sept. 1963, C.V. Covell, 1 male. Pennsylvania-Carbon Co., Hickory Run St. Pk., Hickory Run, 29 Aug. 1978, J.A. Wojtowicz, 1 male adult, 1 female MMT (reared).

Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 July 1976, J.S. Weaver, III, 37 males, 6 females; 28-29 Aug. 1976, 33 males, 6 females; 28-29 Aug. 1977, 12 males; Kelletville, Ross Run, 27-28 Aug. 1976, J.S. Weaver, III, 12 males, 1 female. Lancaster Co., Christiana, Pine Cr., 18-19 Sept. 1976, J.S. Weaver, III, 2 males, 1 female; Welsh Mtn., New Holland Watershed Area, 5-6 Oct. 1977, J. S. Weaver, III, 3 males, 1 female. Somerset Co., Kooser Run St. Pk., 25-26 Sept. 1976, J.L. Sykora & J.S. Weaver, III, 10 males, 19 females. Westmoreland Co., Laughington, Furnace Run, 25-26 Sept. 1976, J.S. Weaver, III, 4 males, 2 females; Rector, Powdermill Run Nature Reserve, Maul Spring, 10 Sept. 1975, J.S. Weaver, III & J.L. Sykora, 1 male MMT; Spruce Run, 21-22 June 1976, J.S. Weaver, III, 1 male; 25-26 Sept. 1976, 2 males, 1 female. South Carolina-Aiken Co., Savannah R. Plant, Upper Three Runs Cr., Q SRP-1, 19-20 November 1976, Herlong, Pritchard, 37 males, 52 females. Oconee Co., Walhalla Fish Hatchery, light 875, 1 Oct. 1970, Coll.?, 25 females. Pickens Co., Wildcat Cr., 9 km. NW of Clemson, 21-22 Oct. 1979, J.S. Weaver, III, 4 males, 4 females. Tennessee-Anderson Co., New River, coll. 18 Sept. 1980, emerged 6 Oct. 1980, E.B. Williams, 1 female (reared). Blount Co., Parson's Branch at Tapoco Boundary, below exit of Cades Cove Rd. on Rt. 129 toward Fontana, 16 Sept. 1978, J.A. Wojtowicz & E.B. Williams, 1 female (abd. no longer with specimen). Cumberland Co., Plateau Exper. Sta. nr. Crossville, 6 Oct. 1972, W. VanLandingham, 5 males, 4 females. Madison Co., Univ. of Tenn., Dept. of Economic Entomol. light trap at Jackson, 3 Oct. 1966, Coll.?, 6 males, 3 females. Monroe Co., Jake Best Branch, trib. to Citico Cr., Cherokee Natl. For., 21 Oct. 1978, J.A. Wojtowicz & E.B. Williams,

5 males, 1 female. Morgan Co., trib. to Clear Cr., N of Catoosa, off Rt. 62W, 30 Sept. 1978, A. Cady & M. Post, 1 male; 10 Oct. 1978, J.A. Wojtowicz, 1 male, 1 female. Scott Co., Lowe Branch nr. Laco Mining Co., trib. of New R., 19 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 female adult, 8 male, 6 female MMT; Indian Cr., trib. to New R., 19 Sept. 1979, E.B. Williams & J.A. Wojtowicz, 2 female adults, 3 male, 4 female MMT. Virginia-Bath Co., Big Lick Cr., Rt. 601, 4 mi. junc. Rt. 39, 11 Sept. 1979, J.R. Voshell, Jr., 1 female. Giles Co., Stoney Cr., White Rocks, 2 Sept. 1978, A. Beck, 1 male; White Rocks Branch, Rt. 613, ca. 110 m. from Rt. 635 at light, 2750' elev., 28 Sept. 1977, C.R. Parker, 1 male, 2 females; North Fork Stoney Cr., Jefferson Natl. For., 15 Aug. 1979, Fairservice, 1 male; Stoney Cr., Rt. 613 nr. Rt. 635, 28 Sept. 1977, C.R. Parker, 1 male, 1 female. Highland Co., Beaver Ponds on Back Run, Locust Sprs. Run, 12 Sept. 1979, B. Kondratieff, 1 male; Laurel Fork at Rt. 642, Mullenax Run, 22 Aug. 1981, B. Kondratieff, 1 male, 4 females, 1 female MMT. Madison Co., Whiteoak Canyon Parking Area, Shenandoah Natl. Pk., 28 Aug. 1978, J.A. Wojtowicz, 2 male adults, 5 males, 6 female MMT. Montgomery Co., Brush Mtn., 17 Sept. 1976, K. Cannon, 1 male; 12 Sept. 1967, F. Bryan, 1 male; 11 Oct. 1971, R. Hobbs, 1 male. Nelson Co., unnamed sm. str., Rt. 667, 12 Sept. 1980, B. Kondratieff, 1 female. Rockbridge Co., Guys Run, light trap, 14 Sept. 1977, M. Meschter, 2 males, 1 female.

Pycnopsyche rossi Betten. (Pycnopsyche rossi Betten, 1950. Ann. Entomol. Soc. Amer. 43: 520, figs. 49-54)

Description. Male--Total length 18.5-20 mm. Length of forewing 16-18.5 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 26A, Appendix B) with darkening in discoidal, subradial, thyridial, and Cu1 cells and vaguely along cord to posterior wing margin. Darkening on cord from cells R3 to M2. Apex of wing with darkening from cell R3 to posterior margin. Slight extension of darkening basally along M and Cu veins. Lighter spots in darkenings, especially along wing apex, but also in basal area. Wing lightly spotted throughout with even sized, small brown spots. Tibial spur formula typically 1-3-3, rarely 1-3-4. Genitalia: Lateral-(Fig. 26B, Appendix B). VIII with posterolateral processes arising medially on tergite. These processes roughly rectangular with rounded posterior margins. Posterior portions of VIII and posterolateral projections heavily set dorsally with short black spicules. Lighter areas anterior to spines on VIII. IX tall and narrowly elliptical. Segment X barely visible. Cercal lobes of X narrowed and rounded, set with setae. Medial processes of X slightly raised, wide at bases, distinctly tapered apically with apices rounded and curved sharply downward at tips. Clasper bases narrow and set with setae. Clasper tips tapered then slightly expanded at apex and curved slightly anteriorly. Dorsal-(Fig. 26C, Appendix B). Entire segment VIII narrowed slightly posteriorly. Posterior VIII heavily set with short black spines. Lateral projections strongly declivitous and more strongly set with setae at tips. Lighter area anterior to spines on

VIII. Cercal lobes of X narrow and rounded posteriorly, set with setae. Cercal lobes oriented nearly vertically and slightly oblique to the longitudinal axis of the body. Medial processes of X long, thin, and narrow, very slightly tapered posteriorly, with darkened, slightly outcurved tips. Clasper bases slightly visible and setose. Clasper tips blackened, curved slightly inward and anteriorly at lateral margins. Posterior-(Fig. 26D, Appendix B). Clasper bases somewhat narrow, set with setae. Tips of claspers simple and bladelike, blackened apically, and with apices produced to a slight point laterally. A sclerotized band present ventral to the anus. Aedeagus-(Fig. 26E, F, Appendix B). In lateral view deep at base and indented past the bases of the parameres, widened, and then tapered to a sharply upcurved tip. Bases of parameres long and narrow, approximately one-third total length. Blades of parameres simple, extending to near tip of aedeagus, and gently upcurved distally. In dorsal view widened at base, slightly narrowed past base of parameres, slightly expanded and parallel sided, and finally narrowing to tip. Bases of parameres long and narrow. Blades of parameres simple, extending to sharp points near tip of aedeagus. Distal portion of aedeagus with medial and lateral margins slightly raised with concavities between.

Female--Total length 16-21 mm. Length of forewing 14.5-19 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-3. Genitalia: Lateral-(Fig. 27A, Appendix B). IX and X fused, delineated only by a fine suture line. Dorsal IX rapidly declivitous caudally to X. IX widened dorsally, narrowed medially, and broadened ventrally. Ventral IX forming a

slight lip ventral and anterior to X, not projecting noticeably below X. Lateral portion of IX dorsal to ventral lip, distinctly concave. X somewhat tubular, setose dorsally, ventrally, and laterally. Dorsal portion of X produced slightly posteriad of ventral X. Ventral X a sclerotized scoop. Caudal border of X slightly emarginate on mid-lateral surface. Supragenital area membranous and triangular with apex caudad. Vulvar scale triangular, with distinctly pointed apex caudad. Ventral-(Fig. 27B, Appendix B). Supragenital area membranous and somewhat pentagonal. Ventral IX forming a distinct posteriorly rounded lobe caudad to vulvar scale. Ventral X just caudad of apex of ventral IX with a setose patch medially. Ventral X distad forming sclerotized floor of anus (roughly scooplike) with roughly emarginate border. Dorsal X slightly visible and setose. Caudal terminus of dorsal X slightly emarginate. Dorsal-(Fig. 27C, Appendix B). Combined IX and X broad basally and tapered distinctly caudad. IX and X differentiated by a fine suture line. Posterior border of IX produced medially near to tip of X. Dorsal X appearing as lateral setose lobes. Posterior border of terminus slightly u-notched.

Diagnosis. Male--This species is most easily confused with P. guttifer, P. scabripennis, P. conspersa, P. antica, and P. sp. A. It differs from P. scabripennis, P. conspersa, and P. antica by the lack of uneven sized spots on the forewings, in the shape of the clasper apices, in the peculiar thinned appearance of the medial processes of X (in lateral view), in the reduced size of the horn covering the opening of the abdominal scent gland on the anterolateral portion of sternite V, and in the 1-3-3 tibial spur formula (see

variation). It differs from P. sp. A in wing coloration pattern, tibial spur formula, shape of the tip of the claspers, and shape of the medial processes of X. It differs from P. guttifer mainly in the simple stylets of the aedeagal parameres and in the position of the posterolateral projections of tergite VIII (lateral view).

Female--This species is most likely confused with P. circularis, P. divergens, P. sp. A, P. guttifer, and P. luculenta. It can be distinguished from P. sp. A and P. luculenta by the lack of a ventral posterior IX lobe beneath X, by the more extensive wing coloration pattern, and by the tibial spur formula, 1-3-3 (see variation). It can be distinguished from P. circularis by ventral X not being a distinctly flattened, sclerotized plate, and from P. divergens by the shape and position of ventral IX, and by IX and X not being tubular in shape. It differs from P. guttifer by the rapidly declivitous nature of IX in lateral view and by the emarginate ventral sclerite of X.

Type locality. McCann Spring, Wolf Lake, Illinois.

Distribution. See chapter IX and Fig. 61 (Appendix B).

Variation. Male--The extent of wing coloration pattern is somewhat variable. The cord may lack color in cell R3 and may be slightly colored in R5, or may be more extensively patterned and include cell R2. Coloration may not extend basally along the M and/or Cu veins. Wing apex coloration may extend from cell R2 to the posterior margin. The coloration pattern in cell R4 on the cord and wing apex may connect. The tibial spur formula may be 1-3-4 or mixed (1-3-3, 1-3-4, same individual). The medial process of X may be broader than

illustrated in dorsal and/or lateral view.

Female--See variation under male description. See also notes. The indentation in ventral X may be more v-shaped.

Notes. Male--This is a unique species previously known from only the type locality (1 male, 2 females). Recently two new localities in Indiana were discovered by Robert Waltz (Wayne Co., 1980) and by Robert L. Jones (Harrison Co., 1981). This species appears to be very restricted in distribution. All localities where it has been found were springs. Though records are limited, the flight period of this species appears to range from 22 August to 6 October. Though uncommon, this species probably occurs throughout central and southern Illinois and Indiana.

Female--The description of this female is based on only four specimens including the allotype female. A greater amount of variation than noted above might be expected. See also notes under male description.

Material examined. Illinois-Union Co., McCann Spr., Wolf Lake, 6 Oct. 1947, Ross & Smith, 1 female (ALLOTYPE, INHS). Indiana-Wayne Co., Salamander str. at Hayes Arboretum, W-16, 22 Aug. 1980, R.D. & N. Waltz, 6 males; Richmond Hayes Arboretum Waterworks Swamp, 23 Aug. 1980, R.D. & N. Waltz, 1 male. Harrison Co., Boone Township, spr. branch in Buck Cr. bottoms, 2.1 mi. S of St. Rd. 337 and Buck Cr. Valley Rd. junct., E.Z. Alcorn Farm, 29 Aug. 1981, R.L. Jones & J. Forbis, 8 male, 1 female adults, and 1 female adult and 1 female MMT reared.

Pycnopsyche sonso (Milne). (Stenophylax sonso Milne, 1935. St. N. Amer. Trichoptera 2: 32)

Description. Male--Total length 17-20.5 mm. Length of forewing 15-18 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 28A, Appendix B) with darkening in subradial and thyridial cells. Darkening along cord from slightly in cell R3 to cell M2, both sides. Apex of wing darkened from cell R4 to the posterior margin of wing. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 28B, Appendix B). VIII with blunt posterolateral hooks. Posterolateral portion of VIII slightly raised and heavily set with black spines. IX tall and elliptical. Cercal lobes of X rectangular, posteriorly truncate, setose, and oriented upward at a slight oblique angle. Medial processes of X arising from dorsal portion of X, slanting upward with the distal one-third sharply flexed and produced to ventrally oriented, sharp, blackened points. Claspers narrow with bases setose, tips small, slightly bifid, and blackened. Dorsal-(Fig. 28C, Appendix B). VIII with posterolateral projections. VIII slightly raised posteromedially and with rectangular patch of black spines. Cercal lobes of X rounded, roughly vertical, and oriented slightly obliquely to the longitudinal axis of the body. Central projections of X fused to the point of flexion with tips separate, divergent, and blackened. Anus sclerotized on all sides and situated directly below medial processes of X. Clasper bases setose, tips of claspers medial and blackened. Anus nearly horizontal. Posterior-(Fig. 28D, Appendix B). Claspers fairly narrow with bases setose, slightly tapered ventrally. Tips narrow, slightly bifid, and medially situated with very

tips of apices blackened. Anus with broad sclerite ventrally. Aedeagus-(Fig. 28E, F, Appendix B). In lateral view broad basally, sharply indented past bases of parameres, widened, and gradually, then distinctly tapered to sharply upturned tip. Paramere bases long and narrow, approximately one-third total length. Blades of parameres simple, gently curved upward, and extending to near tip of aedeagus. In dorsal view broadened at base, slightly indented past base of parameres, again widened, and then gradually tapered to narrow tip. Paramere bases long, nearly one-half total length. Blades simple and upcurved, reaching near to tip of aedeagus. Distal approximately one-third of aedeagus with medial and lateral ridges (lateral ridges more raised) and slight concavities between.

Female--Total length 19.5-21 mm. Length of forewing 17.5-19.5 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 29A, Appendix B). Segments IX and X distinct and separated by vague suture line. Both IX and X sclerotized. Combined segments rapidly declivitous to posterior. Segment IX roughly rectangular. Dorsal X setose, and with apex extending beyond ventral X. Venter X with lateral, setose lobe and slightly visible medial sclerotized plate. Supragenital area a membranous triangle with apex posterior. Vulvar scale triangular with venter flat and produced to a sharp point posteriorly. Ventral-(Fig. 29B, Appendix B). Vulvar scale semi-circular with small, distinct, rounded lobe posteromedially. Supra-genital plate pentagonal and membranous. Ventral IX rectangular with two lateral, triangular shaped, setose, raised areas with a membranous

area between. Ventral X consisting of two oval, lateral lobes and a posteriorly rounded medial plate, all setose. Posterior of dorsal X with a broad, roughly rectangular excavation. Setae evident on lateral and posterior dorsal X. Dorsal-(Fig. 29C, Appendix B). IX a long rectangle with the longitudinal axis transverse. X produced into two lateral lobes with a deep, rounded indentation between. Ventral X slightly visible from above.

Diagnosis. Male--This species is most closely allied to P. sp. B and P. luculenta. It differs from P. luculenta by fusion of the medial processes of X, the rectangular shape of the cercal lobes of X in lateral view (tapered to a rounded point in P. luculenta), the slightly more extensive wing coloration pattern, and the difference in the apices of the claspers. It differs from P. sp. B mainly in the shape of the tip of the claspers and the more narrowed and elongate tips of medial segment X when viewed laterally.

Female--This species may be most easily confused with P. sp. B and P. virginica. It may be distinguished from P. virginica by the shape and position of segment IX laterally and ventrally, the presence of a rectangular emargination on the terminal segments in ventral view, the shape of the posterior portion of the vulvar scale, the more extensive wing coloration pattern, and the 1-3-4 tibial spur formula. Pycnopsyche sp. B females are presently indistinguishable from this species except by non-overlaping ranges. Also see notes for P. aglona.

Type locality. Bryson City, Deep Creek, Smoky Mountains, North Carolina.

Distribution. See chapter IX and Fig. 64 (Appendix B).

Variation. Male--The wing coloration pattern may vary somewhat. The discoidal cell may show a slight darkening. Cord cells R3 and M2 may lack darkening. Wing apex coloration may start in cells R4 or R5. Rare individuals may show development of a slight lateral lobe on the clasper base. Occasional specimens may show an apparent 1-3-3 tibial spur formula or a mixed formula (1-3-3, 1-3-4).

Female--For possible wing coloration pattern and tibial spur formula variation see male description. Also see notes.

Notes. Male--I have seen the holotype of this species and the present concept of the species agrees well with it. This species is restricted to SE Tennessee, NW South Carolina, NE Georgia, and SW North Carolina. Its closest relative is P. sp. B with records from northern North Carolina and Virginia. At present the ranges of the two species are not known to overlap. Throughout its range P. sonso commonly occurs sympatrically with P. luculenta. The flight period of this species extends from mid-August to late October.

Female--Presently the female of P. sonso is inseparable from that of P. sp. B. See also notes for male.

Material examined. Georgia-? Co., Neel Gap, Wolf Cr., 20 Sept. 1945, P.W. Fattig, 1 male. North Carolina-Swain Co., Smoky Mtns., Bryson City, Deep Cr., 2000 ft., 27 Aug. 1930, Darlington, 1 male (HOLOTYPE: MCZ # 20150). Tennessee-Blount Co., Great Smoky Mtns. Natl. Pk., Little R. at Elkmont, 26 Aug. 1972, C. Saylor, 1 male; Parson's Branch at Tapoco Boundary where Cade's Cove Rd. exits

onto Rt. 129 to Fontana, N.C., 16 Sept. 1978, J.A. Wojtowicz & E.B. Williams, 11 males, 2 females; 24 Aug. 1979, J.A. Wojtowicz, 1 female pupa. Monroe Co., Falls Branch Parking Area, Laurel Branch on new Robinsville Hwy., light trap, 22 Aug. 1979, J.A. Wojtowicz, 19 male, 1 female adults, 2 male MMT; Jake Best Branch, trib. to Citico Cr., Cherokee Natl. For., 15 Sept. 1978, J.A. Wojtowicz & E.B. Williams, 6 males, 4 females. Sevier Co., Great Smoky Mtns. Natl. Pk., Little Pigeon R., 4200' elev., 28 Sept. 1949, Coll.?, 1 female.

Pycnopsyche virginica (Banks). (Potamorites virginicus Banks, 1900. Trans. Am. Entomol. Soc. 26: 239-260)

Description. Male--Total length 12-14 mm. Length of forewing 11-13 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 30A, Appendix B) with darkening in discoidal, subradial, and thyridial cells. Cord with darkening in cells R2, R3, and R4. No appreciable darkening noticeable in wing apex. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 30B, Appendix B). Posteroventral angles of VIII produced into blunt lobes laterally. Posterodorsal border of VIII with a dense patch of black spines. Area on VIII lateral to spines light colored and membranous. Segment IX triangular and with apex ventral. Cercal lobes of X modified into a light, triangular, sclerotized patch of setae. No distinct medial process of X visible. Claspers massive (greatest width greater than width of IX) with bases roughly triangular with apex ventral. Bases set with setae. Tips of claspers situated midway between anterior and hind margins of base. Posterior border of clasper base angulate. Tips

sclerotized, tapering to a distinct point curved slightly mesad. Dorsal-(Fig. 30C, Appendix B). Segment VIII with slight posterolateral extensions. Roughly u-shaped patch of black spines on posteromedial border of VIII with distinct u-shaped membranous patches laterad. Segment X roughly triangular with apex posterior. Cercal lobes of X modified into anterolateral, raised, triangular, sclerotized patches of setae. Medial processes of X modified into long, rectangular, sclerotized patches of setae laterad of anus, and oriented obliquely to the longitudinal axis of the body. Straplike sclerite ventral to anus, incomplete. Claspers massive, bases with large, distinct posterior shoulders, set with setae. Tips situated anteriorly on bases, sclerotized with distinctly pointed apices oriented mesad. Anus nearly horizontal. Posterior-(Fig. 30D, Appendix B). Clasper bases narrow, tapered slightly ventrally, with distinct shoulders set posteriorly. Tips sclerotized, tapered to a point apically, curved slightly mesad, and with slight points laterad, approximately midway on tip. Aedeagus-(Fig. 30E, F, Appendix B). In lateral view base thickest. Slightly narrowed past base of parameres, then slightly sinuate, tapering gradually to a slightly upcurved tip. Bases of parameres short, approximately one-fourth total length, blades simple, slightly sinuate with sharp points reaching near to tip of aedeagus. In dorsal view broadest at base, constricted past base of parameres, widened distally, then tapering to tip. Paramere bases short and stocky, blades simple, extending to near aedeagal tip (twisting of blades in illustration an artifact). Distal widening with medial and lateral margins raised with slight concavity between.

Female--Length of forewing 11.4 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 31A, Appendix B). IX and X fused, delimited laterally by distinct line and fold, dorsally by only a faint suture line. IX somewhat narrowed dorsally and widened ventrally. X (?) more or less triangular with a blunt posterior apex, a lighter setose area dorsally, and heavily setose area ventrally. Ventral IX ending dorsally of ventral X. Supragenital area membranous, triangular, with apex posterior. Vulvar scale barely produced posteriorly (?) (may be artifact). Ventral-(Fig. 31B, C, Appendix B). Vulvar scale semicircular, posterior truncate with small, triangular medial point. Supragenital area membranous and somewhat pentagonal. Ventral IX visible laterally, somewhat triangular. Ventral X broad and roughly trapezoidal, heavily setose with posterior border emarginate, defining two rounded posterolateral lobes. Dorsal-(Fig. 31D, Appendix B). Combined IX and X somewhat trapezoidal. Limits of IX defined by a very vague suture line. X with u-shaped excavation posteriorly. Rounded posterior lobes, lighter in color and setose.

Diagnosis. Male--This species is not easily confused with any other species. The reduction of the lateral cercal lobes and medial processes of X to lightly sclerotized, setose patches easily distinguishes P. virginica from all other species.

Female--This species is most likely confused with P. sonso and P. sp. B. It can be distinguished from these by the shape and position of segment IX laterally and ventrally, the lack of a rectangular

emargination on the terminal segments in ventral view, the shape of the posterior portion of the vulvar scale, the less extensive wing coloration pattern, and the 1-2-2 tibial spur formula.

Type locality. Richmond, Virginia.

Distribution. See chapter IX and Fig. 66 (Appendix B).

Variation. Male--See notes. I have noted slight variation in vein M conformation in the hind wing.

Female--See male description. See also notes.

Notes. Male--I have seen relatively few specimens of this species. Flint (1966) described the male of this species with only two known specimens (one each from North Carolina and South Carolina). There are now additional specimens known from South Carolina (J.C. Morse, pers. comm.) and Alabama (K. Manuel, pers. comm.). This species appears to be restricted to the Coastal Plain and is either extremely rare, or, as I suspect, possibly a day active species, accounting for the poor capture record. Although Flint (1966) placed this species in the genus Pycnopsyche based largely on the aedeagal morphology, my opinion remains guarded as to its proper placement here. In any case, I do not believe it to be a member of the P. lepida group. The flight period of this species extends from late October through mid-November.

Female--This description is based on the holotype female, the only female reported to have been collected for this species. The reason for this is suspected to be the poor description and lack of

illustrations available in the literature. It is hoped that illustration of this specimen here may aid in the collection of additional data for this species.

Material examined. Alabama-Calhoun Co., Coldwater Spr. (W-12), Anniston Water Supply, 15 Nov. 1978, K. Manuel, 1 male. North Carolina-Duplin Co., Faison, light trap, 31 Oct. 1956, Coll.?, 1 male. South Carolina-Dorchester Co., Four Holes Swamp, Mellard's Lake, 18 Nov. 1976, J.C. Morse, 1 male. Virginia-Henrico-Chesterfield Cos., Richmond, 1900?, Mrs. A.T. Slosson, 1 female (HOLOTYPE: MCZ # 11638).

CHAPTER IV

NEW SPECIES OF *Pycnopsyche*

In the following are discussed two species of *Pycnopsyche* whose original descriptions were made in the course of this study (Wojtowicz & Etnier, in preparation). *Pycnopsyche* sp. A was first collected in 1966 and determined by Dr. D.A. Etnier to be an undescribed *Pycnopsyche* species (D.A. Etnier, pers. comm.). *Pycnopsyche* sp. B is a species previously thought to be an "unusual" *P. sonso* which is morphologically and geographically distinct from that species. Both are relatively localized, *P.* sp. A more so than *P.* sp B.

Pycnopsyche sp. A

Description. Male--Total length 18-20 mm. Length of forewing 16-18 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 32A, Appendix B) with darkening in subradial and thyridial cells. Darkening on cord in cells R4 and M1. Darkening along apex of wing from cell R4 to posterior margin, often vague. Tibial spur formula 1-3-4. Abdomen-(Fig. 32G, Appendix B). Opening of scent gland on anterolateral portion of sternite V produced to a slight point anteriorly. Genitalia: Lateral-(Fig. 32B, Appendix B). VIII with posterolateral projections somewhat rectangular with broadly rounded posterior border, leaving the tergite medially. Posterior of dorsum VIII and posterolateral projections heavily set

with short, light colored spicules. IX tall and elliptical. Cercal lobes of X projecting posteriad to rounded point with distal one-half setose, oriented obliquely upward. Central processes of X slightly raised, projecting posteriad, curved, and tapering to an acute point. Clasper bases relatively narrow, set with setae. Dorsum of base broadly rounded into a posterior shoulder. Tip of claspers tapered with lateral portion produced to a point and more medial portion curved slightly posteriad. Cercal lobes obliquely oriented. Dorsal-(Fig. 32C, Appendix B). Segment VIII tapering slightly posteriorly. VIII with posterolateral projections declivitous. Posterior border of VIII and posterolateral projections heavily set with short, light colored spicules. Posterior VIII with a broad band of lighter area constricted medially. Posterior VIII with slight concavity medially. Cercal lobes of X oriented vertically and parallel to the longitudinal axis of the body, with setae greater on distal one-half. Central projections of X moderately large, tapered to point, gently curved laterally at their apices, and setose. Sclerotized band visible below anus. Claspers with bases rounded distally and setose. Distinct shoulder visible posterior to clasper tips. Tips of claspers placed anteriorly on base, apices narrow, with sharp medial point and lesser anteromedial point. Posterior-(Fig. 32D, Appendix B). Clasper bases widest medially, tapering slightly dorsally and ventrally, heavily setose. Dorsum of base forming distinct posterior shoulder. Tips of claspers sclerotized and produced into slight lateral point and medial, beaklike projection. Medial portion of shoulder of base angulate or occasionally produced into slight

point. Sclerotized band visible ventral to anus. Anus oriented near to vertical. Aedeagus-(Fig. 32E, F, Appendix B). In lateral view deep basally, narrowed by slight notch posterior to bases of parameres, widened distally, and then gradually tapered to a slightly upturned tip. Paramere bases narrow and short (approximately one-fifth total length of paramere), recessed slightly into base of aedeagus. Blades of parameres simple, extending near to tip of aedeagus, and with points upcurved. In dorsal view slight constriction past bases of parameres, expanding beyond, and gradually tapering to tip. Distal portion with medial and lateral edges raised with slight concavities between. Paramere bases narrow and short, blades simple and extended to near tip with apices slightly bent laterally.

Female--Total length 19-21.5 mm. Length of forewing 17-19.5 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 33A, Appendix B). IX and X fused, demarcated by a vague suture line. Dorsum IX and X steeply sloped downward. IX broad dorsally and ventrally with slight medial constriction. Ventral IX setose and forming posterolateral lobe. X roughly wedge shaped with a rounded posterior point. Dorsal X with a circular patch of setae posteriorly. Lateral X with setae. Supragenital plate roughly triangular, rounded posteriorly. Vulvar scale triangular, pointed posteriorly. Ventral-(Fig. 33B, Appendix B). Vulvar scale semicircular with three distinct lobes posteriorly. Supragenital plate membranous and pentagonal. Ventral IX visible as a roughly rectangular plate with posterior border indented. Ventral X small, and roughly rectangular. Dorsal X

setose, tapered to a fine point posteriorly. Dorsal-(Fig. 33C, Appendix B). IX and X distinctly narrower than VIII, slightly tapered to rounded posterior. IX roughly pentagonal with medial projection to tip of X forming a small point. Ventral IX visible laterad. Dorsal X with two lateral patches of setae.

Diagnosis. Male--This species is most likely confused with P. antica, P. scabripennis, P. conspersa, and P. rossi. Its lightly patterned wings with no spots, the shape of its clasper apices, and the shape of the opening of the abdominal gland on sternite V differentiate it from P. antica, P. conspersa, and P. scabripennis. Its tibial spur formula (1-3-4), the shape of the medial process of X, and the shape of the apices of the claspers separate it from P. rossi.

Female--This species is most likely confused with P. luculenta, P. circularis, P. divergens, P. rossi, and P. guttifer. It may be distinguished from P. circularis, P. divergens, P. rossi, and P. guttifer by its much reduced wing coloration pattern and its 1-3-4 tibial spur formula. It may be distinguished from P. luculenta by the shape of ventral X and by the distinctly three-lobed (subequal) posterior border of the vulvar scale.

Type locality. Buck Cr. on Catoosa Wildlife Management Area, Morgan Co., Tennessee.

Distribution. See chapter IX and Fig. 55 (Appendix B).

Variation. Male--Slight variation in wing coloration pattern has been noted. Cord coloration may include a slight patch in cell R5.

Wing apex coloration is often extremely vague. Clasper tips are somewhat variable in shape. The medial points are occasionally somewhat blunted, and the lateral tips are occasionally diminished, sometimes being squared off. The medial shoulders of the bases are occasionally either less prominent than figured or produced into slight upward directed points.

Female--Wing coloration variation is as in the male. There is slight variation in the size of the medial lobe of the vulvar scale, which is usually subequal to the lateral lobes, but occasionally larger.

Notes. Male--This species is very restricted in distribution, so far known only from three counties in Tennessee. Where it is found it occurs in low elevation streams of small to moderate size. The species is probably much more widespread in Tennessee than now realized and probably also extends into at least the Cumberland Plateau area of Kentucky and possibly Alabama. The flight period of this species extends from early September to early October.

Female--See notes for male.

Material examined. Tennessee-Cumberland Co., Cottrell Cr. nr. Grasslands Exper. Sta., S of Crossville, 29 Aug. 1979, J.A. Wojtowicz, 2 females (reared); Univ. of Tenn., light trap at Plateau Exper. Sta. NW of Crossville, 19 Sept. 1966, G. Russell, 7 males, 4 females; 29-31 Aug. 1970, Coll.?, 1 male; 1-2 Sept. 1970, Coll.?, 1 male; 4 Sept. 1970, Coll.?, 1 male; 9-10 Sept. 1970, Coll.?, 1 male, 1 female; 11 Sept. 1970, Coll.?, 1 male, 1 female; 13-15 Sept. 1970, Coll.?, 3 males, 3 females; 15 Sept. 1972, Coll.?, 1 male, 4 females; 17 Sept.

1972, Coll.?, 2 males, 3 females; 23 Sept. 1972, Coll.?, 2 males, 1 female; 2 Oct. 1972, Coll.?, 1 male; 6 Oct. 1972, Coll.?, 2 males; Polecat Cr. at Catoosa Wildlife Management Area, 6 Sept. 1979, J.A. Wojtowicz, 1 female (to be designated as Allotype) (reared). Madison Co., light trap at Jackson, 3 Oct. 1966, Coll.?, 1 male, 2 females. Morgan Co., Buck Cr. at Catoosa Wildlife Management Area, 6 Sept. 1979, J.A. Wojtowicz, 1 male (to be designated as Holotype) (reared).

Pycnopsyche sp. B

Description. Male--Total length 17.5-21.5 mm. Length of forewing 16-19.5 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 34A, Appendix B) with darkening in subradial and thyridial cells. Darkening on cord from slightly in cell R3 to slightly in cell M2, on both sides. Darkening on wing apex from cell R4 to the posterior margin. Tibial spur formula typically 1-3-4, occasionally 1-3-3. Genitalia: Lateral-(Fig. 34B, Appendix B). Segment VIII with a roughly triangular posterolateral projection, rounded posteriorly. Posterodorsal portion of VIII slightly raised and set with heavy black spines medially. Distinctly lighter area on VIII laterad of spines. IX tall and narrowly elliptical. Lateral cercal lobes of X rectangular, setose, truncate posteriorly, and oriented obliquely upward. Mesal processes of X arising dorsally, tips blackened and sharply deflexed at apex. Claspers moderately wide with bases setose. Tips of claspers large with two distinct, blackened points, anterior and medial-most tallest and pointed. Posterior point short and rounded. Anus oriented nearly horizontal. Dorsal-

(Fig. 34C, Appendix B). VIII with posterolateral projections. Posteromedial portion of VIII raised and set with a dense patch of heavy black spines. Lighter u-shaped areas lateral of spines. Cercal lobes of X set slightly off vertical and slightly oblique to the longitudinal axis of the body, set with setae. Medial processes of X dorsal, fused basally, and with free tips acute and pointed obliquely laterad forming a broad v-notch between. Posterior border of X surrounding venter of anus. Anus nearly horizontally set. Clasper bases laterad and setose. Tips of claspers mesad and with two points. Longest points tubular and directed mesad. Shortest points somewhat rounded and directed posteriorly. Both with setae. Posterior-(Fig. 34D, Appendix B). Bases of claspers roughly quarter-moon-shaped, set with setae. Tips bifid, with larger points oriented medially and more anterior, shorter, posterior points directed dorsad. Both with apices blackened. Broad sclerotized band beneath anus. Anus nearly horizontally positioned. Aedeagus-(Fig. 34E, F, Appendix B). In lateral view deepest basally, deeply indented past base of parameres, broadened, and then tapered to upward curved tip. Distal portion of aedeagus slanted upward. Bases of parameres long and thin, nearly one-half total length. Blades simple, curved upward, sharp pointed apically, and reaching to near tip. In dorsal view widest at base, constricted past bases of parameres, widened slightly, and then tapering to tip. Bases of parameres long and thin, blades simple, reaching to near tip. Distal portion of aedeagus with raised medial and lateral edges with concavities between.

Female--See diagnosis and notes.

Diagnosis. Male--This species is most closely allied to P. luculenta and P. sonso. It may be distinguished from P. luculenta by the fusion of the medial processes of X, the rectangular shape of the lateral cercal lobes of X (vs. tapered to a rounded point in P. luculenta), the more pronounced wing coloration pattern, and the difference in the shape of the clasper apices. It differs from P. sonso mainly in the shorter and more stocky points of mesal X (lateral view) and the difference in the shape of the claspers (P. sp. B having two distinct lobes).

Female--This species is presently indistinguishable from P. sonso except by an apparent lack of overlap in the ranges of the two species.

Type locality. Whiteoak Canyon Parking Area, Shenandoah Natl. Park, Virginia.

Distribution. See chapter IX and Fig. 60 (Appendix B).

Variation. Male--The wing coloration pattern may vary in extent. Cord darkening in cell M2 may be lacking. The wing apex darkening may begin in cell R5. I have noted no great variability in genitalic characters. In some cases the points of medial X may approach those of P. sonso in length (lateral view).

Female--For wing coloration pattern variability see male description. See also notes.

Notes. Male--This species is remarkably similar to P. sonso, but the key characters do not seem to vary appreciably. There also appears, at least at present, to be a distinct range difference in

these two species. This species appears to be restricted to higher elevation streams in northern North Carolina and in Virginia, just as P. sonso is slightly further south in North Carolina, Tennessee, South Carolina, and Georgia. The flight period of this species extends from late July (possibly as early as 12 July) to mid-September.

Female--Presently indistinguishable from the female of P. sonso. See also notes under male description.

Material examined. North Carolina-Yancey Co., Black Mtns., Hemphill Spr., elev. 4760', 2-3 Sept. 1978, J.S. Weaver, III, 46 males, 3 females. ? Co., Foscoe, spr. fed str. flowing into Carter Cr., 20 Aug. 1976, E.C. Morgan, 1 female (may be P. sonso?). Virginia-Giles Co., Mtn. Lake Biological Sta., light trap, 30 July 1953, W.H.C., 1 male; Approximately 4 mi. on hiking trail past Mtn. Lake, 2 Sept. 1973, J.R. Voshell, Jr., 3 males; Stoney Cr. at light, White Rocks, 2 Sept. 1978, A. Beck, 1 male. Madison Co., Whiteoak Canyon Parking Area, rockface streams, Shenandoah Natl. Park, 28 Aug. 1978, J.A. Wojtowicz, 1 male (to be designated as Holotype). Nelson Co., unnamed sm. str., Rt. 667, 12 Sept. 1980, B. Kondratieff, 2 males. Rappahannock Co., Hughes R., Rt. 707, 6 Sept. 1980, B. Kondratieff, 1 male. Smyth Co., Lewis Fork Trail, Rt. 603, 14 Aug. 1979, B. Kondratieff, 1 male. Washington Co., Boar Tree Campground, 28 July 1979, J.R. Voshell, Jr., 1 male.

CHAPTER V

THE *Pycnopsyche lepida* GROUP

General

The *P. lepida* group has been somewhat of an enigma for quite some time, though it has not been quite such a serious problem as the *P. scabripennis* complex. As described by Betten (1950), the *P. lepida* group consisted of three species (*P. lepida*, *P. indiana*, and *P. subfasciata*). Flint (1966) added *P. virginica* to the group (from *Potamorites*).

The history of the group is not as badly convoluted as that of the *P. scabripennis* complex. Milne (1935) synonymized *P. lepida* with *P. subfasciata* with no explanation. Ross (1938a) reelevated *P. lepida* from synonymy, stating only that the two species were distinct and selecting a lectotype for *P. lepida*. Ross (1938b) in a separate paper described a new species, *P indiana*, in the group. In 1944, Ross described a neotype for *P. subfasciata* (Ross, 1944). Betten (1950) in his revision of the genus questioned the species status of *P. indiana*, indicating that it and *P. subfasciata* may possibly be synonymous.

I have studied the types of all the species in this complex except for *P. subfasciata*. In my own estimate, the problem, if any exists, lies not with the above two species (*P. indiana* and *P. subfasciata*), but with *P. indiana* and *P. lepida*. The basic similarities of these two species are quite striking. In both, the variab-

ility of wing coloration pattern is such that the overlap between the species is quite great, making the value of this character questionable. Pycnopsyche subfasciata, with its extensive color pattern, displays little resemblance to the other two species in this respect. The depth of the mesal notch and the extent of spination on posterior tergite VIII appear to be somewhat variable in both P. lepida and P. indiana. Although I have seen no specimens identified as P. indiana with a deep indentation, I have seen specimens identified as P. lepida with a fairly reduced notch. Pycnopsyche subfasciata always lacks a notch. The claspers of P. indiana and P. lepida, as described (and in the type specimens), are quite distinct. Measurements of clasper height, maximum width of base, and maximum width of tip yield evidence that the overall shape of the clasper is quite variable in both species; however, on the average, the maximum width of the clasper tip of P. indiana is wider in proportion to the maximum length and maximum width of the base of the claspers than that of P. lepida. In P. subfasciata the claspers are described as lacking lateral points on the apices, differing in this respect from both P. indiana and P. lepida. Although I have noted quite a significant amount of variability in the overall shape of the clasper apices, only in very few instances have I examined specimens with lateral points on the claspers, and these I suspect to be aberrant specimens (possibly P. lepida-P. subfasciata hybrids). The only remaining character separating P. indiana and P. lepida is that of the shape and stockiness of the aedeagus. Although I have examined relatively few specimens in that respect, I have seen what I interpret to be considerable

variability. Soft parts of the aedeagus, in this group, are difficult to study in other than a subjective manner.

The females, although having not as many identifiable differences, also show some degree of variability. Both P. indiana and P. lepida have the ventral portion of the anus (ventral X) with essentially the same comformation. In P. subfasciata the same structure is broader and more massive and in the majority of the cases easily distinguished from that in the previous two species. A character of vital importance in the separation of P. indiana and P. lepida is the number of posterior points on the dorsum of the terminal segments of the abdomen. Pycnopsyche lepida is described as having two lateral extensions, and P. indiana is reported as having three, one medial and two lateral. There seems to be some difficulty with this character in that I have noted a few specimens (particularly from the Piedmont and Coastal Plain areas) which possess a partly developed third medial point. Because of the otherwise great similarity of these two species, proper placement of these specimens is all but impossible.

In order to determine whether two species are distinct, the best indication is the discovery of reproductive isolating mechanisms (Mayr, 1969). In the absence of such data the decision as to whether or not two species qualify as distinct biological species must be largely inferential. In the case of P. lepida and P. indiana the decision is not an easy one. Although the ranges of the two species appear to overlap quite extensively, in no instance have I found large populations of both species to coexist. In the interior of North America, P. lepida appears to be numerically more plentiful than P.

indiana, and P. indiana, conversely, is definitely more plentiful on the Coastal Plain than P. lepida. Indeed, the majority of the P. indiana specimens which I have seen are from the Coastal Plain. Where these two species do co-occur hybridization may be quite common, accounting for the number of specimens from the area which are difficult to classify (especially where females are concerned). In spite of the apparent variability of all or most of the key characters cited above, I do not feel that I have sufficient evidence at this time to declare the two species synonymous. Instead, I suggest that further work will be necessary, perhaps including biochemical taxonomy, before a final decision can be made concerning the true status of these species.

Concerning P. virginica, I do not feel that this species is a member of the P. lepida complex. Other than the agreement in tibial spur formulas, I see little justification for its placement in this close-knit complex. Therefore, I suggest that it be removed and placed in its own group because of its uniqueness.

As a whole, I feel that the difficulties with the systematics of the P. lepida group may lie in the recent evolution of its species, resulting in somewhat imperfect reproductive isolation.

Discussion of the lepida Group Species

Pycnopsyche lepida (Hagen). (Enoicyla lepida Hagen, 1861. Syn. Neur. N. Amer.: p. 269)

Description. Male--Total length 15-22.5 mm. Length of fore-wing 14-20 mm. Wing and body color pale orange to tan. Wing

coloration pattern (Fig. 35A, Appendix B) varying from slight darkening only on cord in cell R4 to darkening of subradial and thyridial cells and cord cells R3 to M1 or M2. Apex of wing nearly concolorous. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 35B, Appendix B). VIII rapidly declivitous in posterior one-third. Lateral posterior VIII slightly produced posteriorly in dorsal one-third. Posterior VIII set with black spines dorsally. IX tall and elliptical. X with cercal lobes long, thin, and slightly tapered. Medial X raised, with central lobes bluntly rounded posteriorly and lateral lobes slightly inferior, projecting laterally, and blunt. Claspers nearly as tall as segment VIII, basally set with setae. Tips medial, gently curved anteriorly to a point. Sharp shoulder shorter, and lateral to medial tips. Dorsal-(Fig. 35C, Appendix B). Posterior VIII with small lobes laterally. Posteriorly often heavily set with spines and with a moderate to deep indentation medially. Dorsal VIII occasionally slightly concave medially near posterior border. Cercal lobes of X approximately parallel to the longitudinal axis of the body. Central portion of X with paired medial projections usually pointed posteriorly, but variable. Lateral projections of medial X varying in size but usually inferior to the medial projections and oblique to the longitudinal axis of the body. Medial tips of claspers high and gently curved anteriorly. Lateral shoulders inferior. Posterior-(Fig. 35D, Appendix B). Clasper bases setose, wider than tips, and tapering basally. Tips with medial points long and produced to sharp tips, lateral shoulders short but produced to sharp points. A bandlike sclerite visible below anal opening. Anal

opening nearly vertical. Aedeagus-(Fig. 35E, F, Appendix B). In lateral view moderately stocky to stocky. Generally, tapering posteriorly with distal one-third curved sharply upward. Bases of parameres approximately one-third total length. Blades of parameres simple, not extending to the tip of the aedeagus, and sharply curved upward distally. Aedeagus moderately to deeply notched distal to bases of parameres. Aedeagus widened slightly past notch and then tapering to tip. In dorsal view widest in distal one-half. Base moderately wide, narrowed slightly past the base of the parameres, and then widened, afterwards tapering to tip. Distal approximately one-half with lateral and medial ridges with slight concavities between. Paramere bases long and thin, approximately one-third total length. Blades of parameres curving medially.

Female--Total length 18-23 mm. Length of forewing 16.5-21 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 36A, Appendix B). Segment IX and X distinct, separated by a faint suture line. Segment IX broad dorsally and narrowed to a small lobe ventrally. X consisting of setose posterolateral projections dorsally, and a medial sclerotized scoop and lateral and anterior sclerotized setose bulbous areas ventrally. Supragenital plate a triangular (flexed in illustration; an artifact of preservation), membranous projection with apex posteriad. Vulvar scale triangular with the venter flattened and with a blunted point posteriorly. Ventral-(Fig. 36B, Appendix B). Vulvar scale semicircular with posterior border slightly emarginate or not. Supragenital plate somewhat

pentagonal and membranous with a posterior point. Segment IX a narrow, transverse rectangle ventrally. X consisting of raised, setose protuberences anteriorly and a medial sclerotized scoop posteriorly. Scoop v-notched, depth of notch somewhat variable (extreme condition illustrated). Setose dorsalateral projections of X easily visible. Dorsal-(Fig. 36C, Appendix B). IX rectangular and sclerotized, posterior border truncate. Segment X with setose posterolateral projections, occasionally with medial projection developed (part of IX and X?). Ventral sclerotized scoop of X usually readily visible, occasionally somewhat obscured by development of medial projection.

Diagnosis. Male--This species is most likely confused with P. subfasciata and P. indiana. It may be distinguished from P. subfasciata by the shape of the tips of the claspers (with lateral and medial points in P. lepida), the presence of a mesal notch of variable depth on the posterior border of tergite VIII, the lack of a prominent mesal concavity on posterior tergite VIII, and a less extensive wing coloration pattern. It may be distinguished from P. indiana by the proportionately lesser width of the clasper apices, the greater depth of the mesal indentation on posterior VIII, and the usually less stocky and deeply indented aedeagus.

Female--This species is most easily confused with P. subfasciata and P. indiana. It may be distinguished from P. subfasciata by the narrower ventral lip of the anal opening (ventral X), by its much reduced wing coloration pattern, and by the presence of only two terminal points dorsally on the abdomen. It may be distinguished from P. indiana by the lack of a prominent medial point

on the dorsum of the terminal segments of the abdomen. See also notes and variation.

Type locality. Pennsylvania.

Distribution. See chapter IX and Fig. 57 (Appendix B).

Variation. Male--Wing coloration is variable from nearly concolorous to darkened subradial and thyridial cells and cells R3 to M2 along the cord. A rare individual may exhibit a pattern even more extensive. The extent of spination and depth of the mesal notch on dorsal, posterior tergite VIII is somewhat variable. The height of the clasper and width of the clasper base and tip is highly variable, but the clasper apex is usually less wide proportionately than that of P. indiana. The stockiness of the aedeagus and depth of the aedeagal notch are somewhat variable.

Female--The wing coloration pattern is as in the male. The development of the third dorsal, posterior projecting point is variable. Ventral X is either fused in its entirety or deeply cleft.

Notes. Male--I have seen the lectotype of this species. Although it agrees with the description of this species, its body size is more in line with that of P. indiana. Variation of the key characters within this species and P. indiana require that caution be used in determinations, especially of P. indiana. The flight period for this species in the northern part of its range extends from as early as mid-May or more typically from early June to mid-October. In the southern part of its range records as early as 7 June and 7 July

are recorded with most being from early August to late October or mid-November.

Female--See notes for P. indiana male and female and P. lepida male. Occasional specimens of this species may not be clearly separated from P. indiana.

Material examined. Alabama-Lee Co., Auburn, in light trap, 2 Oct. 1967, T.D. Eicklin, 1 male, 1 female (?). Georgia-? Co., Neel Gap, Wolf Cr., 3.5 mi. N, 10 Sept. 1945, P.W. Fattig, 3 males; 30 Aug. 1945, 1 male. Illinois-Kankakee Co., Momence, Kankakee R., 7 Sept. 1937, Frison & Ross, 1 male. Indiana-Fountain Co., Portland Arch, 5 Sept. 1980, R.D. & N. Waltz, 1 male, 2 females. LaGrange Co., Pigeon R. at 1100 E, 8 Sept. 1973, Coll.?, 1 female (poss. lepida-subfasciata hybrid). LaPorte Co., light trap in pine planting, 31 Aug. 1959, D.L. Schuder, 1 male. Wayne Co., Milton Heiser Sta. Rd., 7 Sept. 1975, J.W. Hart, 2 males. Michigan-Chippewa Co., Sugar Island, 28 July 1957, T. E. Moore, 1 female. Montmorency Co., Hunt Cr., Sec. "C", T29N R2E Sec. 35, 30 Aug. 1940, J.W. Leonard, 1 female. Van Buren Co., Paw Paw, 28 Aug. 1943, J.S. Ayars, 1 male. ? Co., Allais Cr. nr. Almena, 24 Aug. 1940, L. & J.S. Ayars, 1 male; Millpond nr. Almena, 7 Sept. 1939, J.S. & R.C. Ayars, 2 males. Minnesota-Hubbard Co., Univ. of Minn. Dept. of Entomol., light trap at Guthrie, 16 July 1965, Coll.?, 1 male. Lake Co., Univ. Minn. Entomol., light trap at Finland, 3 Aug. 1965, Coll.?, 5 males. New Hampshire-Grafton Co., Franconia, 20 Aug. 1947, B.D. Burks, 1 male. New York-Tompkins Co., McLean Res., 8 Sept. 1963, C.V. Covell, 1 male. Pennsylvania-Beaver Co., Raccoon St. Pk., Traverse Cr., 18-19 Aug. 1976, J.S. Weaver, III, 3 males. Cumberland Co., Boiling Sprs., Yellow Breaches Cr., 17-18 Sept. 1976,

J.S. Weaver, III, 10 males, 1 female. Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 Aug. 1976, J.S. Weaver, III, 8 males, 3 females; 28-29 July 1976, 6 males, 2 females. Westmoreland Co., Ligonier, Loyalhanna Cr., 24 Sept. 1976, J.S. Weaver, III, 1 male. ? Co., Pennsylvania, no data, Hagen?, 1 male (LECTOTYPE: MCZ # 10697). South Carolina-Aiken Co., Savannah R. Plant, Upper Three Runs Cr., @ SPR 8-1, 15-16 Oct. 1976, Herlong, Pritchard, 5 males, 1 female. Tennessee-Blount Co., light along Little R., Tuckaleechee Village, 30 Sept. 1977, J.E. Hope, 1 male. Cumberland Co., probably Plateau Exper. Sta., 7 June 1966, Coll.?, 3 males, 3 females; Univ. Tenn. light at Crossville, 29-31 Aug. 1970, Coll.?, 7 males, 3 females; 9-10 Sept. 1972, Coll.?, 8 males, 4 females; Univ. Tenn. light trap at Plateau Exper. Sta. nr. Crossville, 9-10 Sept. 1970, Coll.?, 2 females; Rest stop before exit to Cumberland St. Pk., I-40W, 21 Sept. 1978, J.A. Wojtowicz, G.W. Wolfe, & D.A. Etnier, 2 females. Morgan Co., Trib. to Clear Cr., N of Catoosa, off Hwy 62W, 30 Sept. 1978, A. Cady & M. Post, 2 males. Virginia-Bath Co., 29-30 Aug. 1973, B. Strickler, 1 male, 1 female; Back Cr., Blowing Sprs. Campground, Rt. 39, 10 Sept. 1979, J.R. Voshell, Jr., 3 males; Jackson R., Rt. 603, Richardson Gorge, 11 Sept. 1979, B. Kondratieff, 1 female. Bedford Co., North Otter R., N. Boone Farm, 28 Sept. 1980, Despins, 2 males, 1 female. Carroll Co., New R., Fries, 26 Aug. 1976, C.R. Parker, 1 male. Franklin Co., Amherst, 7 July 1973, A. Buckman, 1 male. West Virginia-Randolph Co., Elkins, 1 Oct. 1936, T.H. Frison, drew 2 Oct. 1936, C.O. Mohr, 1 male. Wisconsin-Vilas Co., Sayner, Plum Cr., 25 Aug.

1937, H.H. Ross, 2 male pupae. CANADA: Nova Scotia-Lunenburg Co., Petite R., 4 Sept. 1956, D.C. Ferguson, 1 male, 4 female. Ontario-James Bay, Little Partridge Cr., 30 July 1946, H.C. Hanson, 1 male, 1 female.

Pycnopsyche indiana (Ross). (Stenophylax indiana Ross, 1938. Proc. Ent. Soc. Wash. 40: 121, fig. 10)

Description. Male--Total length 15-18 mm. Length of forewing 13.5-16 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 37A, Appendix B) with darkening in subradial and thyridial cells. Darkening along cord from cell R4 to M1. Wing apex coloration very vague. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 37B, Appendix B). Slight posterolateral projection on VIII one-third from dorsal plane. Dorsum of posterior one-half tergite VIII declivitous. Patch of light colored setae on dorsum of posterior VIII. Vague light patches lateral to these setae. IX tall and elliptical. Cercal lobes of X elongate, thin, and setose with dorsal borders somewhat sinuate. Central processes of X with thin, setose medial processes and shorter, setose lateral processes. Claspers stocky with bases setose. Tip with short, narrow anterolateral points, and long, broad bladelike, more posterior points which gently curve and taper to a slightly anteriorly oriented apex. Dorsal-(Fig. 37C, Appendix B). Posterior VIII with slight posterolateral projections visible. Posterior border of VIII with a triangular shaped patch of short, stout setae on either side of midline. The patches bordered laterally by slightly lighter u-shaped areas.

X with lateral cercal lobes long, rounded, and setose, oriented oblique to vertical, and approximately parallel to the longitudinal axis of the body. Central projections of X medially short and thin, pointed and setose, lateral lobes stockier and oriented approximately parallel to transverse axis. Clasper bases rounded posteriorly and setose, medial tips of claspers higher with apices curved slightly anterior. Lateral points inferior. Posterior-(Fig. 37D, Appendix B). Bases of claspers wider than tips, tapered slightly ventrally, and setose. Tips sclerotized, with higher medial points and lower but sharp lateral points. Both tapered to acute points. A thin, dark sclerite ventral to anus. Anus oriented roughly vertical. Aedeagus-(Fig. 37E, F, Appendix B). In lateral view stocky, broad basally, indented deeply past base of parameres, broadened slightly, and tapered to a slightly upcurved tip. Paramere bases stocky, approximately one-third of total length. Blades simple, somewhat sinuate with sharply upcurved tips reaching near to tip of aedeagus. In dorsal view base wide, constricted past bases of parameres, widened distally, and then tapered to tip. Parameres with bases thin and approximately one-third total length. Blades simple, warped slightly outward with apices pointed and oriented medially. Distal widening of aedeagus with raised medial and lateral margins with slight concavity between.

Female--Total length 16-21 mm. Length of forewing 15.5-17 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 38A, Appendix B). Segments IX and X distinctly separate dorsally, but only indistinctly separated by a faint suture line ventrally.

Segment IX roughly rectangular with ventral lobe small. Dorsal X produced into distinct, setose medial and posterolateral projections. Ventral X scoop shaped medially, and with slightly raised, setose areas laterally and anteriorly. Supragenital plate a membranous, triangular lobe with apex posterior. Vulvar scale triangular with apex bluntly rounded and oriented posteroventrally at an angle. Ventral-(Fig. 37B, Appendix B). Vulvar scale semicircular posteriorly, generally with slight median lobe. Supragenital plate pentagonal. Ventral IX a long, transverse rectangle anterior to X. Ventral X with raised, setose area anterior to scoop shaped, subanal sclerite. Tip of scoop v-notched. Setose dorsolateral lobes of X visible. Dorsal-(Fig. 37C, Appendix B). Segment IX roughly rectangular but with distinct posterior, triangular projection medially. Posterolateral lobes of X setose. X expanded posteromedially by projection of IX. Venter of X visible, scoop shaped, with deep v-notch.

Diagnosis. Male--This species is most easily confused with P. lepida and P. subfasciata. It may be distinguished from P. subfasciata by the shape of the clasper apices, the less extensive wing coloration pattern, and the more stocky and deeper notched aedeagus. It may be distinguished from P. lepida by the much reduced depth of the posteromedial indentation of VIII, by the proportionately wider clasper apices, and by the usually stockier and more deeply notched aedeagus.

Female--This species may be easily confused with P. subfasciata and P. lepida. It may be distinguished from P. subfasciata by the narrower opening formed by ventral X and by the much reduced wing

coloration pattern. It may be distinguished from P. lepida by the presence of three terminal points on the abdominal terminus, rather than two. See also notes for P. indiana male and P. lepida male and female, and variation for P. indiana and P. lepida females.

Type locality. Rogers, Inidana.

Distribution. See chapter IX and Fig. 56 (Appendix B).

Variation. Male--The extent of wing coloration pattern is variable and often somewhat vague. Basally, the coloration may be restricted to the subradial and thyridial cells or may occasionally include the discoidal cell. Cord coloration may be restricted to cell R4 or may extend from R4 or rarely R3 to slightly into cell M2. The presence or absence and depth of the notch on the medial posterior border of VIII, the extent of spicule development on VIII, the height, width of the bases, and width of the tips of the claspers, and the stockiness of and depth of the notch in the aedeagus may all be somewhat variable.

Female--The wing coloration pattern is as in the male. The extent of development of a third lobe on the dorsum of combined segments IX and X is somewhat variable.

Notes. Male--I have seen the holotype male of P. indiana. Betten (1950) suspected difficulties with this species and P. subfasciata. I see it as a problem involving P. lepida and P. indiana. The key characters of P. indiana all seem to be quite variable and show a great deal of overlap with the same characters in P. lepida.

Coastal Plain populations of this species appear to show little variation in characters; however, P. lepida specimens from the Coastal Plain are less distinctly that species. Because I lack conclusive evidence that these two species are not reproductively isolated, I suggest that P. indiana continue to be recognized as distinct until such time that sufficient negative or positive evidence has been acquired. The flight period of this species in the northern portion of its range extends from mid-July (one record) or more typically mid-September to early October. In the southern portion of its range it extends typically from late August to late October or mid-November, with some indication that emergence may occur as early as June in some areas.

Female--See notes under male description. Variation in the characters separating this species from P. lepida may make many determinations difficult.

Material examined. Alabama-Calhoun Co., Coldwater Spr., Anniston Water Supply, 25 Oct. 1978, K. Manuel, 2 males. Georgia-Clayton Co., Jonesboro, Jester's Lake, 2.5 mi. N, 12 Sept. 1945, P.W. Fattig, 1 male (?). Houston Co., Perry, Thorpes Pond, 5.5 mi. N, 12 Oct. 1945, P.W. Fattig, 4 females. Monroe Co., last rest stop before Macon, I-75S, 13 Oct. 1978, E.B. Williams, 1 male. Talbot Co., Prattsburg, Oak Chunk Cr., 10 mi. E, 29 Oct. 1945, P.W. Fattig, 1 male. Taylor Co., Butler, Patsilaga Cr., 4.6 mi. N, 29 Oct. 1945, P.W. Fattig, 2 males, 1 female. Illinois-Champaign Co., Urbana, 24 Sept. 1938, G.T. Riegel, 2 females. Indiana-LaPorte Co., light trap, 15 July 1959, D.L. Schuder, 1 male. ? Co., Rogers, 7 Oct. 1937,

Ross & Burks, 1 male (HOLOTYPE: INHS). Kentucky-Union Co., Morganfield, light trap, 16 Oct. 1942, C.O. Mohr, 1 female (?). Louisiana-St. Tammany Parish, Talisheek Cr. at Hwy. 435 Spur in Talisheek, 17 Oct. 1979, R.W. Holzenthal, 2 males, 1 female; 17 Oct. 1979, Holzenthal & Magnuson, 8 males; 12 Oct. 1979, R.W. Holzenthal, 1 female MMT (reared). South Carolina-Berkeley Co., Four Holes Swamp, Mim's Lake, 14 Oct. 1976, J.C. Morse, 46 males, 13 females; 18 November 1976, 12 males, 10 females. Tennessee-Cumberland Co., Univ. of Tenn., Plateau Exper. Sta., 6 Oct. 1966, Coll.?, 1 female. Madison Co., Univ. of Tenn., Dept. of Economic Entomology, light trap at Jackson, 3 Oct. 1966, Coll.?, 1 male. Virginia-Carroll Co., New R. at Fries, 26 Aug. 1976, C.R. Parker, 1 female (?). Louisa Co., Ferncliff, 27 Sept. 1936, T.H. Frison, 1 male. Montgomery Co., Tom's Cr. Valley, Pr. T.C., 9-10 Sept. 1976, C.R. Parker, 1 female.

Pycnopsyche subfasciata (Say). (Phryganea subfasciata Say, 1828. Amer. Entomol. 3: 44)

Description. Male--Total length 16-20 mm. Length of forewing 14-18 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 39A, Appendix B) with darkening in discoidal, subradial, thyridial, and slightly in Cu1 cells. Darkening on cord from cell R2 to M2, both sides. Wing apex with darkening from cell R3 to posterior margin. Coloration extending basally along Cu vein. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 39B, Appendix B). Broadly rounded posterolateral projections of VIII leaving midway on tergite. Posterior one-third of VIII slanted sharply downward.

Posterior margin of VIII set with short, light colored setae. Segment IX tall and elliptical. Lateral cercal lobes of X long and narrow with dorsal border emarginate. Central projection of X a slightly raised, elongate lobe with posterior border rounded. Lateral extensions of central projection visible as a small, upward directed process, laterad of central blade. Claspers narrow, bases setose. Tips with apparently two sclerotized processes, a short, triangular one anteriorly and a tall, bladelike, more medial process, tapered to a sharp anteriorly curved point, and situated more posterior. Dorsal-(Fig. 39C, Appendix B). VIII with lateral projections visible. Posterior border of VIII with two roughly triangular patches of light setae with a distinct concavity between. Cercal lobes of X large and obliquely set from the vertical axis, setose, and with medial borders angulate. Central processes of X small and pointed posteriorly. Lateral lobes of these processes small, rounded, and setose. Claspers with bases rounded posteriorly and setose. Tips more medial with apical points curved anteriorly. Posterior-(Fig. 39D, Appendix B). Clasper bases moderately wide, tapered ventrally, and set with setae. Tips sclerotized, broad basally, abruptly narrowed, tapered to a slightly rounded apex, and located slightly medially. Shoulders of tips where tips narrow, rounded and without a lateral point. Narrow sclerotized band present below anal opening. Anus nearly vertical. Aedeagus-(Fig. 39E, F, Appendix B). In lateral view deepest at base, constricted past base of parameres, widening to nearly depth of base, and then tapering to a sharply upcurved point. Bases of parameres short and cylindrical, approximately one-third total length. Blades

of paramere simple, sharply upcurved to pointed apices, reaching near to tip of aedeagus. In dorsal view base widest, narrowed abruptly past bases of parameres and fairly parallel sided, widening only slightly distally, and then tapering to the tip. Bases of parameres narrow and cylindrical. Blades produced nearly directly backward, reaching near apex of aedeagus. Distal one-half of aedeagus with raised lateral and medial portions with slight concavity between.

Female--Total length 18-22 mm. Length of forewing 16-20 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-2-2. Genitalia: Lateral-(Fig. 40A, Appendix B). IX and X differentiated by a vague suture line. IX broad dorsally and narrowed ventrally. IX declivitous posteriorly ending in a distinct medial lobe. Posterior IX set with setae dorsally and laterally. Basal lobe of IX small. Dorsal X consisting of two posterolateral lobes directed caudally. Ventral X bulbous and setose anteriorly and produced into a sclerotized, scooplike process posteriorly. Supragenital plate membranous and triangular with apex posteriorly. Vulvar scale triangular, produced to apex posteriorly. Ventral-(Fig. 40B, Appendix B). Vulvar scale semi-circular, generally with small medial lobe on posterior margin. Supragenital plate membranous and pentagonal. Ventral IX a narrow, transverse rectangle. Lateral IX visible. Tubular ventral X raised, setose, and with broad v-shaped notch posteriorly. Dorsal X visible lateral to and posterior to ventral X, set with setae. Dorsal-(Fig. 40C, D, E, Appendix B). Segment IX comprising majority of terminal segments with posterior border generally produced to form a

distinct posteromedial lobe (See Fig. 40C, D, E, for variation, Appendix B). Development of lateral lobes of X variable, sometimes pointed, sometimes rounded. Posterolateral projections of X typically set with setae. Some setae generally on lateral and dorsal IX.

Diagnosis. Male--This species is most closely related to P. lepida and P. indiana from which it may be differentiated by the more extensive wing coloration pattern, lack of a posterior indentation medially on tergite VIII, presence of a prominent mesal concavity on the posterior border of VIII, and by the lack of a lateral, pointed shoulder on the apices of the claspers viewed posteriorly.

Female--This species is most likely confused with P. lepida and P. indiana from which it may be distinguished by the more extensive wing coloration pattern and the broader opening of the ventral lip of the anus viewed ventrally. It differs from P. lepida also, in having three dorsal projections on the posterior abdominal segments (two in most P. lepida).

Type locality. (Neotype) McHenry, Illinois.

Distribution. See chapter IX and Fig. 65 (Appendix B).

Variation. Male--The extent of wing coloration pattern is somewhat variable. The discoidal cell may be very slightly darkened and the cord darkening may begin in cell R3 or R1. Wing apex coloration may extend from cells R2 or R4 and may be vague, or even restricted to the vicinity of the apical veins. The wing may occasionally possess even sized brown spots throughout. The shape

of the clasper in rear view is somewhat variable, the shoulder on the base being distinctly developed (as figured) or totally lacking.

Female--The wing coloration pattern variation is as in the male description. The shape and development of lateral and medial, dorsal projections of the abdomen are somewhat variable (Fig. 40C, D, E, Appendix B). The ventral width of the lip of the anal opening viewed ventrally is slightly variable but seldom as small as P. lepida.

Notes. Male--Betten (1950) noted some doubt as to whether or not this species and P. indiana were distinct because of variability in characters. Although I have seen apparent hybrids between this species and possibly P. lepida, I have seen none that I feel to be intergrades between P. subfasciata and P. indiana. In all specimens I have examined the characters are distinct enough for relatively easy separation of P. indiana and P. subfasciata. If synonymization of any species seems warranted, I suspect it should be P. indiana with P. lepida. Previously thought to be restricted to northern States, P. subfasciata has been shown to occur in some southern States (Sherberger, 1970; O.S. Flint, Jr., pers. comm.) and even on the Coastal Plain (J.C. Morse, pers. comm.). The flight period of this species in the northern portion of its range extends from as early as mid-June, but more typically from mid-July to early to mid-October. In the southern portion of its range the flight period extends from late August or early September to late October or mid-November.

Material examined. Georgia-Clarke Co., Athens, 10 Oct. 1971, R. Baer, 1 female. Crawford Co., Roberta, 20 Oct. 1944, P.W. Fattig, 1 male. Illinois-Dewitt Co., Wapella, small str., 29 Sept. 1950, Ross & Stannard, 3 males, 2 females. Kankakee Co., Momence, Kankakee R., 4 Oct. 1937, Ross & Burks, 2 females. Indiana-LaGrange Co., Pigeon Cr., 1100 E, 8 Sept. 1973, Coll.?, 1 male, 2 aberrant males. Wayne Co., Milton Hieser Station Rd., 7 Sept. 1975, J.W. Hart, 1 female. New Jersey-Burlington Co., Bel Haren Lake, @ Rt. 542, R.W. Bouchard, 28 Sept. 1979, 1 male, 1 female. Minnesota-Cass Co., Walker, Shingobee Island, 21 Sept. 1963, D.A. Etnier, 1 male. Cook Co., Lewis Island, Lake Saganaga, 20 Aug. 1963, D.A. Etnier, 3 males, 1 female; Approx. 5 Sept. 1966, D.A. Etnier, 4 males, 6 females. Itasca Co., Deer Lake at Grand Rapids, 18 Sept. 1958, 1 female. Lake Co., Upper Sand Lake (Midiwan), 7 Sept. 1964, D.A. Etnier, 1 male. South Carolina-Berkeley Co., Four Holes Swamp, Mim's Lake, 14 Oct. 1976, J.C. Morse, 12 males, 8 females; 18 Nov. 1976, 15 males, 18 females. Virginia-Montgomery Co., Blacksburg, Terrace View, ex.: household, 14 Sept. 1978, D. Rowe, 1 female. Wisconsin-Walworth Co., Whitewater R. at Whitewater, 23 Sept. 1978, D. Bergsten, 3 males. Waupaca Co., Clintonville, along Pigeon R., 29 Aug. 1949, H.H. Ross, 1 male.

CHAPTER VI

THE *Pycnopsyche scabripennis* COMPLEX

General

The *P. scabripennis* complex has long been a problem group. The identity of *P. scabripennis* Rambur (described in *Limnephilus*, 1842) has never been resolved and there is little likelihood that it ever will be. The holotype for the species is a female and Betten (1934, 1950) and Banks (1943) both state that the abdomen is lacking. In addition, Banks (1943) indicated that there is no locality data with the specimen, precluding the possibility that a tentative determination might be made based on locality of collection. Unfortunately, except for *P. antica*, where the tip of the first anal cell is distinctly blackened, no reliable determination of species can be made using characters other than the genitalia. Indeed, with females some difficulty may be experienced in assigning even complete specimens to the proper species.

Pycnopsyche antica was described by Walker (as *Neuronia antica*, 1852) and was reduced to synonymy by Hagen (1861). Betten and Mosely (1940) later reelevated this species after examination and redescription of the Walker types. Banks (1943) and Ross (1944) also recognized *P. antica* as a distinct species. Betten (1950), without thoroughly examining the complex, expressed doubt that any of the forms described under *P. scabripennis* s.l. would prove to be of full specific status and effectively synonymized *P. antica*, *P. conspersa*,

P. minima, and P. perplexa under the name P. scabripennis.

Pycnopsyche conspersa, although apparently long recognized as a morph of P. scabripennis (see Betten, 1934), was not described until Banks (1943). It also was synonymized by Betten (1950). Sykora et al. (1976) reelevated P. conspersa to full specific status based on its distinctly different emergence period as compared to P. scabripennis.

Two other species have been described in the complex. Betten and Mosely (1940) separated P. perplexa based on color differences between it and Walker's P. antica types. Banks (1943) described P. minima based on its smaller size as compared to specimens of P. antica. Both species were synonymized by Betten (1950).

In this paper I have recognized and redescribed three of the previously recognized members of the P. scabripennis complex (i.e., P. antica, P. conspersa, and P. scabripennis s.s.). The assignment of the specimens to P. scabripennis s.s. is tentative and has been accomplished simply through the process of elimination (the identity of P. antica and P. conspersa are not in doubt). Both males and females are described for each species. Included are short discussions of P. minima and P. perplexa which I do not believe warrant full specific status.

Discussion of the scabripennis Complex Species

Pycnopsyche antica (Walker). (Neuronia antica Walker, 1852. Cat. Neur. Brit. Mus.: p. 9)

Description. Male--Total length 16.5-22 mm. Length of fore-

wing 14.5-20 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 41A, Appendix B) with discoidal, subradial, thyridial, and Cu1 cells to posterior wing margin darkened. Darkening on cord from slightly in cell R2 to cell M1 or below, sometimes both sides. Wing apex vaguely darkened from cell R4 to posterior margin. Apex of cell 1A distinctly darkened. Remainder of wing with uneven sized spots throughout. Tibial spur formula 1-3-4. Abdomen: Opening of scent gland on anterolateral portion of sternite V near tip of sharp pointed, anteriorly curved horn (Fig. 41G, Appendix B). Genitalia: Lateral-(Fig. 41B, Appendix B). Segment VIII with posterolateral projections medially on tergite. These projections roughly rectangular with gently rounded, almost truncate tip set with small, brown to black spicules. Segment IX tall and roughly elliptical. X with only cercal lobes easily visible in lateral view. Cercal lobes either larger or at least subequal in depth to lateral projections of VIII. Medial projections of X not easily visible in lateral view, but are slightly raised and curved gently caudad to sharp, downward oriented tips. Claspers narrow, bases set with setae. Tips of claspers usually hidden in lateral view, but when seen, anterior erect with medial lobe projecting nearly horizontally posteriad. Dorsal-(Fig. 41C, Appendix B). Dorsal VIII with lateral lobes extending posteriorly and slightly deflexed. Posterior VIII heavily set with light spicules. Cercal lobes of X parallel to the longitudinal axis of the body, more or less vertical in allignment, and setose. Central projections of X slightly raised, fairly massive, and with tips curved laterally and tapering to a point. Posterior X roughly truncate.

Claspers with bases setose, tips with medial lobes somewhat circular, and lateral, higher lobes, forming long triangles with the apices medial. A subanal sclerite slightly visible. Posterior-(Fig. 41D, Appendix B). Clasper bases broad and tapering ventrally, set with setae. Tips distinctly sclerotized with broad lateral and smaller medial lobes. Lateral lobes taller and often produced to sharp, upward oriented points, laterad, and with a duller point mesally. Medial lobe smaller and somewhat rectangular. Anus with bandlike sclerite ventrally, nearly vertically set. Aedeagus-(Fig. 41E, F, Appendix B). In lateral view moderately stocky, tapered distally with tip sharply upcurved. Bases of parameres short, less than one-third total length. Blades of parameres long and simple, upcurved at tips, extending to tip of aedeagus. Slight indentation visible in aedeagus distal of the bases of the parameres. In dorsal view roughly parallel sided with base slightly broader and narrowing slightly past bases of parameres. Bases of parameres short, narrow, blades reaching near tip of aedeagus, slightly curved inward at tips. Aedeagus tapering distally to tip. Distal approximately one-third of aedeagus with medial and lateral ridges with shallow concavities between.

Female--Total length 18.5-24 mm. Length of forewing 16.5-21 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 42A, Appendix B). IX and X differentiated by a faint suture line. IX expanded ventrally into a lobe extending posteriorly below ventral X. Dorsal IX and X setose. Lateral and ventral X setose. Supragenital plate a membranous triangle with apex caudad. Vulvar scale triangular,

venter flattened, and posterior border with slightly mucronate lobe (sometimes rounded). Ventral-(Fig. 42B, Appendix B). Vulvar scale seimicircular with posterior border occasionally with a small medial lobe, usually broadly rounded. Supragenital plate roughly trapezoidal, membranous, and produced to a posterior point. Ventral IX trapezoidal with base posterior, with patches of setae on either side. Ventral X forming ventral border of anal opening. Posteroventral border of X a distinct sclerotized rim. X dorsal to anus, with a sharply bifid excision. Setae visible on lateral and dorsal X. Dorsal-(Fig. 42C, Appendix B). IX and X fused, separated by a vague suture line. IX roughly pentagonal. X v-shaped with apex posterior and slightly v-notched. Dorsal IX with few setae. X heavily setose. Ventral lobes of IX and lateral lobes of X visible from dorsal view.

Diagnosis. Male--The male of P. antica may be confused with P. conspersa, P. scabripennis s.s., P. rossi, and P. sp. A. It differs from P. rossi and P. sp. A in the extensive spotting of the forewing by brown spots of uneven sizes and also by the shape of the apices of the claspers. It differs from P. rossi also in typical spur count (1-3-3 vs. 1-3-4), although caution must be exercised in this respect (see variation of P. rossi). Pycnopsyche antica may be distinguished from P. conspersa and P. scabripennis s.s. by the darkening of the apex of the first anal cell in the forewing and by the shape of the apices of the claspers. It may additionally be distinguished from P. scabripennis s.s. by the sharpness of the membranous horns containing the opening of the scent gland on the anterolateral portion of abdominal sternite V, and from P. conspersa

by the shape of the medial processes of X in dorsal view (more accuminate in P. conspersa).

Female--The female of this species is most easily confused with P. scabripennis s.s. and P. conspersa. In specimens with fully developed wing coloration patterns this species may be identified readily by a distinct brown spot in the apex of the first anal cell of the forewing. Pycnopsyche antica also may be separated from both P. conspersa and P. scabripennis s.s. by the acute notch formed by the dorsal portion of the anal opening viewed ventrally. It may additionally be reliably separated from P. scabripennis s.s. by the width of the ventral lobes of IX (ventral view) appearing as wide as the remainder of combined segments IX and X (it is distinctly narrower in P. scabripennis s.s.).

Type locality. Georgia.

Distribution. See chapter IX and Fig. 48 (Appendix B).

Variation. Male--The extent of wing coloration in this species may be somewhat reduced in certain specimens with the discoidal cell lacking dark pigment and the coloration on the cord restricted to below cell R2. The wing apex occasionally has pigment extending into cell R3 or may have pigment starting in cell R5. Intensity of coloration varies from extremely dark and distinct to very vague. Clasper tips are somewhat variable, laterally varying from being produced to an extreme sharp point to being angulate and without a point. The mid-dorsal margin varies from truncate to rounded.

Female--For wing coloration variation see the male description.

In ventral view the vulvar scale may possess a somewhat distinct medial lobe (Fig. 42B, Appendix B) or may lack such a lobe. Dorsal X may occasionally possess very distinct lobes as pictured for P. scabripennis s.s. (Fig. 44A, Appendix B). This is not restricted to areas where the two species occur sympatrically and is therefore not an indication of hybridization. The development of ventral X may be more distinct in lateral view than is figured (Fig. 42A, Appendix B).

Notes. Male--This is the most common and widespread species of the P. scabripennis complex. It occurs in both relatively high elevation mountain streams and lower elevation, larger streams and even in the blackwater streams of the Gulf Coastal Plain, exhibiting the broadest range of tolerance of the three recognized species in this group. Collection records indicate that it may occur sympatrically with both P. scabripennis s.s. and P. conspersa. I have reared both P. antica and P. scabripennis s.s. from the same stretch of a stream in Virginia. The flight period of this species in the northern portion of its range extends from mid-June to mid-October. In the southern portion of its range I have seen one record in late June, but more typically the period is from mid-August to late October or mid-November.

Female--See notes under male description. The female of this species may be somewhat difficult to separate from P. scabripennis s.s. in teneral adult or MMT specimens. In specimens with full color developed the darkening of the apex of the first anal cell is diagnostic.

Material examined. Alabama-Cherokee Co., Jenkins Spr., Broomtown Comm., U.V. light, R11E, T85, S5SW, Gaylesville Quad., 16 Sept. 1977, K. Manuel, 1 male, 1 female. Georgia-Habersham Co., Big Panther Cr. at Panther Cr. Picnic Ground, 1 mi. N Turnerville, 29 Sept. 1969, F.F.S., 1 male, 2 females. Monroe Co., I-75S, Rest stop before Macon, 13 Oct. 1978, E.B. Williams, 1 male. Union Co., Suches, Canada Cr., 31 Aug. 1945, P.W. Fattig, 1 male. ? Co., Atlanta, 30 Sept. 1951, C.O. Mohr, 1 male. ? Co., Neel Gap, Wolf Cr., 3.6 mi. N, 29 Sept. 1945, P.W. Fattig, 1 male. Indiana-Fountain Co., Portland Arch, 5 Sept. 1980, R.D. & N. Waltz, 2 males. LaGrange Co., Curtis Cr. Trout Rearing Station light, 9 July 1958, N. Wilson, 1 male. LaPorte Co., July 1959, D.L. Schuder, 1 male; Light trap in pine planting, Aug. 1959, 1 male; L.T. in pine planting, 1 Aug. 1959, 2 females; L.T. in pine planting, 2 Aug. 1959, 3 males; L.T. in pine planting, 6 Aug. 1959, 2 males; L.T., 10 Aug. 1959, 3 males; L.T., 5 Sept. 1959, 1 male; L.T., 13 Oct. 1960, Coll.?, 1 male. Wayne Co., Richmond Hayes Arboretum, B.L.T., 22 Aug. 1980, R.D. & N. Waltz, 1 male; Milton Hieser Sta. Rd., J.W. Hart Farm, 16 Aug. 1975, J.W. Hart, 6 males, 7 females. Michigan-Montmorency Co., Hunt Cr., Sect. "C" T29N, R2E, Sec. 3.5, 30 Aug. 1940, J.W. Leonard, 1 female. ? Co., Allais Cr. nr. Almena, 24 Aug. 1940, L. & J.S. Ayars, 1 male. New York-Herkimer Co., light trap sample at beginning of trail to Cedar Pond nr. Old Forge, 2 Sept. 1978, J.A. Wojtowicz, 2 males. Tompkins Co., McLean Res., 8 Sept. 1963, C.V. Covell, 4 males. ? Co., Ringwood Res., 22 Aug. 1963, C.V. Covell, 1 male. North Carolina-Jackson Co., Whiteside Cove, 27 Aug. 1938, Coll.?, 1 female.

Macon Co., Highlands, 16 Aug. 1941, T. Howell, 1 female; Coweeta Exper. For. light trap #3, 3 mi. W of Otto, 5 Sept. 1953, Coll.?, 2 males. Watauga Co., Newland nr. Boone, 15-16 Sept. 1979, R.C. Stone, Jr., 1 male. ? Co., Creek Way, Block Gap, rd. 64, 29 Sept. 1949, Coll.?, 1 male. Pennsylvania-Beaver Co., Raccoon St. Pk., Traverse Cr., 18-19 Aug. 1976, J.S. Weaver, III, 18 males, 1 female. Crawford Co., Linesville Cr.-24, 28 Aug. 1976, B. Swegman, 13 males, 3 females; 7 Sept. 1973, 2 males; 22 Sept. 1973, 1 female; 23 Sept. 1973, 5 males. Fayette Co., Bear Run-5, 29 Aug. 1978, B. Swegman, 1 male. Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 Aug. 1976, J.S. Weaver, III, 49 males, 31 females; 28-29 July 1976, 1 male; 28-29 Aug. 1977, 4 males, 4 females; Kelletville, Ross Run, 27-28 Aug. 1976, J.S. Weaver, III, 2 males, 6 females. Lancaster Co., Welsh Mtn., New Holland Watershed Area, 16-17 June 1977, J.S. Weaver, III, 5 males, 1 female; 4-5 July 1977, 2 males, 1 female; 24-25 July 1978, 3 males, 1 female; Christiana, Pine Cr., 18-19 Sept. 1976, J.S. Weaver, III, 7 males, 2 females. Somerset Co., Kooser Run St. Pk., Kooser Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 11 males, 2 females; 25-26 Sept. 1976, 1 male; Laurel Hill St. Pk., Jones Mill Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 2 males, 2 females. Westmoreland Co., Spruce Run, 21-22 June 1976, J.S. Weaver, III, 1 female. South Carolina-Aiken Co., Savannah R. Plant, Upper Three Runs Cr., Q SRP 8-1, 19-20 Nov. 1976, Herlong, Pritchard, 34 females. Dorchester Co., Four Holes Swamp, Goodson's Lake, 14 Oct. 1976, J.C. Morse, 6 males, 1 female; Mellard's Lake, 14 Oct. 1976, J.C. Morse, 5 males, 4 females. Pickens Co., Wildcat Cr., 9 km. NW Clemson, 21-

22 Oct. 1979, J.S. Weaver, III, 1 male, 3 females. Tennessee-Blount Co., Parson's Branch at Tapoco Boundary, below exit of Cades Cove Rd. onto Rt. 129, 16 Sept. 1978, J.A. Wojtowicz & E.B. Williams, 2 females. Cumberland Co., Univ. of Tenn., Dept. of Econ. Entomol., L.T. at Crossville, Plateau Exper. Sta., 1-2 Sept. and 4 Sept. 1970, Coll.?, 9 males, 4 females; 19 Sept. 1966, Guy Russell, 12 males, 5 females. Hardin Co., light trap at Walker Branch, trib. to Tenn. R. nr. Pickwick Dam, 22 Sept. 1978, J.A. Wojtowicz, D.A. Etnier, & G.W. Wolfe, 2 males. Madison Co., light trap prob. at Jackson, Fall 1965, Coll.?, 1 male, 2 females; Univ. of Tenn., Dept. of Econ. Entomol., light trap at Jackson, 3 Oct. 1966, Coll.?, 6 males. Monroe Co., Jake Best Branch, trib. to Citico Cr., Cherokee Natl. For., 21 Oct. 1978, J.A. Wojtowicz & E.B. Williams, 5 males, 1 female. Scott Co., Indian Cr., trib. to New R., 19 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 female pupa. Virginia-Bath Co., small marsh on Rt. 601 draining Little Back Cr., 5 mi. from Rt. 39, 11 Sept. 1979, B. Kondratieff, 1 female; Confluence Cummings Run and Back Cr., 29-30 Aug. 1973, B. Strickler, 2 males, 1 male hybrid? Carroll Co., New R. by Fries Bridge, 26 Aug. 1976, C.R. Parker, 2 males. Fairfax Co., Falls Church, 8 Oct., Year?, N. Banks, 1 male (Holotype of P. minima, MCZ # 25825). Giles Co., 4 mi. NW on hiking trail, Mtn. Lake, 2 Sept. 1973, J.R. Voshell, Jr., 1 male; Big Stoney Cr., Rt. 722, 25 Aug. 1977, C.R. Parker, 5 males, 1 female; White Rocks Branch, Rt. 613, ca. 110 m. from Rt. 635, 2750' at light, 28 Sept. 1977, C.R. Parker, 1 male. Montgomery Co., Tom's Cr. Area, 8 Sept. 1976, K.A. & C.R. Parker, 2 males. Nelson Co., unnamed sm. str. along Rt. 667, 12

Sept. 1980, B. Kondratieff, 1 female. Rockbridge Co., L.T. at Guy's Run, 4.9 km. off Rt. 39, 15 Sept. 1977, M. Meschter, 2 males. West Virginia-Hardy Co., Wardensville, 21 Aug. 1937 (?), P.N. Musgrave, 1 male. Wisconsin-Florence Co., Little Popple, L.T., 24 Aug. 1970, Coll.?, 3 males. Sauk Co., Otter Cr., in pool, 12 Dec. 1980, J. Stevens, 1 female (reared); Otter Cr. #50, 14 Aug. 1980, Coll.?, 1 male (reared).

Pycnopsyche conspersa Banks. (Pycnopsyche conspersa Banks, 1943. Bull. Mus. Comp. Zool. 92: 345, figs. 45, 46)

Description. Male--Total length 17-21.5 mm. Length of forewing 15-19 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 45A, Appendix B) with darkening in discoidal, subradial, thyridial, and Cu1 cells. Darkening on cord from cells R3 to M1, often slightly on both sides. Wing apex darkened from cell R3 to posterior margin. Lightly spotted with uneven sized spots over the remainder of the wing. Tibial spur formula 1-3-4. Abdomen: Opening of scent gland on anterolateral portion of sternite V at tip of anteriorly curved, sharply pointed horn (Fig. 45G, Appendix B). Genitalia: Lateral-(Fig. 45B, Appendix B). VIII with distinct, rectangular, posterolateral projections with posterior borders gently rounded. Posterior VIII tergite set with short, light brown to black spicules both dorsally and, especially, on posterolateral processes. A lighter u-shaped area visible on VIII anterior to distal border. IX tall and elliptical. Cercal lobes of X short, rounded, and setose, roughly subequal in depth to posterolateral processes

of VIII. Mesal processes of X slightly raised, curved ventrally to an acute downward oriented point distally. Clasper narrow in lateral view, set with setae. Tips of claspers narrower than bases, tapering dorsally, and with apex curved caudad (often not visible in lateral view without effort). Dorsal-(Fig. 45C, Appendix B). Posterior VIII with posterolateral projections. Posterior border of VIII and dorsolateral projections set with light colored to black spicules, especially on the lateral processes. Lighter w-shaped band anterior of posterior border of VIII. Cercal lobes of X short, thin, and setose, set slightly off vertical. Medial processes of X long, thin, tapering to rounded posterior points, set lightly with setae. Clasper bases only slightly visible and setose. Tips of claspers with two medial, rounded projections. Posterior-(Fig. 45D, Appendix B). Clasper bases widest medially and setose, tapered ventrally. Tips sclerotized and setose. Apices sinuate or rounded laterally, with a rounded point medially. A deep medial indentation defining a lower, sharp, medial lobe. A broad sclerotized band ventral to anus. Anus oriented nearly vertically. Aedeagus-(Fig. 45E, F, Appendix B). In lateral view deep basally, with moderately deep indentation past bases of parameres, deepened, and then tapering to slightly upcurved tip. Bases of parameres long and thin, approximately one-third total length. Blades simple, reaching near to tip of aedeagus with tips acute and gently curved dorsal. In dorsal view widest basally, tapering past midpoint in length, parallel sided, and finally tapering to tip. Distal portion with medial and lateral surfaces raised with slight concavities between. Paramere bases long and thin, approximately one-third total

length. Blades simple, extending to near tips of aedeagus with apices slightly curved mesad.

Female--Total length 18-21.5 mm. Length of forewing 16-19 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 46A, Appendix B). IX and X fused, only vaguely demarcated by a suture line. IX roughly rectangular, slightly constricted medially on the posterior border. Dorsal IX slightly raised posteriorly, often with a small, nipplelike projection. Ventral IX projecting partly beneath X as a setose lobe. Dorsal X a vaguely defined, setose lobe. Ventral X vaguely tubular, projecting no further posteriorly than ventral lobe of IX, and setose. Supragenital plate membranous and triangular with apex caudad. Vulvar scale triangular with rounded apex posteriorly. Ventral-(Fig. 46B, Appendix B). Vulvar scale semi-circular, posterior border slightly indented (rounded if viewed from a more anterior perspective). Supragenital plate membranous and polygonal. Ventral IX consisting of two rectangular, setose lobes with posterior u-notch between, projecting posteriad slightly ventral of X. Ventral X forming only a narrow rim beneath and lateral to anal opening, not distinctly tubular. Dorsal X not drawn into two distinct posterolateral lobes, instead setose and with posterior border with shallow, broadly rounded indentation. Anal opening broad, nearly circular. Dorsal-(Fig. 46C, Appendix B). IX and X fused, faintly separated by a suture line. Combined segment roughly rectangular. IX produced posteriorly to sharp point. X setose laterally with broadly rounded indentation posteriorly. Ventral IX slightly visible laterally.

Diagnosis. Male--This species is most likely confused with P. antica, P. scabripennis s.s., P. rossi, and P. sp. A. It may be distinguished from P. rossi and P. sp. A by the unevenly sized spots of the forewings and by differences in the shape of the apices of the claspers. It differs from P. rossi also in typical spur count (1-3-3 for P. rossi), but caution should be exercised in this respect (see variation of P. rossi). It may be distinguished from P. antica by the absence of darkening in the apex of the first anal cell on the forewing, by the more tapered tips of the medial processes of X (dorsal view), and by differences in the shape of the clasper tips. It differs from P. scabripennis s.s. in the more tapered condition of medial segment X (dorsal view), the shape of the clasper apices, and the more sharply produced openings of the scent glands on the anterolateral border of sternite V.

Female--This species is most easily confused with P. antica and P. scabripennis s.s. It may be separated from P. antica by the lack of a distinct darkening in the apex of the first anal cell and by the broader and shallower notch in the dorsal portion of the anal opening, as well as the thin and shallowly protruding ventral X sclerite. It differs from P. scabripennis s.s. by the greater width of ventral IX (as wide or wider than the remainder of combined segments IX and X), by the thin, slightly protruding ventral X sclerite, and by a lack of development of distinct lateral lobes on dorsal X.

Type locality. White Mountains, New Hampshire.

Distribution. See chapter IX and Fig. 50 (Appendix B).

Variation. Male--The wing coloration pattern of this species may vary slightly. Occasional specimens may lack a darkened area in the discoidal cell. Cord patterns may be slightly more extensive than figured (Fig. 45A, Appendix B), darkening more of cell R3 and part of cell M2 and being on both sides of the cord. The wing apex may show slightly less extensive darkening, beginning in cell R4 and not above. Apical darkening may occasionally be very vague. Importantly, rare specimens may show a darkening in the first anal cell, but this is never of the intensity and distinctness of the brown "splotch" found in P. antica. The clasper tips may show some degree of variability as figured (Fig. 45D, Appendix B). The extent of spicule development on the posterior border of tergite VIII is not consistent.

Female--For wing coloration pattern variation see the male description. I have noted very little variation in the female genitalia. This may be less a matter of lack of variation than the difficulty of evaluation. Dorsal IX may either have a reduced nipple-like projection or may lack this structure totally. There also seems to be some variability in the shape of the anal opening. Ventral X is usually shallowly produced and the opening is quite broad, but X may be more obvious than depicted (Fig. 46A, Appendix B).

Notes. Male--I have seen the holotype of this species and the present concept of the species and the above description of it are well in agreement. This species is fairly widespread but highly

localized in occurrence. Records show sympatric occurrence of its adults with both P. antica and P. scabripennis s.s. It appears that this species, more so than the other two, prefers cold water streams or springs. The flight period of this species based on available records extends from early May to late August and early September in the northern portion of its range. In the southern portion of its range it extends from mid-May to early or mid-September.

Female--See notes under description of male. The female of this species has not, to my knowledge, been previously described. It may prove difficult at times to separate from P. antica and P. scabripennis s.s., especially if only teneral adults or MMT specimens are available. This species may prove one and the same with P. perplexa as described by Betten and Mosely (1940).

Material examined. New Hampshire-Coos Co., Abenaki Brook, Jefferson Notch Rd., 7-8 June 1977, J.S. Weaver, III, 33 males, 4 females; Ammonoosuc R., Base of Mt. Washington, 7-8 Aug. 1977, J.S. Weaver, III, 3 males; Cutler R., Pinkham's Notch, 8-9 July 1977, J.S. Weaver, III, 1 male, 1 female; Mt. Pleasant Brook, Mt. Washington, Jefferson Notch Rd., 9-10 June 1977, J.S. Weaver, III, 27 males, 4 females; Sebosis Brook, Jefferson Notch Rd., 7 July 1977, J.S. Weaver, III, 37 males, 10 females. ? Co., White Mtns., no date, Morrison, 1 male (HOLOTYPE: MCZ # 25826). Pennsylvania-Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 July 1976, J.S. Weaver, III, 1 male; 28-29 Aug. 1976, 17 males, 4 females; 28-29 Aug. 1977, 1 male. Somerset Co., Kooser St. Pk., Kooser Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 1 male; Laurel Hill

St. Pk., Jones Mill Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 1 male. Westmoreland Co., Laughington, Furnace Run, 14-15 July 1976, J.S. Weaver, III, 1 male; Linn Run St. Pk., Linn Run, 30 July 1976, J.S. Weaver, III, 1 male, 1 female; Rector, Powdermill Run Nature Reserve, Maul Spr., 19 June 1975, J.L. Sykora & J.S. Weaver, III, 1 male; 15 May 1976, J.S. Weaver, III, 2 females; 20-21 May 1977, J.S. Weaver, III & J.L. Sykora, 2 males, 5 females; 22 June 1977, J.S. Weaver, III, 1 female; 20 July 1977, J.S. Weaver, III, 11 males, 20 females; 16 Aug. 1978, J.A. Wojtowicz & G.W. Wolfe, 1 male, 12 females; 27 July 1979, J.A. Wojtowicz & E.B. Williams, 3 males, 8 females. Tennessee-Sevier Co., Indian Gap, Indian Spr. about 2 mi. from top, Great Smoky Mtns. Natl. Pk., 16 May 1975, G. Tolbert & G. Schuster, 1 male; Walker Prong, West Prong Pigeon R., elev. 4500', nr. spr., Great Smoky Mtns. Natl. Pk., 4 July 1979, J.S. Weaver, III, 1 male. Virginia-Bath Co., Confluence of Cummings Run and Back Cr., 29-30 Aug. 1973, B. Strickler, 1 male; Back Cr., Blowing Sprs. Campground, Rt. 39, 10 Sept. 1979, J.R. Voshell, Jr., 1 male. Highland Co., Watercress in Blue Spr. 1 mi. N of W'ville on Rt. 678, 3 May 1981, K. Loyd, 1 male, 1 female.

Pycnopsyche scabripennis (Rambur). (Limnephilus scabripennis Rambur, 1842. Hist. Nat. Insect Neurop.: p. 488)

Description. Male--Total length 16.5-21 mm. Length of forewing 15-19 mm. Wing and body color pale orange to tan. Wing coloration pattern (Fig. 43A, Appendix B) with darkening in discoidal, subradial, thyridial, and Cu1 cells, often vaguely continued to the

posterior wing margin, and also slightly basally along veins M and Cu. Darkening along cord from Cell R3 to slightly in cell M2, may be on both sides. Wing apex from cell R3 to posterior margin, often vague. Tibial spur formula 1-3-4. Abdomen: Opening of scent gland on anterolateral portion of sternite V at tip of membranous horn, pointed anteriorly and with tip distinctly rounded (Fig. 43G, Appendix B). Genitalia: Lateral-(Fig. 43B, Appendix B). VIII with distinct, roughly rectangular, posterolateral projections set with light colored setae and rounded distally. Posterior border of VIII also set with light colored spicules. Lighter u-shaped area anterior of posterior border of VIII. IX tall and narrowly elliptical. Cercal lobes of X narrow and elongate, set with setae, often distinctly narrower than posterolateral lobes of VIII. Mesal projections of X slightly visible (deep to cercal lobes), curved ventrally and produced to a distinct point. Clasper bases moderately wide, set with setae. Tips distinctly narrowed, slightly bifid medially, blackened only at apices. Dorsal-(Fig. 43C, Appendix B). VIII with posterolateral projections. Posterior borders of VIII and posterolateral projections both set with short, light colored spicules dorsally, especially on posterolateral projections. Roughly w-shaped light band present on posterior border of VIII. Cercal lobes of X narrow, elongate, and setose, set slightly off vertical, and parallel to the longitudinal axis of the body. Medial processes of X moderately large, setose, and tapered to slightly laterally directed points. Posterior border of X angulate. Bases of claspers rounded posteriorly and setose. Tips of claspers with slightly rounded medial lobes. Apex of clasper with small medial

point. Posterior-(Fig. 43D, Appendix B). Clasper bases widest medially, tapered slightly dorsally and ventrally, set with setae. Tips with apex rounded or slightly sinuate. Central portion slightly raised above lateral. Medial notch in clasper tips defining a small, distinct inner lobe. A sclerotized band ventral to anus. Anus oriented nearly vertically. Aedeagus-(Fig. 43E, F, Appendix B). In lateral view deepest at base, indented past bases of parameres, slightly deepened, and then tapering to sharply upcurved tip. Paramere bases narrow and short, approximately one-third total length. Paramere blades simple, gently curved upward, and reaching near to tip of aedeagus. In dorsal view widest basally, slightly constricted past base of parameres, parallel sided, then tapered to tip. Paramere bases narrow and short, approximately one-third or less total length. Paramere blades simple, extending to near tip, and slightly curved medially. Aedeagus beyond base of parameres with lateral and medial portions slightly raised with concavities between.

Female--Total length 19-23 mm. Length of forewing 17-21 mm. Wing and body color pale orange to tan. Wing coloration pattern as in male. Tibial spur formula 1-3-4. Genitalia: Lateral-(Fig. 44A, Appendix B). IX and X fused, separation demarcated by only a vague suture line. IX widened dorsally, constricted medially, and expanded ventrally in a setose, subanal lobe. Dorsal X a semicircular, setose lobe. Ventral X projected posteriad as tubular, subanal structure. Supragenital plate a membranous, triangular lobe with apex posterior. Vulvar scale triangular with acute apex oriented caudad. Ventral-(Fig. 44B, Appendix B). Vulvar scale semicircular with posterior

truncate (rounded if viewed from more anterior perspective). Supra-genital plate membranous and pentagonal. Ventral IX consisting of two rectangular, setose lobes with medial notch between. Ventral X a short, tubular projection beneath and lateral to anus. Dorsal X consisting of posteriorly truncate, setose lobes with u-shaped notch between. Dorsal-(Fig. 44C, Appendix B). Fused segments IX and X slightly narrowed from VIII. IX (?) roughly rectangular with rounded posterior border. X with two truncate, posterolateral, setose lobes with broad u-shaped notch between.

Diagnosis. Male--This species is easily confused with P. antica, P. conspersa, P. sp. A, and P. rossi. It differs from P. sp. A and P. rossi by the uneven sized spots of the forewing, by the shape of the apices of the claspers, and by the development of the openings of the scent glands on the anterolateral portions of sternite V into horns with rounded apices. It additionally differs from P. rossi by its tibial spur count (1-3-3 in P. rossi); however, caution should be used in this respect (see variation in P. rossi). It differs from P. antica in the lack of darkening of the tip of the first anal cell, by the shape of the apex of the claspers, and by the horn supporting the opening of the abdominal scent gland being rounded and not produced to a sharp anterior point. It differs from P. conspersa in the shape of the clasper apex and in the rounded nature of the horn of the abdominal scent gland opening.

Female--This species shows greatest similarity to P. antica and P. conspersa. It differs from P. antica in lacking a darkening in the apex of the first anal cell on the forewing and by the less

acute (often vague) dorsal portion of the anal opening. It differs from P. conspersa in the ventral portion of IX being narrower than the caudal portion of IX and X (ventral view), in the more pronounced ventral sclerotized lip of the anal opening, the development of distinct lobes on dorsal X, and the narrower, deeper indentation in the posterior margin of X (viewed dorsally or ventrally).

Type locality. North America.

Distribution. See chapter IX and Fig. 63 (Appendix B).

Variation. Male--The wing coloration pattern is somewhat variable. Cord coloration may be reduced to cells R4 to M1, and the apical wing coloration pattern may begin in cells R4 or R5. The shape of the claspers may be somewhat variable with the lateral apex slightly lower than the medial apex, or not. The lateral apex is occasionally more angulate, not rounded. The size of the lateral cercal lobes of X is somewhat variable, often being distinctly less than the depth of the lateral projections of VIII. The exterior horns of the scent glands are occasionally produced to a more acute point.

Female--See the male description for wing coloration pattern variation. Some variability is noted in the shape of the anal opening, occasionally having the exterior border more completed and defined than figured (i.e., dorsal and ventral X more obviously continuous; Fig. 44B, Appendix B). The notch in X in dorsal view may be narrower and more v-shaped.

Notes. Male--See also notes on P. antica and P. conspersa. The assignment of the name P. scabripennis s.s. to this species is

tentative and is done mainly because P. antica and P. conspersa have been more adequately described. This species is widespread, but less so than P. antica, and is perhaps intermediate to P. antica and P. conspersa in habitat preference. The flight period in the northern portion of its range occurs from as early as late May, but more typically from mid to late June to late September. In the southern portion of its range the flight period extends from mid to late June to mid-September.

Female--See notes under the male description. Although the type of this species was a female, the female of this species has never been adequately described. Some difficulty may arise in separating this species from P. antica and P. conspersa, especially where teneral adults or MMT specimens are involved.

Material examined. Pennsylvania-Beaver Co., Raccoon Cr. St. Pk., Traverse Cr., 18-19 Aug. 1976, J.S. Weaver, III, 5 males, 3 females; Raccoon Cr. St. Pk., Mineral Run, 30 May 1976, J.S. Weaver, III, 4 females. Crawford Co., Linesville Cr., 28 Aug. 1973, B. Swegman, 1 male, 2 females; 7 Sept. 1973, 1 male, 1 female; 23 Sept. 1973, 2 males; 22 Sept. 1973, 4 males, 2 females. Fayette Co., Bear Run, 29 Aug. 1978, B. Swegman, 3 females. Forest Co., Pigeon, Hatchery Spr., Marienville Rod and Gun Club, 28-29 Aug. 1976, J.S. Weaver, III, 12 males, 10 females; 28-29 July 1976, 3 males; 28-29 Aug. 1977, 2 males; Kelletville, Ross Run, 27-28 Aug. 1976, J.S. Weaver, III, 2 males. Fulton Co., Crystal Spr., Chestnut Bridge, Hol. Run, 31 Aug. 1976, J.S. Weaver, III, 1 male. Somerset Co., Kooser St. Pk., Kooser Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 2 males,

1 female; Laurel Hill St. Pk., Jones Mill Run, 20-21 Aug. 1976, J.L. Sykora & J.S. Weaver, III, 2 males. Washington Co., Amity, small spr. nr. Ten Mile Run, 2 Sept. 1976, B. Owens, 3 males, 2 females; 15 Aug. 1976, 3 males, 2 females. Westmoreland Co., Laughington, Furnace Run, 20-21 Aug. 1976, J.S. Weaver, III, 3 males, 1 female; Linn Run St. Pk., Linn Run, 30 July 1976, J.S. Weaver, III, 1 female; 20-21 Aug. 1976, 3 males, 3 females; Spruce Run, 21-22 June 1976, J.S. Weaver, III, 2 males, 2 females; 20-21 Aug. 1976, 39 males, 11 females; Rector, Powdermill Run Nature Reserve, Maul Spr., light trap, 16 Aug. 1978, J.A.Wojtowicz & G.W. Wolfe, 1 male. Virginia-Bath Co., Confluence of Cummings Run and Back Cr., 29-30 Aug. 1973, B. Strickler, 1 male. Giles Co., Stoney Cr. at light, White Rocks, 2 Sept. 1978, A. Beck, 1 female; Mtn. Lake, July 1948, A.C. Cole, 1 male. Montgomery Co., Brush Mtn., porchlight, 17 Sept. 1976, K. Cannon, 3 males. West Virginia-Pochahontas Co., Cranberry Glade, 2000-2300' elev., 20 June 1975, W. Knausenberger, 1 male. CANADA: Ontario-? Co., Rostrevor, 5 Sept. 1907, A. Gibson, 1 male (L.J. Milne Coll.). Quebec-Rouville Co., Mont. St. Hilaire, West Cr., 4 Aug. 1970, R. Mackay, 9 males, 1 female.

Pycnopsyche minima Banks. (Pycnopsyche minima Banks, 1943. Bull Mus. Comp. Zool. 92: 345, figs. 38, 39)

I have studied the holotype of this species. Like P. antica the wing coloration pattern includes a distinct darkening of the first anal cell in the forewing, and the claspers fall well within the variation expected of P. antica. Banks (1943) separated P. minima based on size. I determine the length of the forewing of the

holotype to be ca. 16 mm. which is not unusually small for P. antica (Range 14.5-20 mm.). Many species of Pycnopsyche contain smaller than typical specimens (Betten, 1950); therefore, even if P. minima were an extremely small morph (which it is not), I do not believe that this alone would warrant specific recognition. It appears from the material I have studied that Coastal Plain populations of Pycnopsyche tend to be somewhat smaller than other populations. In my judgement, there appears to be no stable characters differentiating P. minima from P. antica. In light of this, I believe that P. minima should remain in synonymy; however, as I am reelevating P. antica, I suggest that P. minima should be considered synonymous with that species and not with P. scabripennis s.s.

Pycnopsyche perplexa Betten & Mosely. (Pycnopsyche perplexa Betten & Mosely, 1940. Walker Types of Trichoptera, p. 145, fig. 72)

Betten and Mosely (1940) described this species based mostly on wing coloration differences from the P. antica types of Walker (1852). Since its description, some confusion has surrounded the identity of this species. Banks (1943) identifed the male of P. gentilis as belonging to this species. Later, Betten (1950) synonumized P. perplexa under P. scabripennis s.l. Although I have not seen the type of P. perplexa, based on the description and figure provided by Betten and Mosely (1940), I suspect that it will prove to be either P. conspersa or perhaps a somewhat teneral specimen of P. antica. In all the material I have examined, I have seen no evidence to indicate the existence of any species in the complex

other than those which I have described herein. At present, P. perplexa remains in synonymy with P. scabripennis s.l.

CHAPTER VII

REVISED KEYS TO MALES AND FEMALES OF *Pycnopsyche*

Much of the following keys has been adapted from those of Betten (1950). A large portion of the couplets are, however, original. Several of the species keyed here were not known or not recognized at the time that the keys of Betten (1950) were constructed. An effort has been made to use only those characters which are known to be relatively stable and recognizable even in MMT or teneral adult specimens. Whenever possible several characters have been used in each couplet to make identification of specimens more certain.

Key to Males of *Pycnopsyche*

1a. Segment X with mesal processes sclerotized and variously modified into tapered, pointed or blunt, bladelike processes (Fig. 8B, 10B, 12B, 14B, Appendix B). 2

1b. Segment X without sclerotized mesal processes, modified instead with lateral, triangular, setose areas (= cercal lobes of X) and more mesal, rectangular, setose patches (= mesal processes of X) (Fig. 30C, Appendix B). . . . . *virginica*

2a. Lateral portion of tergite VIII with a distinct rectangular, rounded, or pointed and hook shaped, posterior extension (Fig. 8B, 20B, 24B, 34B, 41B, Appendix B) 3

2b. Lateral portion of tergite VIII without such a posterior projection (Fig. 10B, 12B, 14B, 16B, Appendix B). 16

3a. Posterolateral processes of tergite leaving VIII medially or nearly so (Fig. 8B, 24B, 34B, 41B, Appendix B) 4

3b. Posterolateral processes of tergite VIII leaving near ventral margin, with tips with heavy black spines; aedeagal parameres with multiple blades; tibial spur formula 1-3-3; clasper with simple, lateral point when viewed posteriorly (Fig. 20B, D, Appendix B) . . . . . guttifer

4a. Posterolateral processes roughly rectangular with a truncate or gently rounded distal border (Fig. 26B, 32B, 41B, 43B, 45B, Appendix B). 5

4b. Posterolateral processes hook shaped, pointed, or rounded posteriorly (Fig. 22B, 24B, 28B, 34B, Appendix B) 9

5a. Claspers in posterior view with simple apical points (Fig. 26D, Appendix B). . . . . rossi

5b. Apices of claspers not as above, instead with accessory notches or medial points (Fig. 32D, 41D, 43D, 45D, Appendix B) 6

6a. Forewings heavily spotted with brown spots of varying size and shape (Fig. 41A, 43A, 45A, Appendix B); claspers without an abrupt, posterior shoulder at base of apical portion in lateral view (Fig. 41B, 43B, 45B, Appendix B); opening of abdominal scent gland on sternite V at the tip of an anteriorly oriented, sharp or blunt tipped horn (Fig. 41G, 43G, 45G, Appendix B) 7

6b. Forewings without such spots or at most with a few equally sized spots (Fig. 32A, Appendix B); claspers with an abrupt

posterior shoulder in lateral view (Fig. 32B, Appendix B); opening of scent gland on abdominal sternite V at tip of, at most, a slight anterior point (Fig. 32G, Appendix B) . . . . . P. sp. A

7a. Tips of first anal cell of forewings darkened; claspers in posterior view with sharp, apicolateral points (occasionally reduced) and angulate, sharply pointed, medial, subapical points (Fig. 41A, D, Appendix B) . . . . . antica

7b. Tips of first anal cell of forewings not darkened or only very vaguely so; claspers without apicolateral points and with medial processes not angulate and sharp pointed (Fig. 43A, D, 45A, D, Appendix B). 8

8a. Medial portion of clasper in posterior view only slightly indented, forming a slight, knob shaped, medial process; opening of abdominal scent gland on sternite V near tip of bluntly rounded horn; medial processes of X in dorsal view, broad (Fig. 43C, D, G, Appendix B) . . . . . scabripennis

8b. Medial portion of clasper in posterior view deeply indented, forming a thin, apically pointed, medial lobe; opening of scent gland on sternite V near tip of sharply pointed, anteriorly directed horn; medial processes of X long and narrow in dorsal view (tapered posteriorly) (Fig. 45C, D, G, Appendix B). . . . . conspersa

9a. Medial processes of X with distinct posterior and lateral projections (Fig. 35C, 37C, 39C, Appendix B); tibial spur formula typically 1-2-2. 10

9b. Medial processes of X without lateral projections (Fig. 28C, 34C, Appendix B); tibial spur formula typically 1-3-4. . . 12

10a. Claspers in posterior view produced to distinct points both laterally and medially; posterior of dorsal VIII without, or with only a slight medial concavity; posterior margin of VIII often with a moderate to deep emargination, lightly to heavily spinose; wing coloration pattern reduced and often vague (Fig. 35A, C, D, 37A, C, D, Appendix B). 11

10b. Claspers in posterior view without lateral points, at most with rounded lateral shoulders; posterior of dorsal VIII lacking mesal notch and with distinct medial concavity; wing coloration pattern usually extensive and distinct (Fig. 39A, C, D, Appendix B). . . . . subfasciata

11a. Posterior border of dorsal tergite VIII with a moderate to deep mesal notch; aedeagus usually not particularly stocky or deeply notched (Fig. 35C, E, F, Appendix B) . . . lepida

11b. Posterior border of dorsal tergite VIII with only a very slight mesal notch or none; aedeagus usually stocky and with a deep notch past the bases of the parameres (Fig. 37C, E, F, Appendix B) . . . . . indiana

12a. Medial processes of X arising dorsally on segment, broadly fused, and with apices oriented obliquely laterad (Fig. 28B, C, 34B, C, Appendix B) 13

12b. Medial processes of X not arising dorsally, and if fused basally, apices not oriented obliquely laterad (Fig. 8B, C, 22B, C, 24B, C, Appendix B). 14

13a. Claspers in lateral and posterior view with two large, distinct lobes (Fig. 28B, D, Appendix B) . . . . . P. sp. B

13b. Claspers in lateral and posterior view only slightly bifid (Fig. 34B, D, Appendix B). . . . . sonso

14a. Tips of claspers distinctly bifid; aedeagal parameres with simple blades; wing coloration pattern reduced; cercal lobes pointed posteriorly (Fig. 24A, B, D, E, F, Appendix B) . . . . . luculenta

14b. Tips of claspers not bifid; aedeagal parameres with modified blades; wing coloration pattern extensive; cercal lobes rounded or truncate posteriorly (Fig. 8A, B, D, E, F, 22A, B, D, E, F, Appendix B). 15

15a. Apices of claspers in posterior view simple and paddlelike; aedeagal parameres with peculiar wide, flattened blades; central processes of X long and narrow in lateral view (Fig. 22B, D, E, F, Appendix B). . . . . limbata

15b. Apices of claspers with medial, conical projections when viewed posteriorly; aedeagal parameres with multiple blades; medial processes of X broad in lateral view (Fig. 8B, D, E, F, Appendix B) . . . . . aglona

16a. Mesal processes of X with both posterior and lateral projections; tibial spur formula typically 1-2-2 (Fig. 35C, 37C, 39C, Appendix B). 17

16b. Mesal processes of X with only posterior projections; tibial spur formula typically 1-3-3, 1-3-4, or 1-2-4 (Fig. 10C, 12C, 14C, 16C, Appendix B). 19

17a. Claspers in posterior view produced to distinct points both laterally and medially; posterior of dorsal VIII without or with only slight medial concavity; rear margin of VIII often moderately to deeply emarginate; wing coloration pattern reduced and often vague (Fig. 35A, C, D, 37A, C, D, Appendix B). 18

17b. Claspers in posterior view without lateral points, at most with rounded lateral shoulders; posterior of dorsal VIII with distinct medial concavity; posterior border of dorsal VIII without a mesal emargination; wing coloration pattern extensive (Fig. 19A, C, D, Appendix B) . . . . . subfasciata

18a. Posterior border of dorsal tergite VIII with a moderate to deep mesal notch; aedeagus usually not particularly stocky or deeply notched (Fig. 35C, E, F, Appendix B). . . . . lepida

18b. Posterior border of dorsal tergite VIII with only a very slight mesal notch or none; aedeagus usually stocky and with a deep notch past the base of the parameres (Fig. 37C, E, F, Appendix B). . . . . indiana

19a. Posterior margin of dorsal VIII with a deep emargination forming two or three distinct lobes; tibial spur formula typically 1-3-3; aedeagal parameres with only simple blades; wing with a distinct, extensive coloration pattern (Fig. 10A, C, E, F, 12A, C, E, F, Appendix B). 20

19b. Posterior margin of dorsal VIII at most only weakly indented; tibial spur formula typically 1-3-4, occasionally 1-2-4; aedeagal parameres multipointed, spiny clubs; wings

nearly concolorous (Fig. 14A, C, E, F, 16A, C, E, F, Appendix B). 21

20a. Posterior VIII in dorsal view divided into two distinct lobes set with black spines; clasper tips with small, simple, accuminate points (Fig. 12C, D, Appendix B) . . . . . divergens

20b. Posterior VIII in dorsal view with two distinct lateral lobes and a reduced central lobe, all set with black spines; clasper tips with tall, lateral points and shorter, rounded, medial points (Fig. 10C, D, Appendix B). . . . . circularis

21a. Posterior margin of VIII dorsally with a rectangular patch of black spines; mesal processes of X short and stocky in dorsal view (Fig. 16C, Appendix B). . . . . gentilis

21b. Posterior margin of VIII dorsally without such spines; mesal processes of X long and narrow in dorsal view (Fig. 14C, Appendix B) . . . . . flavata

Key to the Females of Pycnopsyche

1a. Tibial spur formula 1-2-2; dorsum of terminal segments with two or three posterior projections arising laterally and/or medially on segment; floor of anal opening produced posteriorly as a sclerotized scoop (Fig. 36A-C, 38A-C, 40A-C, Appendix B). 2

1b. Tibial spur formula either not 1-2-2, or if 1-2-2 terminal segments without posterior projections, or with those projections not arising laterally and/or medially on segment,

floor of anus variable (Fig. 9A-C, 11A-C, 13A-C, 15A-C, 25A-C, 42A-C, Appendix B). 4

2a. Ventral X (floor of anal tube) in ventral view with a broad, v-shaped notch posteriorly (width ca. .26-.32 mm.); wing coloration pattern extensive (Fig. 40B, 39A, Appendix B) . . . . . subfasciata

2b. Ventral X (floor of anal tube) in ventral view with a narrow, v-shaped notch posteriorly (width ca. .13-.19 mm.); wing coloration pattern reduced (Fig. 35A, 36B, 37A, 38B, Appendix B). 3

3a. Terminal segments of abdomen produced into three distinct lobes, two lateral and one medial (Fig. 38C, Appendix B) . . . . . indiana

3b. Terminal segments of abdomen produced into only two distinct lateral lobes (Fig. 36C, Appendix B) . . . . . lepida

4a. Segment IX produced as a distinct lobe projecting posteriorly slightly below ventral segment X in ventral or lateral view (Fig. 13A, B, 15A, B, 25A, B, 33A, B, 42A, B, 44A, B, 46A, B, Appendix B). 5

4b. Segment IX not produced as a distinct lobe projecting posteriorly slightly below ventral segment X in lateral or ventral view (Fig. 9A, B, 11A, B, 23A, B, 27A, B, 29A, B, 31A, B, Appendix B) 12

5a. Floor of anal tube sclerotized and scooplike extending well beyond tip of dorsal portion of terminal segments; wings nearly concolorous (Fig. 14A, 15A, Appendix B) . . . flavata

5b. Floor of anal tube either not a sclerotized scoop, or if so, extending at most to a point equal to the dorsal portion of terminal segments (Fig. 17A, 25A, 33A, 42A, Appendix B) 6

6a. Vulvar scale with three distinct lobes posteriorly, all three lobes produced equally far posteriad, or nearly so; dorsum of X produced to a single point; ventral IX narrower or equal to width of combined terminal segments IX and X; forewings not extensively marked with black; tibial spur formula 1-3-4 (Fig. 33A-C, 32A, Appendix B). . . . *P.* sp. A

6b. Vulvar scale either without three lobes, or with medial lobe longer and more distinct than lateral lobes (Fig. 13B, 17B, 25B, Appendix B). 7

7a. Combined segments IX and X forming a somewhat tubular shaped structure, appearing for the most part separate and distinct from the supragenital area; wings with at most evenly sized spots in the forewing in addition to the areas of dark pattern[1] (Fig. 12A, 13A, 24A, 25A, Appendix B) 8

7b. Combined segments IX and X not forming such a structure, instead appearing to be continuous with supragenital area; wings with uneven sized spots and splotches in addition to areas of dark color pattern, or nearly concolorous (Fig. 16A, 17A, 41A, 42A, 43A, 44A, 45A, 46A, Appendix B) 9

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[1]I have seen a South Carolina population of *P. gentilis* which might key to this couplet.

8a. Ventral X forming two distinct lobes posteriorly in ventral view; middle lobe on posterior border of vulvar scale distinctly mucronate; wing pattern limited in extent and with no even sized spots evident; tibial spur formula 1-3-4 (Fig. 24A, 25B, Appendix B). . . . . luculenta

8b. Ventral X reduced to a sclerite in the floor of ventral IX which is bulbous and setose; middle lobe of vulvar scale at most rounded; wing pattern fairly extensive and with even sized spots in addition to basic pattern; tibial spur formula 1-3-3 (Fig. 12A, 13B, Appendix B). . . . . divergens

9a. Posterior border of vulvar scale with pronounced, pointed, medial lobe; wings nearly concolorous; tibial spur formula 1-3-4 or 1-2-4 (Fig. 16A, 17B, Appendix B) . . . . gentilis

9b. Posterior border of vulvar scale with at most a slightly rounded medial lobe; wings with uneven sized splotches and spots in addition to fairly extensive basic pattern; tibial spur formula 1-3-4 (Fig. 41A, 42B, 43A, 44B, 45A, 46B, Appendix B). 10

10a. Apex of first anal cell distinctly darkened; basal cell dark band narrow; dorsum of anal opening forming a sharp, medial notch (Fig. 41A, 42B, Appendix B) . . . . . antica

10b. Apex of first anal cell not distinctly darkened; basal cell band of color fairly broad; dorsum of anal opening either indistinctly closed or forming a broad notch (Fig. 43A, 44B, 45A, 46B, Appendix B). 11

11a. Dorsal X with distinct lobe in lateral view; ventral IX appearing narrower than terminal portion of IX and X (ventral

view); ventral X a short but distinctly produced sclerotized scoop (ventral and lateral view); anal opening not distinctly broadened (Fig. 44A, B, Appendix B). . . . . scabripennis

11b. Dorsal X with no distinct lobe in lateral view; ventral IX appearing as wide or wider than terminal portion of IX and X (ventral view); ventral X a short sclerite, not distinctly produced; anal opening appearing broad and shallow (Fig. 46A, B, Appendix B). . . . . conspersa

12a. Combined segments IX and X broad and only slightly tapered in dorsal and ventral view, with broad, u-shaped emargination in dorsal view (Fig. 29B, C, 31B, C, Appendix B) 13

12b. Combined segments IX and X distinctly tapering posteriorly, without a broad, u-shaped emargination (Fig. 9B, C, 11B, C, 21B, C, 23B, C, 27B, C, Appendix B). 14

13a. Posterior border of vulvar scale rounded, with small, rounded, medial lobe; tibial spur formula 1-3-4; forewing greater than 15 mm.; with broad, rectangular emargination ventrally on terminal segments[2] (Fig. 29B, Appendix B) . . . . . sonso, P. sp. B[3]

13b. Posterior border of vulvar scale truncate, with small, sharp, medial lobe; tibial spur formula 1-2-2; forewing less than 14 mm.; without broad, rectangular emargination ventrally on

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[2]Betten's concept of P. aglona would most likely key here. See P. aglona female description for more detail.

[3]The ranges of these two species are not presently known to overlap. All Virginia and northern North Carolina specimens are probably P. sp. B. All southern North Carolina, SE Tennessee, NW South Carolina and Georgia specimens are probably P. sonso.

terminal segments (Fig. 31B, Appendix B) . . . . . virginica

14a. Dorsum of combined segments IX and X initially markedly declivitous and less so posteriorly (Fig. 11A, 27A, Appendix B) 15

14b. Either dorsum not so markedly declivitous initially, or if so, then the slope the same throughout (Fig. 9A, 21A, 23A, Appendix B). 16

15a. Ventral X developed into a flattened, heavily sclerotized plate; posterior border of vulvar scale with large, distinct, medial lobe (Fig. 11A, B, Appendix B). . . . . circularis

15b. Ventral X not flattened and heavily sclerotized; posterior border of vulvar scale with medial lobe not so distinct (Fig. 27A, B, Appendix B). . . . . rossi

16a. Posterior border of combined segments IX and X distinctly bilobed; vulvar scale with mesal indentations on posterior border; tibial spur formula 1-3-4 (Fig. 9B, C, 23B, C, Appendix B). 17

16b. Posterior border of combined segments IX and X with only small bifurcation; vulvar scale with slightly produced, rounded, medial lobe; tibial spur formula 1-3-3 (Fig. 21B, C, Appendix B) . . . . . guttifer

17a. Dorsum of terminal segments produced to distinct point caudally in lateral view; posterior of vulvar scale with broad, rectangular emargination; ventral X produced into obvious lateral lobes (Fig. 23A, B, Appendix B). . . limbata

17b. Dorsum of terminal segments rounded caudally in lateral view; posterior border of vulvar scale with u-shaped emargination; ventral X not produced into distinct lateral lobes (Fig. 9A, B, Appendix B) . . . . . aglona

CHAPTER VIII

THE LARVAE OF *Pycnopsyche*

General

As stated in the introduction, the larvae of relatively few of the species of *Pycnopsyche* have been described. For those that have, separation to species has not proved easy. Some of the characters previously thought to be of value in species identifications are proving to be of questionable value in certain instances. Sherberger (1970) states that he found larvae of *P. scabripennis* and *P. guttifer* to be inseparable in samples from the Savannah River Basin. Flint (1960) states that members of the *P. lepida* group, as well as the *P. luculenta-sonso* complex, defy attempts at species identification. Even species group identification is heavily based on the characteristics of case structure because of the paucity of larval morphological characters.

Much of the difficulty in separating the larvae of *Pycnopsyche* to species lies in the conservativeness of the genus as a whole. In all, there are few characters which distinguish groups or species. Among those are modification of various of the major head setae and their placement (particularly setae 13, 14 and 15, 16) (Fig. 5A-C, Appendix B), the number of major setae on the venter of the hind femora (two or more than two) (Fig. 3A, B, Appendix B), the presence or absence of a dorsal spacing hump (Fig. 5D, E, Appendix B), the material and architecture of the fifth instar case, and the number

of setae on the dorsum and venter of the first abdominal segment (Fig. 4A, B, Appendix B). The last of these characters may be somewhat suspect (Wojtowicz, 1982). Because of the extremely small size of the setae, the likelihood of their removal by the abrasion of the animal against the case, and even the dirtiness of the specimen, setal counts may be expected to vary greatly within a species. Since many of the dividing lines of setal numbers between species have been rather fine, the above makes this character of dubious value. Case structure, although fairly stable, can show considerable variation in several species. Despite evidence that some species may select particular substrate sizes for inclusion in their cases (Mackay, 1977), overall, case composition appears to depend greatly on availability of components. This only adds further confusion to identification of larval Pycnopsyche.

Along with the scarcity of good taxonomic characters are several problems which have not often been mentioned in relation to the genus. One problem is that the metamorphotype method (Milne, 1938) and the typical cage rearing method do not work well with this group. Ideally for the metamorphotype method, it is best if several stages of the species are present at the same time (i.e., larvae, MMT pupae, and/or adults). In Pycnopsyche, although the flight period of a species may extend over about a month or more, collections do not often yield a mixture of stages. For the typical rearing method one preserves some larvae from a locality at the time of collection and rears several others to identify the species, preserving the case, pupal exuviae, adult or pharate pupa, and larval sclerites for

association of adult with larval stages. Here an important problem arises with this genus in particular. Seldom is any given collection site occupied by only a single species. Usually a minimum of three or four species may occur sympatrically. I have reared as many as four species from the same stretch of stream. In certain areas this is not a problem as one species may construct a stone case and the others stick cases of different design. The real difficulty, however, arises in situations where sympatric species build similar cases of the same materials. Combined with the conservativeness of the larval morphology, this makes matching of reared adults with the previously preserved larvae an almost impossible task. Under such circumstances even massive rearings may fail to result in elucidation of larval identities. This has especially proven so with P. sp. A and P. antica, P. scabripennis s.s. and P. antica, and P. luculenta, P. sonso, and P. sp. B, all described or discussed below. An added difficulty with this genus lies in a previous failure to recognize the legitimacy of species housed under the name P. scabripennis. All larvae reared and described under this name are suspect because the true identity of the adults is not known.

In this study a number of larvae in the genus have been reared or are reported reared for the first time. These include P. conspersa (also reared by J.S. Weaver, III, pers. comm.), P. scabripennis s.s., P. sp. A, P. sp. B, P. flavata (Wojtowicz, 1982), P. limbata, P. indiana (reared by R. Holzenthal), and P. rossi. Recently, I was informed that P. aglona has also been reared (Michael Reif, pers. comm.). Another population of P. rossi has also been localized and

a further attempt at rearing its larva is planned for the near future (R.D. Waltz, pers. comm.). At this time, only P. circularis and P. virginica remain to be reared. This should not lead one to assume, however, that these rearings will swing open the doors to the identification of Pycnopsyche larvae to species. Anyone waiting for construction of an identification key to the larvae of the genus will have to be patient. Further work with the larvae, perhaps encompassing certain biochemical taxonomy methods will be necessary in order to even separate the larvae into species so that a more intensive search for morphological differences may be made. Preliminary work on comparisons of electrophoretic patterns of hemolymph proteins, which I have attempted, appears promising in this respect. But even with the aid of such techniques the code to the separation of species in certain complexes may not be broken.

As knowledge of the larvae now stands, the genus may be divided into larvae of two distinct types based on head setae. The first group contains P. gentilis and P. flavata whose larvae are the only known in the genus to possess modified, bladelike 13th and 16th head setae. All other known larvae in the genus possess only hairlike head setae. Pycnopsyche gentilis and P. flavata may be further separated by the absence of a dorsal spacing hump in P. gentilis and by a difference of the relative positions of head setae 13 and 16 (see descriptions for details). Further division of the group of larvae with hairlike setae may be done based on the number of major ventral femoral setae on the metafemora. Pycnopsyche luculenta, P. sp. B, P. sonso, and P. divergens all possess more than

two major ventral femoral setae on the hind femora. All other species have only two except in rare instances. Species with more than two major ventral femoral setae may be further subdivided using case characteristics (P. divergens with cylindrical case, others with dorsoventrally flattened cases) and by the fact that P. luculenta group species possess considerably fewer setae on the venter of abdominal segment I than does P. divergens. The remainder of the species in the genus may be separated into groups with some degree of success using case characters (see below and also individual species discussions or descriptions).

The larval cases of Pycnopsyche can be divided into four basic types. The first of these is a cylindrical case of stone possessed by P. gentilis and P. flavata (Fig. 7A-C, Appendix B). A second type is cylindrical and composed of sticks of varying lengths and/or quadrate plant parts (Fig. 7D-H, Appendix B). Species having this type of case include P. scabripennis s.s., P. antica, P. conspersa, P. divergens, P. limbata, P. guttifer, and P. sp. A. A third type of case is cylindrical and composed of sand or stone with plant parts or pieces of sticks included (Fig. 7I, Appendix B). All members of the P. lepida group (i.e., P. lepida, P. indiana, and P. subfasciata) and also P. rossi share this type of case. The final type of case for the genus is a dorsoventrally flattened case composed of a combination of plant pieces and sticks, the sticks attached laterally on the case and often extending posteriorly past the end of the central portion of the case (Fig. 7J, Appendix B). All members of the P. luculenta group (i.e., P. luculenta, P. sonso, and P. sp. B)

possess cases of this type. It should be noted that certain species may build cases of more than one type depending on locality, and availability of materials. For example, P. guttifer may have a case of sticks as stated above, or may have one which is a combination of sand, stone, and plant parts or sticks like those of members of the P. lepida group.

What follows are descriptions or discussions of species or species groups for the known larvae of Pycnopsyche. Although the dearth of readily distinguishable larvae may be somewhat disapponting, one must not overlook the value of at least knowing which larvae resemble those of which other species. A benthic biologist may not reap a benefit from such data; however, such information adds considerably to the understanding of relationships within a genus. To the benthic worker I make the whole-hearted suggestion that if you want to know what larvae of Pycnopsyche you may have collected at a site, with rare exceptions (e.g. P. flavata, P. gentilis, P. luculenta at certain localities), rear them.

Descriptions or Discussions of Known Larvae of Pycnopsyche

Pycnopsyche antica

Length of larva 23-28.5 mm. Maximum width of larva excluding first abdominal segment 4-5 mm. HEAD: Width at eyes 1.68-2.13 mm. Base color yellow to orange or reddish orange with brown to black discrete spots (muscle scars) and splotches. Some muscle scars with lighter centers. All 18 major head setae present. A patch of fine spinules medial to eyes. THORAX: Pro- and mesonotum with paired

sclerites covering the majority of those segments. Base color and muscle scars as in head. Only hairlike setae present. Membrane of metanotum with 0-4 setae lateral to Sa1 sclerites and 0-3 setae lateral to Sa2 sclerites. Legs colored as in head and nota. Middle and hind femora generally with only two major setae ventrally. Mesosternal sclerites in a single row, double row, or mixed in the same specimen. ABDOMEN: First segment ventral: Sa1 areas with 10-20 setae each. Sa2 sclerites generally with 5-7 setae each. Sa3 areas with 3-6 setae each. Dorsal: Combined Sa1 + Sa2 areas with 9-17 setae each. Sa3 areas with 4-8 setae each. VIII with 9-16 setae posteriorly. IX with 11-12 setae on dorsal sclerite. First segment with dorsal and lateral spacing humps. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 0-1,0-1; VI 0,0-1. Dorsolateral: III 1,0; IV 1,0. Ventrolateral: II 0,1; III 0,1; IV 0,0-1; V 0,0-1; VI 0,0-1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,1. CASE: (Fig. 7F, Appendix B). The case of this species is typically cylindrical and neatly constructed of either short pieces of sticks, quadrate pieces of plant material, or some combination thereof. It may, however, be variable and in the extreme may be somewhat sloppily built and have additional sticks with their free ends extending caudally, approaching those of P. sp. A and P. guttifer in appearance. I have seen numerous triangular leaf cases similar to those of P. gentilis but larger and more loosely constructed which, I suspect, may be early instar cases of this species. NOTES: The above description is based for the most part on a total of six larvae from sites in Tennessee (3) and Mississippi (3). Because of the difficulty with sympatrically occurring species,

these were the only larvae I felt reasonably certain to be of this and no other species. Numerous other specimens which I have seen appear to fit well with the above description. This species is the commonest and most widespread of the members of the P. scabripennis complex (see distributions, Fig. 48, 50, 63, Appendix B). The habitat preference of this species seems quite broad and includes small to moderate sized streams at various elevations. The final instar larvae of this species, as in other members of its complex and P. lepida, often burrow in the substrate where they may spend their summer inactive period and may also eventually pupate. As in P. lepida not all larvae of this species burrow. A number of them may simply secrete themselves in crevices in logs and branches or may only attach the head of their cases to a log or rock. I have not been able to find any characters which would allow separation of the larvae of this species from those of P. conspersa or P. scabripennis s.s. This species may occur sympatrically with P. conspersa, P. scabripennis s.s., P. divergens, P. guttifer, P. circularis, P. lepida, P. sp. A, P. gentilis, P. luculenta, P. sonso, P. sp. B, P. rossi, P. indiana, and P. subfasciata. The larvae of P. scabripennis s.s., P. indiana, P. lepida, P. gentilis, P. guttifer, P. sp. A, P. sp. B, and P. luculenta have also been found to be syntopic with those of P. antica in various parts of its range. MATERIAL REARED: New York-Warren Co., Charles Lanthrop Pack Demonstration Forest, nr. Warrensburg, sm. woodland str., 30 Aug. 1978, J.A. Wojtowicz, 1 male MMT. South Carolina-Aiken Co., str. nr. Petticoat Junct., 10 Sept. 1979, D.A. Etnier & J.A. Wojtowicz, 1 male, 1 female adults, 1 female

MMT. Tennessee-Cumberland Co., Basses Cr., S of Crossville and Lake Tansi, nr. Univ. of Tenn. Grasslands Exper. Sta., 29 Aug. 1979, J.A. Wojtowicz, 6 male, 12 female MMT. Hardin Co., Walker Branch, trib. to Mud Cr., nr. Pickwick Dam, 22 Sept. 1978, D.A. Etnier, J.A. Wojtowicz, G.W. Wolfe, 4 female adults, 2 female MMT; Barbwood Branch, str. nr. rd. over Pickwick Dam, 22 Sept. 1978, D.A. Etnier, J.A. Wojtowicz, G.W. Wolfe, 1 male, 1 female MMT. Monroe Co., str. above Tellico Plains, summer 1978, J.A. Wojtowicz, 1 male teneral adult; str. 4 mi. above North R. turnoff on new Robinsville Hwy., 22 Aug. 1979, J.A. Wojtowicz, 4 male, 1 female MMT; Citico Cr. proper, Cherokee Natl. For., 23 Aug. 1979, J.A. Wojtowicz, 1 female MMT. Morgan Co., trib. to Clear Cr., N of Catoosa off Hwy. 62W, 3 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 male, 1 female MMT; Buck Cr. at Catoosa Wildlife Area, 6 Sept. 1979, J.A. Wojtowicz, 1 female MMT. Union Co., str. at enterance to Camp Tanasi Girl Scout Camp, nr. Andersonville, 2 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 male, 1 female MMT. ? Co., Lick Cr. on return trip from Pickwick Dam, 22 Sept. 1978, D.A. Etnier, J.A. Wojtowicz, and G.W. Wolfe, 2 males, 3 female MMT. ? Co., Gattis Cr. on return trip from Pickwick Dam, 22 Sept. 1978, D.A. Etnier, J.A. Wojtowicz, and G.W. Wolfe, 1 male, 1 female MMT. TN, Central?, East?, locality uncertain, 1978, J.A. Wojtowicz, 2 male, 3 female MMT. Virginia-Bath Co., first trib. to Back Cr., Cummings Run?, on Va. Rt. 600 approximately .5 mi. N from Va. Rt. 39, 26 July 1979, J.A. Wojtowicz & E.B. Williams, 2 male, 1 female MMT. Bedford Co., Peaks of Otter on Blue Ridge Prkwy, 12 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male adult, 2 male MMT.

Giles Co., White Rocks Cr. on Va. Rt. 613, .5 mi. from intersection Va. 613 and Va. 635, 25 July 1979, J.A. Wojtowicz & E.B. Williams, 1 male MMT (coll. and preserved). ? Co., Blue Ridge Prkwy. nr. mi. marker 156, .3 mi. N of Va. Rt. 6, 12 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male adult, 2 male, 1 female MMT.

Pycnopsyche conspersa

Length of larva 20-24.5 mm. Maximum width of larva excluding first abdominal segment 4-4.5 mm. HEAD: Width at eyes 1.65-1.87 mm. Base color yellow to pale orange or orange with brown or black discrete spots and splotches. Occasionally some muscle scars with paler centers. All 18 major head setae present. A patch of fine spinules medial to eye on each side. THORAX: Pro- and mesonotum with paired sclerites covering the majority of those segments. Base color and muscle scars as for head. Only hairlike setae present. Membrane of metanotum with 0-2 setae lateral to Sa1 sclerites and with 0-4 setae lateral to Sa2 sclerites. Legs colored as in head and nota. Middle and hind femora generally with two major ventral setae, rarely more than two. Mesosternal sclerites with a single row, double row, or mixed in the same specimen, sometimes vague. ABDOMEN: First segment ventral: Sa1 areas with 13-22 setae each. Sa2 sclerites with 4-9 setae each. Sa3 areas with 2-6 setae each. Dorsal: Combined Sa1 + Sa2 areas with 8-15 setae each. Sa3 areas with 2-5 setae each. VIII with 9-18 setae posteriorly. Sclerite of IX with 11-17 setae. Dorsal and lateral spacing humps present on first abdominal segment. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 0,0-1; VI 0,0-1. Dorsolateral: III 1,0; IV 1,0. Ventrolateral: II 0,1; III 0,1; IV 0,1. Ventral: II 0,1;

III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,0-1. CASE: (Fig. 7G, Appendix B). The case of this species is short and cylindrical. It is unusually neatly constructed of small pieces of sticks, alone or in combination with quadrate plant parts. Although this case has never been described, it is identical to that of other members of the P. scabripennis complex. NOTES: The specimens of this species which I have studied indicate that P. conspersa is an inhabitant of higher elevation springs. Relatively few localities are known for this species, in part due to its longtime synonymy with P. scabripennis Rambur. Evidence indicates that this species occurs sympatrically with P. gentilis, P. luculenta, P. scabripennis s.s., P. antica, P. divergens, P. circularis, P. flavata, P. lepida, P. guttifer, and possibly also P. sonso and P. sp. B. I only have direct evidence for the larvae of P. gentilis and P. luculenta occurring syntopically with P. conspersa. A number of the above mentioned sympatric species are possibilities, however. Although I have described this larva separately from a site where it is the only known representative of the P. scabripennis complex (Maul Spring, Westmoreland Co., Pa., larvae and some MMT's provided by J.S. Weaver, III), I have not been able to determine any characters which would identify this species in a mixed series of larvae. MATERIAL REARED: Pennsylvania-Westmoreland Co., Rector, Powdermill Run Nature Reserve, Maul Spr., 16 Aug. 1978, J.A. Wojtowicz & G.W. Wolfe, 2 female adults; 27 July 1979, J.A. Wojtowicz & E.B. Williams, 2 male, 1 female adults, 5 male, 1 female MMT, 1 male, 1 female pupae.

Pycnopsyche divergens

Length of larva ca. 18 mm. Maximum width of larva excluding first abdominal segment 3 mm. HEAD: Width at eyes 1.71 mm. Base color yellow to orange with discrete spots (muscle scars) and splotches. All 18 major head setae present. An additional seta present near seta 17 on each side of head (may be an aberrant specimen). A patch of spinules present medial to each eye. THORAX: Pro- and mesonotum with paired sclerites covering the majority of those segments. Base color and muscle scars as for head. Only hairlike setae present. Mesonotum with 5 setae on membrane lateral to Sa1 sclerites, and 5-6 setae present lateral and anterior to Sa2 sclerites. Legs colored as in head and nota. Middle and hind femora generally with greater than two major setae on ventral margin. Mesosternal sclerites slightly double on one side and with a single row on the other, both sides vague. ABDOMEN: First segment ventral: Sa1 areas with 12 or 17 setae. Sa2 sclerites with 6 or 7 setae. Sa3 areas with 6 or 8 setae. Dorsal: Combined Sa1 + Sa2 areas with 15 or 16 setae. Sa3 areas with 6 or 7 setae. VIII with 11 setae posteriorly. Dorsal sclerite of IX with 13 setae. First segment with dorsal and lateral spacing humps. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 0-1,0. Dorsolateral: III 1,0; IV 1,0. Ventrolateral: II 0,1; III 0,1; IV 0,1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 0-1,1. CASE: The case of this species is cylindrical and composed of quadrate plant parts. See Flint (1960) for further details. NOTES: I have seen only one specimen assumed to be of this species (kindly loaned by Dr. O.S. Flint, Jr.). I have not reared this species. The larva

appears to differ from all but those of the P. luculenta group by its number of major ventral femoral setae. The combination of this character with the case type separates this species easily from all others. Although little is known of the larva of this species, adult records indicate that it may occur sympatrically with P. gentilis, P. conspersa, P. luculenta, P. scabripennis s.s., P. antica, P. lepida, P. guttifer, P. circualris, P. limbata, and possibly P. sp. B and P. indiana. Flint (1960) gives the impression that the larva of P. gentilis may occur syntopically with this species. Larvae of the above mentioned sympatric species all remain possibilities, however. Based on the description of the case type and the locality, I suspect that the larvae that Sibley (1926) described as P. lepida may well have been of this species.

Pycnopsyche flavata

Length of larva 19.8-24.8 mm. Maximum width of larva excluding first abdominal segment 3-4 mm. HEAD: Width at eyes 1.68-2.06 mm. Base color yellowish brown with discrete spots (muscle scars) with paler centers. Front of head distinctly flattened with ridge of spines arcing from eye to eye, lateral and dorsal to frons. All 18 major head setae present. Setae 13 and 16 flattened and bladelike. Seta 16 on ridge of head appearing as member of arcuate band of spines. THORAX: Pro- and mesonotum yellowish brown with dark and/or light centered muscle scars and spinelike and hairlike setae, each consisting of paired sclerotized plates. Pronotum bordered anteriorly by spines. Membrane of metanotum with 0 setae lateral to Sa1 sclerites, and with 5-13 setae lateral and anterior to Sa2 sclerites. Many

setae on membrane between Sa2 sclerites. Legs yellowish brown. Middle and hind femora with two major ventral setae. ABDOMEN: First segment ventral: Sa1 areas with 20-31 setae each. Sa2 sclerites with 4-9 setae each. Sa3 areas with 2-6 setae each. Dorsal: Combined Sa1 + Sa2 areas with 42-54 setae each. Sa3 areas with 1-5 setae each. VIII with 11-19 setae posteriorly. Dorsal sclerite of IX with 10-15 setae. First segment with both dorsal and lateral spacing humps present. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 1, 0-1; VI 0-1,0. Dorsolateral: III 1,0; IV 0-1,0. Ventrolateral: II 0,1; III 0,0-1. Ventral: II 0,0-1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,1. CASE: The case of this species is cylindrical and composed of small stones much as in that of P. gentilis. As in P. gentilis, the early instar cases of this species may be triangular in cross section and composed of leaves, or initial construction may begin with mineral substrates. NOTES: See also Wojtowicz (1982). This species is limited to high elevation seeps and headwater streams in a five state area of the southern Appalachians. Potential associates of this species based on light trap samples include P. gentilis, P. luculenta, P. sonso, P. sp. B, P. lepida, P. antica, and P. conspersa. Larval rearings have shown only P. gentilis to occur syntopically with this species; however, P. luculenta, P. sonso, P. sp. B, and P. conspersa are also distinct possibilities. Pycnopsyche flavata is among the earliest emerging Pycnopsyche species, adults being evident as early as May or June throughout its range, with its flight period continuing as late as early October in some areas. The major emergence period appears to extend through late August with fewer specimens flying later. At the same latitudes the major flight period of P. gentilis

occurs in September and October. The difference in major flight periods undoubtedly serves as an isolating mechanism between these two closely related species. DIAGNOSIS: Of the known larvae of Pycnopsyche, that of P. flavata bears closest resemblance to that of P. gentilis. The larvae of both species possess bladelike 13th and 16th head setae. In P. gentilis both seta 13 and 16 are located on the curvature of the genae distinctly separate from other setae and spines of the head (Fig. 5B, C, Appendix B). In P. flavata seta 16 is located in close apposition to an arcuate band of spines extending from eye to eye (Fig. 5A, Appendix B). In addition, the head of P. flavata is distinctly flattened anteriorly. The head of P. gentilis, although often with a band of spines, displays a gradual rounding both laterally and dorsally. Finally, P. gentilis larvae lack a dorsal spacing hump on the first abdominal segment, while P. flavata larvae possess at least the remnants of such a hump (Fig. 5D, E, Appendix B). MATERIAL REARED: Tennessee-Monroe Co., Mill Branch at ridge top, above Doublecamp Campground, Cherokee Natl. Forest, Citico Cr. Area, 5 July 1978, J.A. Wojtowicz & R.C. Stone, Jr., 4 male, 1 female adults, 1 male MMT; 30 June 1979, J.A. Wojtowicz, 1 male, 3 female adults, 6 male, 2 female MMT.

Pycnopsyche gentilis

Length of larva 16-25.5 mm. Maximum width of larva excluding first abdominal segment 3.25-4.0 mm. HEAD: Width at eyes 1.55-1.97 mm. Base color yellowish brown with mostly discrete spots having lighter centers. All 18 major head setae present. Setae 13 and 16 modified into bladelike structures (Fig. 5B, C, Appendix B). Front

of head with an arc of spicules surrounding frons laterally and dorsally, extending from eye to eye. Setae 13 and 16 not in close apposition to other spines of the head. THORAX: Pro- and mesonotum with a pair of platelike sclerites colored as in head. Pronotum with spines anteriorly and spinelike and hairlike setae dorsally. Mesonotum with spinelike and hairlike setae dorsally. Metanotum with 0 setae on membrane lateral to Sa1 sclerites and 3-20 setae lateral and anterior to Sa2 sclerites. Many setae between Sa2 sclerites on metanotum. Femora colored as in head. Middle and hind femora with two major ventral setae. ABDOMEN: First segment ventral: Sa1 areas with 11-28 setae each. Sa2 sclerites with 5-12 setae each. Sa3 areas with 1-7 setae each. Dorsal: Combined Sa1 + Sa2 areas with 33-70 setae each. Sa3 areas with 2-11 setae each. VIII with 14-30 setae posteriorly. Dorsal sclerite of IX with 12-20 setae posteriorly. First segment with only lateral spacing humps (Fig. 5D, Appendix B). GILLS: Dorsal: II 0,1; III 1,1; IV 1,0-1; V 0-1,0-1; VI 0-1,0-1. Dorsolateral: III 0-1,0; IV 0-1,0; V 0-1,0. Ventrolateral: II 0,1; III 0,0-1; IV 0,0-1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 0-1,0-1. CASE: (Fig. 7A-C, Appendix B). The case of this species has been described by a number of authors including Lloyd (1921, as Arctoecia consocia), Sibley (1926), Flint (1960), and Mackay (1972). It is cylindrical and composed of small stones, the size of which appears to be mediated more by availability than by selection for particle size as suggested by Mackay (1977). Cases of P. gentilis and P. flavata from localities where the two species are sympatric do not seem to differ noticeably. The ontogeny of case development was described

in part or in whole by Lloyd (1921), Flint (1960), and Mackay (1972). Typically the early instar larval case is triangular in cross section and composed of leaves. Under some circumstances the initial leaf case may be by-passed and construction initiated using mineral materials. NOTES: Though restricted to a particular habitat type (generally cool springs or streams, usually at higher elevations), this species ranges throughout eastern North America from southern Canada to northern South Carolina, Georgia, and Alabama. It is one of the commonest inhabitants of higher elevation springs, seeps, and streams and may occur sympatrically with P. luculenta, P. scabripennis s.s., P. antica, P. conspersa, P. sonso, P. sp. B, P. flavata, P. incongrua, and possibly also P. lepida, P. circularis, P. guttifer, P. divergens, P. limbata, and P. indiana in various parts of its range. The larva of this species is known to occur syntopically with P. conspersa, P. antica, P. luculenta, P. sonso, P. sp. A, P. flavata, P. guttifer, and P. sp. B. As mentioned for the adults, this is probably the most variable of the species of Pycnopsyche. Flint (1960) indicated differences between northern and southern larvae of this species, in particular the more highly developed head spination of the southern vs. the northern larvae (Fig. 5B vs. 5C, Appendix B). It should be noted that there does not appear to be a correspondence between variability in the adults between two populations and variability in their larvae. The larvae seem to show fewer consistent differences, not surprising considering the conservative nature of the larvae of the genus. These larvae are among a very few in the genus which are readily and consistently identifiable to the species level.

DIAGNOSIS: The only larvae likely to be confused with P. gentilis are those of P. flavata. Outside of the Appalachian Mountains of Virginia, North Carolina, Georgia, Tennessee, and South Carolina, all larvae with stone cases and setae 13 and 16 modified and bladelike will be P. gentilis. Where sympatric the two species may be distinguished by the lack of a dorsal spacing hump in P. gentilis (present in P. flavata), and by the positioning of setae 13 and 16 away from the arc of spines in P. gentilis (vs. seta 16 in close apposition to other spines of the head in P. flavata). The flight period of this species ranges from August to late October where its range compliments that of P. flavata. MATERIAL REARED: New York-Essex Co., seep strms. on trail to Indian Falls on Mt. Marcy above Adirondak Loj, 7 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 3 male, 2 female MMT, 1 male, 2 female pupae. Ulster Co., seep on Slide Mtn. in Catskills, 8 mi. from Rt. 28 on Ulster Co. Rd. 47S, 10 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 3 male adults, 1 female MMT. Pennsylvania-Westmoreland Co., Rector, Powdermill Run Nature Reserve, Maul Spr., 16 Aug. 1978, J.A. Wojtowicz & G.W. Wolfe, 8 male, 11 female adults, 2 male, 3 female MMT, 1 female pupa. Tennessee-Blount Co., Parson's Branch trib., Xing Rt. 129 to Fontana, N.C., Aug. 1978, J.A. Wojtowicz, 2 male adults, 1 male, 5 female MMT. Monroe Co., Mill Cr. headwaters, trib. to Doublecamp Cr., nr. Citico Cr., Cherokee Natl. Forest, 13 Sept. 1978, J.A. Wojtowicz & R.L. Jones, 3 male MMT, 1 female pupa (coll. and preserved); 30 June 1979, J.A. Wojtowicz, 2 male, 1 female adults, 2 male, 3 female MMT; Falls Branch Parking Area, Laurel Branch ca. one-fourth mile past end of pavement on new Robinsville Hwy. above

Tellico Plains, 22 Aug. 1979, J.A. Wojtowicz, 4 male adults, 2 male, 2 female MMT, 2 female pupae. Morgan Co., trib. to Clear Cr., N of Catoosa, off Hwy. 62W, 3 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 male, 1 female adults, 1 male, 2 female MMT; Dry Branch, trib. to Emory R., off Rt. 27N outside of Wartburg, 3 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 3 male MMT. ? Co., locality unknown, 1978, J.A. Wojtowicz, 1 female adult. Vermont-Bennington Co., Brook on Grn. Mtn. Natl. For., 1.3 mi. off Vt. Rt. 9, .3 mi. east of Woodford, 1st right past Red Mill Brk. Rec. Area sign, 9 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 2 male MMT. Virginia-Bedford Co., Peaks of Otter Pk. on Blue Ridge Prkwy., 12 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male adult, 1 male MMT. Madison Co., Whiteoak Canyon Parking Area, Shenandoah Natl. Prk., 28 Aug. 1978, J.A. Wojtowicz, 1 male MMT (coll. and preserved). ? Co., Yankee Horse Ridge Parking Area, Blue Ridge Prkwy., elev. 3145', 28 Aug. 1978, J.A. Wojtowicz, 3 male, 1 female MMT (coll. and preserved).

Pycnopsyche guttifer

Length of larva 19-24 mm. Maximum width of larva excluding first abdominal segment 3-4.5 mm. HEAD: Width at eyes 1.61-1.84 mm. Base color yellow to orange with brown to black spots and splotches. All 18 major head setae present. THORAX: Pro- and mesonotum with paired plates, color as in head, and with only hairlike setae. Metanotum usually with 0-3 setae on membrane lateral to Sa1 sclerites and 0-4 setae lateral and anterior to Sa2 sclerites. Femora color as in head. Hind femora usually with two major ventral setae. Mid-femoral setae usually two. Mesosternal sclerites usually in more

than one row, at least in part. ABDOMEN: First segment ventral: Sa1 areas with 6-17 setae each. Sa2 areas with 3-8 setae each. Sa3 areas with 3-10 setae each. Dorsal: Combined Sa1 + Sa2 areas with 8-25 setae each. Sa3 areas with 3-8 setae each. VIII with 7-13 setae posteriorly. IX dorsal sclerite with 10 or 11 setae. First abdominal segment with both dorsal and lateral spacing humps. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 1,1; VI 0,0-1. Dorsolateral: III 1,0; IV 1,0; V 1,1. Ventrolateral: II 0,1; III 0,1; IV 0,1; V 0,0-1. Ventral: II 0,1; III 1,1 (rarely not); IV 1,1 (rarely not); V 1,1; VI 1,1; VII 1,1. CASE: (Fig. 7D, Appendix B). The final instar case of P. guttifer is cylindrical and usually composed mainly of sticks. Generally the sticks are attached longitudinally around the circumference of the cylinder. The sticks may extend beyond the case, and the case may be rather sloppily constructed. A certain amount of mineral material may be mixed with wood and sticks dependent on the locale where the larvae are collected. Little information is available on early instar cases for this species. Cummins (1964) states that they are constructed of leaves, but gives no indication of their conformation. I have not collected other than 5th instar larvae or pupae of this species. NOTES: The larvae of this species are not always readily separable from those of the P. scabripennis complex. The differences in the 5th instar case conformation is usually the only reliable character. Use of setal counts of the first abdominal segment as suggested by Flint (1960) does not appear to work consistently. Howard (1976) mentioned the possibility of using the conformation of the mesosternal sclerites in identifying this species in local "known" species

complexes of this genus. I have found this character to have only rare exceptions for this species. However, it appears from other larvae I have studied that P. subfasciata, P. antica, and perhaps other species may share this character. Since these species may occur sympatrically with P. guttifer in a number of northern locales, this is a potential difficulty in separating their larvae. Species which may occur sympatrically with P. guttifer include P. circularis, P. divergens, P. gentilis, P. luculenta, P. sp. A, P. lepida, P. indiana, P. subfasciata, P. antica, P. conspersa, and P. scabripennis s.s. Species whose larvae have been shown to be syntopic with P. guttifer include P. gentilis, P. lepida, P. antica, and P. luculenta. As suggested by Flint (1960) this species appears to prefer larger, warmer streams and even lakes in the north. I have also found northern P. guttifer to be quite common in smaller streams. In the south this species appears to be restricted to small to medium sized rivers. The above description is based on larvae from Warren Co., N.Y. (10), Coburg, Ontario, Canada (5), Leeds and Grenville Co., Ontario, Canada (5) (all localities from which I have reared specimens), and Hollywood, West Virginia (5) (a locality from which specimens were not reared). I have also cursorily examined larvae from the Current R., Ark. (3), Little Buffalo Cr., Ark. (several), Spavinaw Cr., Okla. (4), and Seneca Mouth, Va. (1). MATERIAL REARED: New York-St. Lawrence Co., trib. to the Oswegatchie R., Rt. 3 N.Y., W of Wanakena Ranger School in Adirondak Preserve, 5 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 female adult. Warren Co., Charles Lanthrop Pack Demonstration Forest, nr. Warrensburg, sm. woodland str., 30 Aug. 1978, J.A. Wojtowicz, 1 male, 1 female adult, 2 male, 1 female MMT. Pennsylvania-Carbon Co.,

Hickory Run St. Pk., Hickory Run, 29 Aug. 1978, J.A. Wojtowicz, 1 female MMT (coll. and preserved). Wisconsin-Eau Claire Co., Taylor Cr., 1.3 mi. S of I-94 on Wisc. 37 & 85, Eau Claire, 28 Aug. 1979, D. A. Etnier, 1 male MMT (coll. and preserved). CANADA: Ontario-Northumberland Co., str. nr. Hardnen and King Construction Co., off Rt. 401E, nr. Coburg, 4 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 4 male, 3 female, MMT. Leeds and Grenville Co., strm. on Co. Rd. 2, approx. 1.8 mi. E? W? of Sweets Corners Elementary School, nr. Alexandria Bay, 4 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 female teneral adult, 3 male, 3 female MMT.

Pycnopsyche sp. A

CASE: (Fig. 7E, Appendix B). The case of this species is similar to those of both the P. scabripennis complex and P. guttifer. It is cylindrical and composed of sticks or other plant parts. Some sticks may extend freely beyond the posterior margin of the cylinder. NOTES: Although I have reared a large number of specimens of this species, I have found no reliable way to identify its larva. The difficulty here arises from the syntopic occurrence of larvae of species with similar morphology and case structure. In my estimate, the larva of P. sp. A appears to be essentially identical in morphology to P. antica with which it commonly occurs syntopically. I have seen two specimens with chloride epithelium on the venter of the second abdominal segment (no species of Pycnopsyche are known to possess this character); however, other localities from which I reared P. sp. A show no similar larvae, leading me to suspect that these larvae were aberrant. Unfortunately, further work will be required to identify the larva of this species. Known sympatric species include P. antica, P. gentilis,

P. luculenta, P. lepida, P. indiana, P. guttifer, and P. circularis. Species whose larvae are known to be syntopic include P. antica, P. luculenta, P. gentilis, and P. lepida, but the other mentioned sympatric species are also possibilities. This species inhabits small to medium sized streams of low to moderate elevation. MATERIAL REARED: Tennessee-Cumberland Co., Basses Cr. nr. Lake Tansi and Univ. of Tenn. Grasslands Exper. Sta., S of Crossville, 29 Aug. 1979, J.A. Wojtowicz, 2 male, 5 female MMT, 2 male pupae?; Cottrell Cr., nr. Univ. of Tenn. Grasslands Exper. Sta., S of Crossville and Lake Tansi, 29 Aug. 1979, J.A. Wojtowicz, 1 male, 2 female adults, 1 male, 1 female MMT; Polecat Br. at Catoosa Wildlife Management Area, 6 Sept. 1979, J.A. Wojtowicz, 1 male, 1 female adult, 3 male, 1 female MMT. Morgan Co., trib. to Clear Cr., N of Catoosa, off Hwy. 62W, 3 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 male adult, 7 male, 5 female MMT; Buck Cr. at Catoosa Wildlife Management Area, 6 Sept. 1979, J.A. Wojtowicz, 1 male adult, 7 male, 7 female MMT; Lick Cr. at Catoosa Wildlife Management Area, 6 Sept. 1979, J.A. Wojtowicz, 1 male, 1 female MMT (coll. and preserved). ? Co., Cumberland Mtns. and Plateau of TN?, locality uncertain, 1 female adult, 3 male, 1 female MMT.

Pycnopsyche indiana

Length of larva 16-18 mm. Maximum width of larva excluding first abdominal segment 3-3.5 mm. HEAD: Width at eyes 1.35-1.58 mm. Base color yellow to pale orange with discrete spots and splotches. All 18 major head setae present. A patch of fine spinules medial to each eye. THORAX: Pro- and mesonotum with paired sclerites covering the majority of those segments. Base

color as in head and with only hairlike setae present. Metanotum with 0-2 setae on membrane lateral to each Sa1 sclerite and 2-4 setae lateral and anterior to each Sa2 sclerite. Legs colored as in head and nota. Middle and hind femora with two major ventral setae. Mesosternal sclerites in single row, double row, or mixed in the same specimen. ABDOMEN: First segment ventral: Sa1 areas with 11-25 setae each. Sa2 sclerites with 4-7 setae each. Sa3 areas with 4-12 setae each. Dorsal: Combined Sa1 + Sa2 areas with 12-17 setae each. Sa3 areas with 4-12 setae each. VIII with 12-14 setae posteriorly. Sclerite on IX with 11-12 setae. First segment with both dorsal and lateral spacing humps. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 1, 1; VI 0-1,0-1. Dorsolateral: III 1,0; IV 1,0. Ventrolateral: II 0, 1; III 0,1; IV 0,1; V 0,0-1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,1. CASE: The case of this species is cylindrical and composed either totally of organic matter (sticks or pieces of wood or other plant parts), or partially of mineral and partially of organic matter. None of the cases I have seen have the major portion composed of mineral matter as in typical P. lepida and P. subfasciata. As in other species, I suspect that case structure depends to a large extent on the availability of materials. It would not surprise me if this species constructed totally mineral cases in other localities. I have seen one specimen from middle Georgia with a mineral case which may be of this species. NOTES: This description is based on specimens (5) from St. Tammany Parish, La. provided by Ralph Holzenthal. Although the larva of this species is, in general, smaller than that of P. lepida or P. subfasciata and appears to possess somewhat fewer

setae on the first abdominal segment (especially ventral Sa1 and dorsal Sa1 + Sa2), I have been unable to separate it with any certainty from other members of the complex. There is some question in my mind as to the validity of recognizing this species as distinct from P. lepida. It is mainly from a lack of evidence to the contrary that this species remains recognized. The larvae of this species appear to be common inhabitants of many Coastal Plain streams including the "black water" streams. Sherberger (1970) stated that the majority of his adult specimens were from the Coastal Plain. J.C. Morse (pers. comm.) has also indicated that the populations of Coastal Plain P. indiana are considerable. It does not seem unreasonable that the P. lepida complex is recently evolved, thus accounting for the extreme similarities (especially between P. lepida and P. indiana) and apparent high frequency of intermediates in the non-Coastal Plain populations of these species. Potential associates of this species based on adult light trap records include P. circularis, P. divergens, P. gentilis, P. guttifer, P. luculenta, P. virginica, P. sp. A, P. lepida, P. subfasciata, and P. antica. Syntopic species based on larval rearings include only P. antica.

Pycnopsyche lepida

Length of larva 19-20.5 mm. (probably in reality greater, see below). Maximum width of larva excluding first abdominal segment 4 mm. HEAD: Width at eyes 1.81-1.84 mm. Base color yellow to orange with discrete spots and splotches. All 18 major head setae present. A patch of fine spicules medial to each eye. THORAX: Pro- and mesonotum with paired sclerites covering the majority of those

segments. Base color and spots and splotches as in head. Only hairlike setae present. Metanotum with 0-2 setae on membrane lateral to Sa1 sclerites and 1-6 setae lateral to Sa2 sclerites. Legs colored as in head. Middle and hind femora with two major ventral setae. Mesosternal sclerites in a single row, partially doubled row, or mixed in the same specimen. ABDOMEN: First segment ventral: Sa1 areas with 24-28 setae each. Sa2 sclerites with 2-3 setae each. Sa3 areas with 4-5 setae each. Dorsal: Combined Sa1 + Sa2 areas with 24-28 setae each. Sa3 with 6-9 setae each. Tergite VIII with 9 setae posteriorly. IX sclerite with 11-12 setae on dorsum. First segment with both dorsal and lateral spacing humps. GILLS: II 0,1; III 1,1; IV 1,1; V 1,1; VI 0,0-1. Dorsolateral: III 1,0; IV 1,0. Ventrolateral: II 0,1; III 0,1; IV 0,1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,1. CASE: (Fig. 7I, Appendix B). The case of this species has been described previously by Flint (1960), Cummins (1964), and Howard (1976). Cummins provided an excellent account of the ontogeny of case development in P. lepida. Its case is cylindrical and composed for the most part of small mineral particles. NOTES: This species has been described previously by Flint (1960), Cummins (1964), and Howard (1976). Descriptions of the larva of this species before Flint (1960) (i.e., Sibley, 1926) are questionable due to the problems with the adult taxonomy prior to the revision of Betten (1950). Cummins (1964) and Howard (1976) provided excellent detailed accounts of the ecology of this species. In the north, this species occurs commonly in small to medium sized streams and small rivers. In the more southern portions of its range it occurs typically in larger

streams and rivers. A peculiar larval habit of this species is the burrowing of the late 5th instar larvae into the substrate for pupation (Cummins, 1964; Howard, 1976). Not all larvae burrow, however; some will simply select secure locales in crevices in logs and rocks. I know of no guaranteed method of separating these larvae from those of P. subfasciata or P. indiana. I feel fairly certain that slight differences in characteristic setal counts would be muddled if more specimens of ascertained status were available. It should be noted here that the larva of P. rossi may also prove to be indistinguishable from that of P. lepida and the other members of its complex (see discussion of P. rossi larva). The majority of the above description is based on two larvae from Ontario, Canada, from a site where the only P. lepida group representative was P. lepida. Larvae from Tennessee which I studied agree well with these larvae in most details. However, since species identifications in this group are uncertain, the data obtained from those specimens has not been included in the description. Potential congeneric associates of this species include P. circularis, P. divergens, P. flavata, P. gentilis, P. guttifer, P. limbata, P. luculenta, P. sonso, P. sp. A, P. indiana, P. subfasciata, P. antica, P. conspersa, and P. scabripennis s.s. in various parts of its range. Based on larval rearings syntopic species include P. guttifer, P. antica, P. luculenta, and P. sp. A. MATERIAL REARED: Georgia-Gilmer Co., Coosa R. System, late summer to early fall, 1978, D.A. Etnier & B. Bauer, 1 female MMT (coll. and preserved). Monroe Co., Deer Cr. on Rumble Rd., off I-75 N, N of Macon, 20 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 female

MMT. Tennessee-Cumberland Co., Basses Cr., S of Crossville and Lake Tansi, nr. Univ. of Tenn. Plateau Grasslands Sta., 29 Aug. 1979, J.A. Wojtowicz, 2 male, 1 female MMT, 1 male pupa? Monroe Co., str. ca. 4 mi. above North R. turnoff on new Robinsville Hwy., above Tellico Plains, 22 Aug. 1979, J.A. Wojtowicz, 1 male pupa? (coll. and preserved). Wisconsin-Eau Claire Co, Taylor Cr., 1.3 mi. S of I-94 on Wisc. 37 & 85, Eau Claire, 28 Aug. 1979, D.A. Etnier, 1 female MMT (coll. and preserved). CANADA: Ontario-Northumberland Co., str. nr. Hardnen and King Construction Co., off Hwy. 401E, nr. Coburg, 4 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male adult, 4 male MMT.

Pycnopsyche limbata

Length of larva 17.5-20 mm. Maximum width of larva exluding first abdominal segment 3 mm. HEAD: Width at eyes 1.42-1.48 mm. Base color yellow to yellowish brown with dark brown to black discrete spots and splotches. All 18 major head setae present. Cheek with dark pigmented area. THORAX: Pro- and mesonotum with paired sclerites covering majority of segments dorsally. Base color, spots, and splotches as in head. Only hairlike setae present. Metanotum with 1-4 setae on membrane lateral to each Sa1 sclerite and 2-4 setae lateral to Sa2 sclerites. Femora color as in head and nota. Middle and hind femora with two major ventral setae. Mesosternum with a single row of sclerites. ABDOMEN: First segment ventral: Sa1 areas with 13-18 setae each. Sa2 sclerites with 5-8 setae each. Sa3 areas with 4-6 setae each. Dorsal: Combined Sa1 + Sa2 areas with 10-16 setae on each side of dorsal hump. Sa3 areas with 3-5 setae each. Posterior

border of VIII dorsally with 11-15 setae. Sclerite of dorsal IX with 11 setae. Both dorsal and lateral spacing humps present on first abdominal segment. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 1,0-1. Dorsolateral: III 1,0; IV 1,0; V 0-1,0. Ventrolateral: II 0,1; III 0,1; IV 0,1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,1. CASE: (Fig. 7H, Appendix B). The case of this species is generally shorter than the total length of the larvae. In construction it is very similar to that of the P. scabripennis complex, being cylindrical and composed of pieces of wood and plant material without long, circumferentially oriented sticks. The neatness of construction varies. NOTES: I have seen only four larvae of this species which were associated mainly by the similarity of case structure and sclerites to those of specimens reared from the same locality. There is a possibility that the larvae I have are not P. limbata, but I suspect that they probably are. I have reared one female adult, two male and two female MMTs, and have collected one female pupa of this species. The above description is based for the most part on three of the four larvae I examined (the fourth larva was in poor condition). Pycnopsyche limbata is an inhabitant of mountain streams and small marshy streams at relatively high elevations in the northern portion of the United States and parts of southern Canada. Little is actually known about the habits of this species, and to my knowledge I am the first to have reared its larva. Species possibly sympatric with P. limbata include P. circularis, P. divergens, P. gentilis, P. luculenta, and P. lepida. I have reared no other syntopic species, but all the above mentioned species must be considered possibilities.

It would also not surprise me to find that the larva of P. aglona occurs syntopically with P. limbata. MATERIAL REARED: New York-Essex Co., str. at Indian Falls on Mt. Marcy, Indian Falls Trail above Adirondak Loj, 7 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 female adult, 1 female MMT. Vermont-Bennington Co., marshy str. in Woodford St. Pk., .6 mi. from office, off Rt. 9, 8 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 2 male, 1 female MMT, 1 female pupa.

Pycnopsyche luculenta

Length of larva 16-24 mm. Maximum width of larva excluding first abdominal segment 3-4 mm. HEAD: Width at eyes 1.45-1.68 mm. Base color yellow to orange with discrete brown to black spots and splotches. All 18 major head setae present. THORAX: Pro- and mesonotum with paired sclerites covering majority of segments dorsally. Base color and spots and splotches as in head. Only hairlike setae present. Metanotum with 0-4 setae on membrane lateral to each Sa1 sclerite and with 0-1 setae lateral to each Sa2 sclerite. Femora color as in head and nota. Hind femora generally with greater than two major setae ventrally. Mid-femora with two or greater than two setae ventrally. ABDOMEN: First segment ventral: Sa1 areas with 3-11 setae each. Sa2 sclerites with 3-6 setae each. Sa3 areas with 2-6 setae each. Dorsal: Combined Sa1 + Sa2 areas with 6-16 setae each. Sa3 areas with 2-5 setae each. Dorsal VIII with 8-17 setae posteriorly. Dorsal sclerite of IX with 9-11 setae. Both lateral and dorsal spacing humps present on first abdominal segment. GILLS: Dorsal: II 0,0-1; III 1,1; IV 1,1; V 0-1,0-1; VI 0-1,0-1. Dorsolateral: III 1,0; IV 1,0; V 0-1,0. Ventrolateral: II 0,1; III 0,1; IV 0,0-1;

V 0,0-1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 0-1, 1. CASE: (Fig. 7J, Appendix B). The typical case of this species is dorsoventrally flattened, made of plant fragments, and usually has a long stick joined to either side laterally, often extending beyond the body of the case both anteriorly and posteriorly. Occasional cases may be found to be more sloppily constructed, approaching those of P. guttifer in appearance. The early instar cases I have seen are for the most part made of leaves and are dorsoventrally flattened. NOTES: This species is a resident of low elevation, moderate sized streams to high elevation mountain streams of varying size, throughout eastern North America. This species might likely occur sympatrically with P. gentilis, P. scabripennis s.s., P. antica, P. conspersa, P. lepida, P. guttifer, P. flavata, P. sp. B, P. sp. A, P. circularis, P. sonso, P. divergens, and P. indiana in various parts of its range. Larvae known to occur syntopically with this species include P. guttifer, P. gentilis, P. lepida, P. conspersa, P. antica, P. sonso, P. sp. A, and P. scabripennis s.s. The larva of P. flavata must also be considered as possibly being syntopic. DIAGNOSIS: Having greater than two major ventral femoral setae on the hind femora, separates this species from all other Pycnopsyche except P. divergens, P. sonso, and P. sp. B. The shape of its case separates it from P. divergens. At present there are no known characters which allow its separation from P. sonso and P. sp. B. MATERIAL REARED: Georgia-Monroe Co., Deer Cr. on Rumble Rd., off I-75N, N of Macon, 20 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 female MMT. New York-Essex Co., seep on Mt. Marcy along Indian

Falls trail above Adirondak Loj, 7 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male MMT (coll. and preserved). St. Lawrence Co., trib. to the Oswegatchie R., Xing Rt. 3 N.Y., west of Wanakena Ranger School, in Adirondak Preserve, 5 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male MMT. Pennsylvania-Carbon Co., Hickory Run St. Pk., Hickory Run, 29 Aug. 1978, J.A. Wojtowicz, 2 female MMT (1 reared, 1 coll. and preserved). Westmoreland Co., Rector, Powdermill Run Nature Reserve, Maul Spr., 16 Aug. 1978, J.A. Wojtowicz & G.W. Wolfe, 5 male, 8 female adults, 5 male, 9 female MMT. Tennessee-Cumberland Co., S of Crossville and Lake Tansi, Basses Cr. nr. Univ. of Tenn. Grasslands Exper. Sta., 29 Aug. 1979, J.A. Wojtowicz, 1 male MMT. Hardin Co., Walker Branch, trib. to Mud Cr., nr. Pickwick Dam, 22 Sept. 1978, D.A. Etnier, J.A. Wojtowicz, & G.W. Wolfe, 3 male, 8 female adults, 3 male, 3 female MMT; Str. nr. Pickwick Dam, Barbwood Br., 22 Sept. 1978, D.A. Etnier, J.A. Wojtowicz, and G.W. Wolfe, 4 male, 2 female adults, 7 male, 5 female MMT. Monroe Co., Falls Br., ca. one-fourth mi. past end of pavement on new Robinsville Hwy., below Falls Branch Parking Area, 23 Aug. 1979, J.A. Wojtowicz, 1 male adult, 4 male, 3 female MMT; Falls Br. Parking Area, Laurel Branch, 22 Aug. 1979, J.A. Wojtowicz, 1 male, 3 female adults, 2 male, 3 female MMT, 1 male pupa; Str. ca. 4 mi. above North R. turnoff, on new Robinsville Hwy., 22 Aug. 1979, J.A. Wojtowicz, 3 male, 6 female MMT; Upper Citico Cr., nr. last bridge from Doublecamp before turnoff to Jake Best Branch, Cherokee Natl. For., 30 June 1979, J.A. Wojtowicz, 1 male adult, 1 male, 1 female MMT; Lower Citico Cr., unnamed trib., in Cherokee Natl. For., 30 June 1979, J.A. Wojtowicz, 1 male adult,

1 female MMT. Morgan Co., trib. to Clear Cr., N of Catoosa, off Hwy. 62W, 3 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 male, 1 female adults, 5 male MMT; Lick Cr. in Catoosa Wildlife Area, 6 Sept. 1979, J.A. Wojtowicz, 1 male adult, 2 male, 1 female MMT. Polk Co., Lost Cr.?, 1st large trib. below Coker Cr. on the Hiwassee R., 1 Oct. 1978, J.A. Wojtowicz & A. White, 1 male, 1 female MMT (coll. and preserved). Union Co., str. at enterance to Tanasi Girl Scout Camp, E of Andersonville, off Rt. 61, 2 Sept. 1979, J.A. Wojtowicz & E.B. Williams, 1 male MMT. ? Co., East? Central? TN., locality and coll. date uncertain, J.A. Wojtowicz & G.W. Wolfe?, 2 male, 1 female adults, 5 male, 5 female MMT. ? Co., poss. West TN., locality, date, and collector uncertain, 1 female adult, 1 male, 2 female MMT. Virginia-Madison Co., Whiteoak Canyon Parking Area, Shenandoah National Park, 28 Aug. 1978, J.A. Wojtowicz, 2 male, 2 female MMT, 2 female pupae (coll. and preserved). ? Co., stream along Blue Ridge Parkway, nr. mi. marker #156, .3 mi. N of Va. Rt. 6, 12 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male, 1 female adults, 3 male, 2 female MMT.

Pycnopsyche sp. B

NOTES: A close relative of P. sonso, the larvae of this species also appear to be indistinguishable from P. luculenta. I have reared or collected MMTs of only a few specimens, however, and have seen no larvae that I was certain was this and no other species. Therefore, at this time, my knowledge of this larva is limited. The cases of specimens which I have reared are virtually identical to those of P. luculenta and P. sonso. MATERIAL REARED: North Carolina-

Yancey Co., Black Mtns., elev. 4760', Hemphill Spr., 2 Sept. 1978, J.S. Weaver, III, 1 male MMT, 2 pupae (coll. and preserved). Virginia-Giles Co., White Rock Cr. on Va. 613, .5 mi. from intersec. of Va. 613 & Va. 635, 25 July 1979, J.A. Wojtowicz & E.B. Williams, 1 male MMT, & 1 male, 1 female MMT without cases associated.

Pycnopsyche rossi

CASE: The case of this species is cylindrical and composed of small stones and pieces of sticks. It looks much like cases of P. subfasciata which I have seen. NOTES: I have reared only two specimens of this species and have seen no larvae which are undisputably this species. Larvae which I have seen from the same area seem to match well with the description of members of the P. lepida group. MATERIAL REARED: Indiana-Harrison Co., Boone Twnshp., spr. br. in Buck Cr. bottoms, 2.1 mi. S of St. Rd. 337 and Buck Cr. Valley Rd. junct., E.Z. Alcorn Farm, 29 Aug. 1981, R.L. Jones and J. Forbis, 1 female adult, 1 female MMT.

Pycnopsyche scabripennis s.s.

CASE: The case of this species is cylindrical and composed of short sticks or quadrate pieces of bark or other plant materials, neatly constructed. It does not appear to differ appreciably from that of other members of the P. scabripennis complex. NOTES: I have reared this species but have found no characters which might be used to separate it from the larva of P. antica. Larvae from the site which I reared this species were mixed with those of P. antica which I reared from the same locality. Ten specimens (mixed series)

which I examined from that site did not differ appreciably from either P. antica or P. conspersa. This species is known from relatively few localities, no doubt due to its previous synonymy with P. scabripennis s.l. Judging from adults from that locale, this species is that whose larvae Mackay (1972, 1977) studied and whose ecology she reported. Based on available data, this species appears to be an inhabitant of moderate sized, cool streams. Presently it is known to occur no further south than Virginia. This species may occur sympatrically with P. antica, P. conspersa, P. divergens, P. circularis, P. guttifer, P. lepida, P. luculenta, P. gentilis, and P. sp. B. Larval rearings have shown only P. antica and P. luculenta to occur syntopically with this species. However, all the other above mentioned species should be considered as possibilities. MATERIAL REARED: New York-Essex Co., coll. on Mt. Marcy?, 7-8 Aug. 1979, J.A. Wojtowicz & E.B. Williams, 1 male MMT. Virginia-Bath Co., Cummings Run?, 1st trib. to Back Cr. on Va. Rt. 600, ca. .5 mi. N from Va. Rt. 39, 26 July 1979, J.A. Wojtowicz & E.B. Williams, 1 male, 1 female adult, 2 male MMT.

Pycnopsyche sonso

CASE: The case of this species is composed of plant fragments and is typically dorsoventrally flattened with a long stick attached laterally on either side of the case. It is essentially identical to those of P. luculenta and P. sp. B. NOTES: The larva of this species is identical to and occurs sympatrically with the larvae of P. luculenta. Flint (1960) and Sherberger (1970) also stated that the larvae of P. sonso are inseparable from those of P. luculenta. Both

Carpenter (1933) and Sherberger (1970) indicate that this is basically a high elevation species. I have also found this to be so. As stated by others (Betten, 1950; Flint, 1960; Sherberger, 1970) the range of this species is restricted to the extreme southern portion of the Appalachians in Tennessee, North Carolina, South Carolina, and Georgia. In attempting to separate the larvae of this species from P. luculenta, I have looked closely at a number of potential characters. Some that for a time looked promising include distinct, dark pigmentation on the cheek area below the eye in P. luculenta, locations of head setae (especially 13 and 16) and distances between them and others, and the generally smaller size of the chloride epithelium on the 3rd and 4th abdominal sternites in P. luculenta. In the end, none of these characters were found to be nonvariable enough for use in identifications. I have also attempted to separate larvae of the two species by looking for electrophoretic protein pattern differences in the hemolymph. Although preliminary results show some promise, much more work would be required to make this a useable method for separations of these larvae. Larvae which were separated by this method yielded no distinguishing morphological characters. Potential associates of this species include P. flavata, P. gentilis, P. luculenta, P. lepida, P. antica, and possibly also P. conspersa. Larval rearings have shown only P. luculenta and P. gentilis to be syntopic. Pycnopsyche flavata and P. antica are also distinct possibilities along with the other above mentioned species.

MATERIAL REARED: Tennessee-Blount Co., Parson's Br. at exit of Cades Cove Rd. onto Rt. 129, 24 Aug. 1979, J.A. Wojtowicz, 2 male, 4 female

MMT. Monroe Co., Jake Best Br., trib. to Citico Cr., Cherokee Natl. For., Aug. 1978, J.A. Wojtowicz, 1 male, 1 female adults, 1 male MMT; 23 Aug. 1979, J.A. Wojtowicz, 1 male adult, 4 male, 5 female MMT; Gold Cabin Br. on rd. to Jake Best Br., Cherokee Natl. For., 23 Aug. 1979, J.A. Wojtowicz, 2 male, 1 female adults, 2 male, 4 female MMT; Upper Citico Cr., last bridge from Doublecamp before Jake Best Br. turnoff, 30 June 1979, J.A. Wojtowicz & E.B. Williams, 2 male, 2 female adults, 3 male, 2 female MMT; 23 Aug. 1979, J.A. Wojtowicz, 1 male adult, 5 male, 4 female MMT; Falls Br. Parking Area, Laurel Br., on new Robinsville Hwy., 23 Aug. 1979, J.A. Wojtowicz, 1 male, 1 female MMT (reared), 1 male MMT (coll. and preserved); Falls Branch proper, 23 Aug. 1979, 1 female MMT. ? Co., East TN., locality uncertain, Aug.?, 1978, J.A. Wojtowicz, 4 male, 2 female adults, 2 male, 3 female MMT.

Pycnopsyche subfasciata

Length of larva 19-19.5 mm. Maximum width of larva excluding first abdominal segment 4 mm. HEAD: Width at eyes 1.68-1.71 mm. Base color pale yellow to reddish orange with brown to black spots and splotches. All 18 major setae present (8 and 18 not ascertained because of condition of specimens). Cheek area below and anterior to eye slightly pigmented (black). Patch of spinules present medial to each eye. THORAX: Pro- and mesonotum with paired platelike sclerites, colored as in head, and with only hairlike setae present. Mesosternum with a single or double row of sclerites. Metanotum with 0-2 setae on membrane lateral to Sa1 sclerites and 1-4 setae lateral to Sa2 sclerites. Color of legs as in head and nota. Hind and middle femora generally with two major setae ventrally. ABDOMEN: First segment

ventral: Sa1 areas with 23-28 setae on each side of midline. Sa2 sclerites with 4-6 setae each. Sa3 areas with 4-6 setae each. Dorsal: Combined Sa1 + Sa2 areas with 18-22 setae on each side of dorsal hump. Sa3 areas with 7-10 setae each. Dorsal VIII posteriorly with 10 setae. Dorsal sclerite of IX with 11 or 12 setae. Dorsal and lateral spacing humps present on first abdominal segment. GILLS: Dorsal: II 0,1; III 1,1; IV 1,1; V 0-1,0. Dorsolateral: III 1,0; IV 1,0. Ventrolateral: II 0,1; III 0,1; IV 0,1; V 0,1. Ventral: II 0,1; III 1,1; IV 1,1; V 1,1; VI 1,1; VII 1,1. CASE: The case of P. subfasciata, as in that of P. lepida, is composed primarily of mineral matter, often with some degree of organic matter (sticks or other plant material) in addition. Rearing of Coastal Plain populations of this species may change this evaluation of case type. NOTES: This description is based on three larvae from a collection from a lake in Weschester Co., N.Y. (see Material Reared). The remainder of that collection was reared and all specimens proved to be P. subfasciata. As a larva, this species is inseparable from P. lepida. This species is, next to P. guttifer, the most widespread species in the genus. Evidence from adult light trap samples suggests that this species may occur sympatrically with P. guttifer, P. indiana, P. antica, P. virginica, and P. lepida. Rearings have not shown any species to be syntopic with P. subfasciata; however, any of the above mentioned species must be considered distinct possibilities. MATERIAL REARED: New York-Weschester Co., from lake, ca. 8 Sept. 1980, P.J. Weldon & K. Soltesz, 6 male, 3 female MMT.

CHAPTER IX

DISTRIBUTION OF SPECIES OF *Pycnopsyche*

General

Since the revision of Betten (1950), no comprehensive work concerning distributions of species in this genus has been completed. A number of faunistic studies, as well as private and museum collections have greatly expanded knowledge of the distribution of a number of the species in the genus. The following is a compilation of records for all species in the genus from both published and unpublished sources. Only adult records have been used except where larval identification to species is considered to be dependable. For the most part, United States records have been given and plotted as county records and not as specific localities. In cases where the county designation of the site could not be ascertained or where the locality could not be located on available maps, the locales have been listed but not plotted on the distribution maps. It should be noted that some of these collection sites may actually be located in already cited counties. Canadian localities have been plotted as specific localities both because of the small number of sites, and because county maps for all provinces were not readily available. As with U.S. localities, sites whose locale could not be found on available maps are listed in the text but not plotted on the maps. Counties or localities from which I have seen specimens of the species in question have been placed in brackets in the text. County records

(U.S.) or site records (Canada) have been plotted using solid dots. Solid triangles have been used for State and Province records where no specific site has been designated. Solid squares indicate records which were listed as areas of a State or Province. A list of sources for these maps is included in the appendix (Appendix A). Both published and unpublished sources are listed, with annotations provided in the case of private and unpublished sources. Though certainly not complete, it is believed that the following is a fairly accurate representation of the distribution of species in the genus Pycnopsyche

Known Records of Pycnopsyche Species

Pycnopsyche aglona

See Fig. 47 (Appendix B). This is a strictly northern species inhabiting the extreme northern U.S. and southern Canada. Relatively few specimens of this species are available in collections. Distribution: Maine-(Oxford Co.). Massachusetts-Betten, 1950. New Hampshire-(Strafford Co.). New York-Pinnacle Mtn. Wisconsin-Florence Co.; (Forest Co.); Onieda Co.; Taylor Co. CANADA: Ontario-(Algonquin Park); Oro Station.

Pycnopsyche antica

See Fig. 48 (Appendix B). This is a wide ranging species reported from southern Ontario to northern Florida and southern Louisiana. The most common and widespread member of the P. scabripennis complex. Distribution: Alabama-(Cherokee Co.); Lee Co. Florida-(Gadsen Co.); Okaloosa Co. Georgia-Fulton Co.; (Gilmer Co.);

(Habersham Co.); (Monroe Co.); (Union Co.); (Atlanta); (Neel Gap); Gehard. Indiana-(Fountain Co.); (LaGrange Co.); (LaPorte Co.); (Wayne Co.). Louisiana-(St. Tammany Parish). Maryland-(Montgomery Co.). Massachusetts-(Hampshire Co.). Michigan-(Alpena Co.); Crawford Co.; Emmett Co.; Macomb Co.; (Montmorency Co.); Ogemaw Co.; Washtenaw Co.; (Almena). Mississippi-(Hancock Co.); Lafayette Co.; (Marshall Co.); Warren Co. New Hampshire-Grafton Co.; Merrimack Co.; Strafford Co.; White Mtns. New Jersey-(Burlington Co.); Ocean Co. New York-(Herkimer Co.); (Tompkins Co.); (Warren Co.); (Ringwood Res.). North Carolina-Avery Co.; Henderson Co.; (Jackson Co.); (Macon Co.); Transylvania Co.; (Watauga Co.); Yancey Co.; (Blk. Mtns.); (Creek Way, Block Gap). Pennsylvania-(Beaver Co.); Centre Co.; (Crawford Co.); (Erie Co.); (Fayette Co.); (Forest Co.); (Lancaster Co.); Perry Co.; (Somerset Co.); (Westmoreland Co.). South Carolina-(Aiken Co.); (Berkeley Co.); Charleston Co.; (Dorchester Co.); Greenville Co.; Horry Co.; Oconee Co.; (Pickens Co.). Tennessee-(Blount Co.); (Cumberland Co.); Fentress Co.; (Hardin Co.); (Madison Co.); (Monroe Co.); (Morgan Co.); (Scott Co.); (Union Co.); (Lick Cr.); (Gattis Cr.). Virginia-(Bath Co.); (Bedford Co.); (Botetourt Co.); (Carroll Co.); (Fairfax Co.); (Faquier Co.); (Floyd Co.); (Giles Co.); (Montgomery Co.); (Nelson Co.); (Rockbridge Co.); (Shenandoah Co.); (Dark Hollow Falls); (Blue Ridge Prkwy. mi. 156). (Washington, D.C.). West Virginia-(Hardy Co.). Wisconsin-(Florence Co.); (Sauk Co.). CANADA: Nova Scotia-Baddeck; Englishtown. Ontario-(Oro Station).

Pycnopsyche circularis

See Fig. 49 (Appendix B). This species is widespread in eastern North America ranging from Nova Scotia to Tennessee, but is seldom collected in great numbers. The larva of this species is unknown. Distribution: Connecticut-(Windham Co.). Maine-Cumberland Co. Maryland-(Frederick Co.). Massachusetts-Hampshire Co. New Hampshire-Coos Co.; Grafton Co.; Strafford Co.; (Dolly Copp Camp, White Mtns.). New York-Essex Co.; Hamilton Co. Pennsylvania-(Erie Co.); Fayette Co.; (Forest Co.); (Westmoreland Co.). Rhode Island-Betten, 1950. Tennessee-(Cumberland Co.); (Madison Co.); (Morgan Co.). Virginia-(Giles Co.); (Shenandoah Co.). West Virginia-(Hardy Co.); Monroe Co.; Putnam Co. Wisconsin-Bayfield Co. CANADA: Nova Scotia-(Petite Rivere); (Green Bay). Quebec-Lac Remi.

Pycnopsyche conspersa

See Fig. 50 (Appendix B). This species is a colder climate, more northern representative of the P. scabripennis complex. The distribution of this species is undoubtedly more widespread than shown by available data. Part of the reason for this is its longtime synonymy with P. scabripennis s.l. Distribution: New Hampshire-(Coos Co.); (White Mtns.). New York-Herkimer Co. Pennsylvania-(Forest Co.); (Somerset Co.); (Westmoreland Co.). Tennessee-(Sevier Co.). Virginia-(Bath Co.); (Highland Co.). CANADA: Ontario-(Georgetown).

Pycnopsyche divergens

See Fig. 51 (Appendix B). This is a colder adapted, more northern species which extends its range southward at higher

elevations. It is also a species with a fairly widespread but localized distribution. Distribution: Connecticut-(Windham Co.). Massachusetts-(Franklin Co.). New Hampshire-Coos Co.; Grafton Co.; Strafford Co.; (Dolly Copp Camp, White Mtns.). New York-Albany Co.; (Essex Co.); Monroe Co.; Tompkins Co. North Carolina-Ashe Co.; Yancey Co.; (Black Mtns.). Ohio-Portage Co. Pennsylvania-(Crawford Co.); (Erie Co.); (Forest Co.); (Somerset Co.); (Washington Co.); (Westmoreland Co.). Virginia-(Bath Co.); (Carroll Co.); (Highland Co.); (Tazewell Co.). West Virginia-Pochahontas Co.; Webster Co.

Pycnopsyche flavata

See Fig. 52 (Appendix B). This is a strictly southern Appalachian species which inhabits only higher elevation seeps and streams. Distribution: Georgia-(Union Co.); (Neel Gap). North Carolina-Henderson Co.; (Jackson Co.); (Macon Co.); (Swain Co.); Transylvania Co.; (Yancey Co.). South Carolina-Oconee Co. Tennessee-(Carter Co.); (Monroe Co.); (Sevier Co.); (Unicoi Co.); (Washington Co.). Virginia-(Grayson Co.); (Patrick Co.); (Smyth Co.); (Washington Co.).

Pycnopsyche gentilis

See Fig. 53 (Appendix B). This is a widespread eastern species occurring from southern Canada to northern Georgia and Alabama. The large number of localities cited may be partly attributed to the ease with which identification of the larva of this species may be made. Distribution: Alabama-(Talledaga Co.). Georgia-Clarke Co.; (Fulton Co.); (Gilmer Co.); Habersham Co.; Rabun Co.; Stephens Co.; Towns Co.

Kentucky-(Bell Co.); Leslie Co.; Whitely Co. Maine-Hancock Co.; Penobscot Co.; (Piscataquis Co.). Maryland-(Frederick Co.); Garrett Co.; (Plummer's Island). Massachusetts-(Berkshire Co.); Franklin Co.; (Hampshire Co.). New Hampshire-(Coos Co.); Grafton Co.; Hillsborough Co.; Strafford Co.; White Mtns. New Jersey-Betten, 1950. New York-(Essex Co.); (Franklin Co.); Hamilton Co.; (Herkimer Co.); (Orange Co.); (St. Lawrence Co.); (Tompkins Co.); (Ulster Co.); (New York City). North Carolina-Avery Co.; (Macon Co.); (Swain Co.); (Yancey Co.). Ohio-Richland Co. Pennsylvania-Beaver Co.; (Bedford Co.); (Carbon Co.); (Chester Co.); (Crawford Co.); (Elk Co.); (Fayette Co.); (Forest Co.); (Fulton Co.); (Lancaster Co.); Lycoming Co.; (McKean Co.); (Somerset Co.); (Washington Co.); (Westmoreland Co.). South Carolina-(Oconee Co.); (Pickens Co.). Tennessee-(Blount Co.); (Campbell Co.); (Carter Co.); (Claiborne Co.); (Cumberland Co.); (Hardin Co.); (Monroe Co.); (Morgan Co.); (Polk Co.); (Scott Co.); (Sevier Co.); (Unicoi Co.); (Union Co.). Vermont-(Bennington Co.). Virginia-(Augusta Co.); (Bath Co.); (Bedford Co.); (Botetourt Co.); (Fairfax Co.); (Faquier Co.); (Frederick Co.); (Franklin Co.); (Giles Co.); (Highland Co.); (Madison Co.); (Montgomery Co.); (Page Co.); (Prince William Co.); (Rappahannock Co.); (Rockbridge Co.); (Smyth Co.); (Tazewell Co.); (Hog Camp, Shenandoah Park); (Yankee Horse Ridge); (Blue Ridge Prkwy. mi. 156); (Dark Hollow Falls). West Virginia-Hampshire Co.; (Hardy Co.); Lincoln Co.; Monroe Co.; Nicholas Co.; (Pendelton Co.); Preston Co.; Raleigh Co.; (Randolph Co.); Wetzel Co. CANADA: Nova Scotia-(Baddeck). Quebec-Matamek R.; (Mt. St. Hilaire).

Pycnopsyche guttifer

See Fig. 54 (Appendix B). This is the most widespread species in the genus, appearing to be more common in the northern portion of its range. Judging from its distribution this species is probably less dependent on the "deciduous forest biome" than other species in the genus. Distribution: Arkansas-(Lawrence Co.). Connecticut-(Fairfield Co.). Georgia-Rabun Co.; Towns Co.; (White Co.). Illinois-Cook Co.; Kankakee Co.; Lake Co. Indiana-(LaGrange Co.); (LaPorte Co.). Kansas-Hamilton & Schuster, 1980 (larvae). Kentucky-Fayette Co.; Jefferson Co. Louisiana-Orleans Co. Maine-Cumberland Co.; (Franklin Co.); (Penobscot Co.); (Piscataquis Co.); (Gilead). Maryland-(Garrett Co.). Massachusetts-Franklin Co.; Hampden Co.; (Hampshire Co.). Michigan-(Alger Co.); (Alpena Co.); (Benzie Co.); Cheybougan Co.; (Crawford Co.); Ingham Co.; Kalamazoo Co.; (Lake Co.); Mackinac Co.; (Montmorency Co.); Ogemaw Co.; Schoolcraft Co.; (Van Buren Co.); Washtenaw Co.; (Almena); Agricultural College. Minnesota-Clearwater Co.; Lake Co.; Olmstead Co.; St. Louis Co.; (Marcel); (Two Inlet). Missouri-(McDonald Co.). Montana-Betten, 1950. New Hampshire-Carroll Co.; Cheshire Co.; Coos Co.; Grafton Co.; Hillsborough Co.; Rockingham Co.; Strafford Co.; (Cherry Mtn.). New Jersey-(Burlington Co.). New York-Franklin Co.; (St. Lawrence Co.); Sullivan Co.; Tioga Co.; (Tompkins Co.); (Warren Co.). North Carolina-(Macon Co.); (Swain Co.); Transylvania Co. North Dakota-Richland Co. Ohio-Portage Co. Pennsylvania-(Carbon Co.); (Crawford Co.); (Fayette Co.); (Forest Co.); Huntingdon Co.; (Somerset Co.); (Westmoreland Co.). South Carolina-Oconee Co. Tennessee-(Cumberland Co.); (Morgan Co.).

Virginia-(Bath Co.); (Craig Co); (Faquier Co.); (Montgomery Co.); (Wythe Co.). West Virginia-Greenbrier Co.; (Hardy Co.); Monroe Co.; (Pendelton Co.); Pochahontas Co.; (Randolph Co.); Tucker Co.; Webster Co. Wisconsin-Bayfield Co.; (Door Co.); (Eau Claire Co.); Florence Co.; Forest Co.; Lincoln Co.; Manitowoc Co.; Marinette Co.; Onieda Co.; Sauk Co.; Sheboygan Co.; Taylor Co.; (Vilas Co.). Wyoming-Betten, 1950. CANADA: Alberta-Charcon Bridge, LaBiche R.; (Blindman R., Hwy. 2); (Fort McMurray). Manitoba-Roseau R. Newfoundland-St. John's; Kitty's Brook. Nova Scotia-(Petite Rivere); (Springhill Jct.); Chester Basin; (Queens Co.). Ontario-(West Bay, Manitoulin Island); (Sweets Corners, Leeds and Grenville Co.); (Coburg, Northumberland Co.); (Chayne). Quebec-Matamek R.; Rigaud; Parc Prov. du Mont Tremblant; St. Hippolyte. Saskatchewan-(LaRonge). ? Province-Hudson's Bay; St. Lawrence R.; Kabine R.; Kagami R.; St. Martin's Falls; Albany R.

Pycnopsyche sp. A

See Fig. 55 (Appendix B). This species is very restricted in distribution. Presently known from only three counties in Tennessee, it is probably more widely distributed in the Cumberland Plateau region of Tennessee, Kentucky and perhaps Alabama. Distribution: Tennessee-(Cumberland Co.); (Madison Co.); (Morgan Co.).

Pycnopsyche indiana

See Fig. 56 (Appendix B). This species is generally distributed south of the Great Lakes with the highest populations occurring along the Coastal Plain. It may be more extensively distributed than now

realized since problems may be encountered in distinguishing it with consistency from some specimens of P. lepida. Distribution: Alabama-(Calhoun Co.). Florida-Okaloosa Co. Georgia-Burke Co.; (Clayton Co.); (Houston Co.); (Monroe Co.); Oglethorpe Co.; Richmond Co.; (Talbot Co.); (Taylor Co.). Illinois-(Champaign Co.); (Franklin Co.). Indiana-(LaPorte Co.); Marion Co.; (Rogers). Kentucky-Barren Co.; (Union Co.). Louisiana-(St. Tammany Parish). Ohio-Athens Co.; Miami Co. South Carolina-Aiken Co.; Allendale Co.; (Berkeley Co.); Dorchester Co.; Horry Co.; Sumter Co. Tennessee-(Cumberland Co.); (Madison Co.). Virginia-(Carroll Co.); (Louisa Co.); (Montgomery Co.). West Virginia-Pendelton Co.

Pycnopsyche lepida

See Fig. 57 (Appendix B). This is a widely distributed species. The third most widespread species in the genus, P. lepida appears to show a slightly more northern distribution than the closely related P. indiana. Distribution: Alabama-(Lee Co.). Georgia-(Gilmer Co.); (Monroe Co.); Rabun Co.; (Neel Gap). Illinois-Lake Co.; (Kankakee Co.). Indiana-(Fountain Co.); (LaGrange Co.); (LaPorte Co.); (Marshall Co.); (Wayne Co.); Needmore. Kentucky-Oldham Co. Maine-Aroostook Co.; Oxford Co. Maryland-(Prince Georges Co.). Massachusetts-(Berkshire Co.); Hampshire Co. Michigan-Benzie Co.; Charlevoix Co.; (Chippewa Co.); Crawford Co.; Dickinson Co.; Gogebic Co.; Hog Island; (Kalamazoo Co.); Lake Co.; Macomb Co.; (Montmorency Co.); Oakland Co.; Ogemaw Co.; (Van Buren Co.); Washtenaw Co.; (Almena); Ausable R.; Marquette R. Minnesota-(Lake Co.); (Hubbard Co.). Mississippi-Oktebbeha Co. New Hampshire-Carroll Co.; Coos Co.;

(Grafton Co.); Rockingham Co.; Strafford Co. New Jersey-Betten, 1950. New York-Onondaga Co.; Sullivan Co.; Tioga Co.; (Tompkins Co.); (Ulster Co.). North Carolina-Jackson Co.; Macon Co.; Robeson Co.; Black Mtn. North Dakota-Ransom Co. Ohio-Ashtabula Co.; Portage Co. Pennsylvania-(Beaver Co.); (Crawford Co.); (Cumberland Co.); Erie Co.; (Forest Co.); (Westmoreland Co.). South Carolina-(Aiken Co.); Oconee Co.; Pickens-Greenville Cos. Tennessee-(Blount Co.); (Cumberland Co.); Fentress Co.; (Monroe Co.); (Morgan Co.); (Wayne Co.). Texas-Bandera Co. Virginia-(Bath Co.); (Bedford Co.); (Carroll Co.); (Faquier Co.); (Franklin Co.). West Virginia-(Fayette Co.); Lincoln Co.; Monroe Co.; (Pendelton Co.); Pochahontas Co.; Putnam Co.; (Randolph Co.); Raleigh Co.; Webster Co. Wisconsin-Bayfield Co.; Buffalo Co.; Burnett Co.; Dunn Co.; (Eau Claire Co.); Florence Co.; Forest Co.; Grant Co.; Lincoln Co.; (Marquette Co.); Onieda Co.; Polk Co.; Richland Co.; Sauk Co.; Sheboygan Co.; Taylor Co.; (Vilas Co.); Waushara Co. CANADA: Newfoundland-Glenwood. Nova Scotia-(Petite Rivere); (Queens Co.). Manitoba-Fort Garry; God's R. Ontario-(James Bay); (Coburg, Northumberland Co.); (Hudson's Bay). Quebec-Matamek R.; Montreal, St. Helen's Island; Res. des Chic Chocs; Parc Prov. du Mont Tremblant; St. Hippolyte.

Pycnopsyche limbata

See Fig. 58 (Appendix B). This is a strictly northern species occurring in the extreme northern U.S. and adjacent southern Canada. It has a distribution similar to that of P. aglona. Distribution: Maine-Franklin Co.; Hancock Co. Massachusetts-(Hampshire Co.). New Hampshire-Coos Co.; Merrimack Co.; Strafford Co. New York-

(Essex Co.); (Hamilton Co.); Herkimer Co.; Tompkins Co. Rhode Island-Betten, 1950. Vermont-(Bennington Co.); (Windham Co.). Wisconsin-(Bayfield Co.); Florence Co.; Forest Co.; Marinette Co.; (Marquette Co.). CANADA: Newfoundland-St. John's; Donovans; Cartwright. Nova Scotia-(Baddeck); (Petite Rivere); (Green Bay). Ontario-Oro Station; Lake Superior Prov. Pk.; Leskand. Quebec-Prov. Parc du Mont Tremblant; St. Hippolyte; Lac Remi; Lac Phillipe; St. Jovite; Lac Julicoenr; Wacouno R.

Pycnopsyche luculenta

See Fig. 59 (Appendix B). This is a wide ranging eastern species. It is fairly common north to south in the Appalachian chain and less common outside that area. Distribution: Alabama-Winston Co. Georgia-Burke Co.; (Gilmer Co.); Habersham Co.; (Harris Co.); (Monroe Co.); Rabun Co.; Towns Co.; (Neel Gap). Indiana-(Montgomery Co.). Kentucky-(Allen-Warren Cos.). Maine-Hancock Co.; Piscataquis Co. Maryland-(Frederick Co.); (Prince Georges Co.); (Forest Glen). Massachusetts-Hampshire Co.; Savoy. Mississippi-Lafayette Co. New Hampshire-Carroll Co.; (Coos Co.); Grafton Co.; Strafford Co. New Jersey-(Sussex Co.). New York-Cortland Co.; (Essex Co.); (Franklin Co.); Hamilton Co.; (St. Lawrence Co.); Sullivan Co.; (Tompkins Co.). North Carolina-Jackson Co.; Macon Co.; Transylvania Co. Ohio-Portage Co. Pennsylvania-(Beaver Co.); (Carbon Co.); Crawford Co.; Erie Co.; Fayette Co.; (Forest Co.); (Fulton Co.); (Lancaster Co.); (Luzerne Co.); (Pike Co.); (Somerset Co.); (Westmoreland Co.). South Carolina-(Aiken Co.); (Edgefield Co.); Greenville Co.; (Oconee Co.); (Pickens Co.). Tennessee-(Anderson Co.); (Blount Co.); (Carter Co.);

Cheatham Co.; (Cumberland Co.); (Hardin Co.); (Madison Co.); (Monroe Co.); (Morgan Co.); (Polk Co.); (Scott Co.); (Union Co.). Vermont-(Bennington Co.). Vitginia-Augusta Co.; (Bath Co.); (Botetourt Co.); (Giles Co.); (Highland Co.); (Madison Co.); (Montgomery Co.); (Nelson Co.); (Rockbridge Co.); (Shenandoah Co.); Smyth Co.; (Blue Ridge Prkwy. mi. 156). West Virginia-Braxton Co.; Greenbrier Co.; Hardy Co.; (Monroe Co.); Pendelton Co.; Pochahontas Co.; Preston Co.; Raleigh Co.; Randolph Co.; Webster Co. Wisconsin-Betten, 1950. CANADA: Quebec-Mont St. Hilaire.

Pycnopsyche sp. B

See Fig. 60 (Appendix B). This species is restricted to the Appalachian Mountains in Virginia and northern North Carolina. It probably also occurs in West Virginia. Distribution: North Carolina-(Yancey Co.); (Foscoe?). Virginia-(Botetourt Co.); (Giles Co.); (Madison Co.); Nelson Co.); (Rappahannock Co.); (Smyth Co.); (Washington Co.).

Pycnopsyche rossi

See Fig. 61 (Appendix B). This is a little known species of restricted distribution. Only recently two populations of this species were discovered in Indiana. Pycnopsyche rossi probably occurs throughout central and southern Illinois and Indiana and possibly also in western Ohio in undeveloped, pristine areas. Distribution: Illinois-(Union Co.). Indiana-(Harrison Co.); (Wayne Co.).

Pycnopsyche scabripennis s.l.

See Fig. 62 (Appendix B). This map represents the distribution of all known records for the P. scabripennis complex. Its purpose here is to give an overall impression of the distribution of the group. It has not been possible to ascertain the species involved for many of the older literature records. Distribution: Alabama-(Cherokee Co.); Lee Co. Florida-(Gadsen Co.); Okaloosa Co. Georgia-Banks Co.; Fulton Co.; (Habersham Co.); (Monroe Co.); Rabun Co.; Towns Co.; (Union Co.); (Atlanta); (Neel Gap); Gehard. Indiana-(Fountain Co.); (LaGrange Co.); (LaPorte Co.); (Wayne Co.). Louisiana-(St. Tammany Parish). Maine-Aroostook Co.; Hancock Co.; Jim Pond. Maryland-(Montgomery Co.). Massachusetts-Franklin Co.; (Hampshire Co.); Plymouth Co. Michigan-(Alpena Co.); Crawford Co.; Emmett Co.; Kalamazoo Co.; Macomb Co.; (Montmorency Co.); Ogemaw Co.; Washtenaw Co.; (Almena). Minnesota-St. Louis Co. Mississippi-(Hancock Co.); Lafayette Co.; (Marshall Co.); Warren Co. New Hampshire-Carroll Co.; (Coos Co.); Grafton Co.; Hillsborough Co.; Merrimac Co.; Strafford Co.; Sullivan Co.; (White Mtns.). New Jersey-(Burlington Co.); Ocean Co. New York-(Essex Co.); (Herkimer Co.); Sullivan Co.; (Tompkins Co.); (Warren Co.); (Ringwood Res.). North Carolina-Avery Co.; Henderson Co.; (Jackson Co.); (Macon Co.); Transylvania Co.; Wake Co.; (Watauga Co.); (Creek Way, Block Gap); (Black Mtn.). Ohio-Ashtabula Co.; Geauga Co.; Portage Co. Pennsylvania-(Beaver Co.); Bedford Co.; Centre Co.; (Crawford Co.); (Erie Co.); (Fayette Co.); (Forest Co.); (Fulton Co.); (Lancaster Co.); Perry Co.; (Somerset Co.); (Washington Co.); (Westmoreland Co.). South Carolina-

(Aiken Co.); Allendale Co.; (Berkeley Co.); Charleston Co.; (Dorchester Co.); Greenville Co.; Horry Co.; Oconee Co.; (Pickens Co.). Tennessee-(Blount Co.); (Cumberland Co.); Fentress Co.; (Hardin Co.); (Madison Co.); (Monroe Co.); (Morgan Co.); (Sevier Co.); (Scott Co.); (Union Co.); (Lick Cr.); (Gattis Cr.). Vermont-Bennington Co. Virginia-(Bath Co.); (Bedford Co.); (Botetourt Co.); (Carroll Co.); (Fairfax Co.); (Faquier Co.); (Floyd Co.); (Giles Co.); (Highland Co.); (Montgomery Co.); (Nelson Co.); (Rockbridge Co.); (Shenandoah Co.); Smyth Co.; (Blue Ridge Prkwy. mi. 156). (Washington, D.C.). West Virginia-Braxton Co.; (Hardy Co.); Kanawha Co.; Lincoln Co.; Mercer Co.; Monongalia Co.; Monroe Co.; Nicholas Co.; Pendelton Co.; (Pochahontas Co.); Preston Co.; Putnam Co.; Raleigh Co.; Randolph Co.; Webster Co. Wisconsin-(Florence Co.); (Sauk Co.). CANADA: Nova Scotia-Englishtown; Baddeck. Ontario-Kendal; (Oro Station); (Georgetown); (Rostrevor). Quebec-Matamek R.; Rimouski; (Mont St. Hilaire).

Pycnopsyche scabripennis s.s.

See Fig. 63 (Appendix B). This species like P. conspersa is a more northern representative of the P. scabripennis complex. Available data would indicate that the habitat preference of this species lies somewhere between that of P. antica and P. conspersa. The distribution of this species is probably more extensive; however, because of its longtime synonymy with other species in the group more accurate records are not available. Distribution: Massachusetts-Plymouth Co. New Hampshire-White Mtns. New York-(Essex Co.). Pennsylvania-(Beaver Co.); (Crawford Co.); Erie Co.; (Fayette Co.);

(Forest Co.); (Fulton Co.); (Somerset Co.); (Washington Co.); (Westmoreland Co.). Virginia-(Bath Co.); (Giles Co.); (Montgomery Co.) West Virginia-(Pochahontas Co.). CANADA: Ontario-(Rostrevor). Quebec-(Mont St. Hilaire).

Pycnopsyche sonso

See Fig. 64 (Appendix B). This species is known to occur only in the very southern portion of the Appalachians. At this time its range is not known to overlap with that of the very similar P. sp. B. Distribution: Georgia-Rabun Co.; Towns Co.; (Neel Gap). North Carolina-Jackson-Transylvania Cos.; Macon Co.; (Swain Co.). South Carolina-Oconee Co.; Pickens Co. Tennessee-(Blount Co.); (Monroe Co.); (Sevier Co.).

Pycnopsyche subfasciata

See Fig. 65 (Appendix B). This is the second most widespread species in the genus. Of special note are the discovery of southern populations of this species which was once believed to be strictly northern in distribution. Distribution: Arkansas-Washington Co. Georgia-(Clarke Co.); (Crawford Co.); Rabun Co.; Towns Co. Illinois-Champaign Co.; (Dewitt Co.); (Kankakee Co.); Lake Co.; McHenry Co.; Mason Co. Indiana-(LaGrange Co.); (Wayne Co.). Iowa-(Johnson Co.). Kansas-Hamilton & Schuster, 1980 (larvae). Maryland-(Plummer's Island). Massachusetts-Betten, 1950. Michigan-(Alpena Co.); Ingham Co.; Mason Co. Minnesota-Anoka Co.; (Cass Co.); Clearwater Co.; (Cook Co.); (Itasca Co.); (Lake Co.). Missouri-Iron Co. New Hampshire-White Mtns. New Jersey-(Burlington Co.). New York-

(Weschester Co.). Ohio-Ashtabula Co.; Logan Co. Pennsylvania-Philadelphia Co.; York Co. South Carolina-(Berkeley Co.); Dorchester Co. South Dakota-Betten, 1950. Virginia-(Montgomery Co.); (Shenandoah Co.). (Washington, D.C.). West Virginia-Jefferson Co.; Lincoln Co.; Monroe Co.; (Morgan Co.); Randolph Co. Wisconsin-Burnett Co.; Dane Co.; Florence Co.; Forest Co.; Onieda Co.; Sauk Co.; (Walworth Co.); (Waupaca Co.). Wyoming-Betten, 1950. CANADA: Alberta-Lethbridge. Manitoba-Roseau R. Ontario-Paisley; Obtanga; Port Credit. Quebec-Ste. Anne de Bellvue.

Pycnopsyche virginica

See Fig. 66 (Appendix B). This is undoubtedly the rarest of the species in the genus. Its populations are distributed mostly on the Coastal Plain. Only one female and perhaps six males are available in collections. Distribution: Alabama-(Calhoun Co.). North Carolina-(Duplin Co.). South Carolina-Berkeley Co.; (Dorchester Co.); Florence Co.; Horry Co. Virginia-(Chesterfield-Henrico Cos.).

CHAPTER X

A PRELIMINARY DISCUSSION OF PHYLOGENETIC RELATIONSHIPS IN THE GENUS *Pycnopsyche*

Although Betten (1950) briefly discussed some characters which showed similarities among certain species, and Schmid (1955) listed species of *Pycnopsyche* under specific groups (Table 3), no serious attempt has been made to elucidate the phylogenetic relationships within the genus. As I have not had the opportunity to adequately study other related genera, no attempt is made here to provide a formally structured phylogenetic tree. Instead this chapter is intended only as a discussion of relationships in the genus. Based on this discussion, I have placed the species of this genus into groups which differ somewhat from those of Schmid (1955) (Table 4).

Within the tribe Stenophylacini in North America, *Hydatophylax* is the only genus not restricted solely to that continent, suggesting perhaps that all genera in that tribe, in North America, are probably descended from the *Hydatophylax* line. Of all Nearctic genera of the Stenophylacini, *Pycnopsyche* shows the closest relationship to *Hydatophylax* based on a number of both adult (Betten, 1950; Schmid, 1955) and larval (Wiggins, 1977) characters. It is interesting, indeed, that the larvae of the two genera are separable only with difficulty.

In the genus *Pycnopsyche* several species form distinctive natural groupings based on similarities in adults and larvae. The

TABLE 3

Species Groups of *Pycnopsyche* (Schmid, 1955)

P. lepida group
- *P. lepida* (Hagen)
- *P. subfasciata* (Say)
- *P. indiana* (Ross)

P. limbata group
- *P. limbata* (McLachlan)
- *P. luculenta* (Betten)
- *P. sonso* (Milne)

P. guttifer group
- *P. guttifer* (Walker)

P. divergens group
- *P. divergens* (Walker)
- *P. circularis* (Provancher)
- *P. rossi* Betten
- *P. gentilis* (McLachlan)
- *P. flavata* (Banks)
- *P. aglona* Ross

P. scabripennis group
- *P. scabripennis* (Rambur)

TABLE 4

Proposed Species Groups of *Pycnopsyche*

P. lepida group
- *P. lepida* (Hagen)
- *P. subfasciata* (Say)
- *P. indiana* (Ross)

P. luculenta group
- *P. luculenta* (Betten)
- *P. sonso* (Milne)
- *P.* sp. B

P. limbata group
- *P. limbata* (McLachlan)
- *P. aglona* Ross

P. gentilis group
- *P. gentilis* (McLachlan)
- *P. flavata* (Banks)

P. guttifer group
- *P. guttifer* (Walker)
- *P. divergens* (Walker)
- *P. circularis* (Provancher)
- *P. rossi* Betten

P. scabripennis group
- *P. scabripennis* (Rambur)
- *P. antica* (Walker)
- *P. conspersa* Banks

P. virginica group
- *P. virginica* (Banks)

Incertae sedis
- *P.* sp. A

P. scabripennis complex members (P. scabripennis s.s., P. antica, and P. conspersa) possess a distinctive wing coloration pattern, including unevenly sized spots, which differs from all other species in the genus, a 1-3-4 tibial spur formula, and larvae with similar morphology and case structure. In addition, male genitalia show a great deal of similarity in the shape of segments VIII and X, as well as in the basic shape of the clasper apices. Female genitalia likewise display great similarity in the various genital segments. Strengthening the belief of a close relationship in the group are the existence of certain specimens which appear to be hybrids of the species in the group.

Another natural grouping involves the P. lepida group (P. lepida, P. indiana, and P. subfasciata). Unlike the P. scabripennis complex, there is no basic similarity in wing coloration pattern. The tibial spur formula, 1-2-2, is, however, the same for all members of the group and is shared with only one other species in the genus (P. virginica). Basic larval morphology and case structure are similar for all species in the group. In the male terminalia segments VIII, X, and the claspers show distinct similarity. Female genitalia show great similarity in the basic form of segments IX and X, as well as the vulvar scale, and shape and adornments of the anal opening. The fact that I have seen what I consider to be hybrids in this group also adds strength to an argument for closeness of their relationship.

Members of the P. luculenta group also show a very close relationship. All wing coloration patterns are basically similar,

tibial spur formulae are 1-3-4, and morphology and case structure of the larvae are nearly identical for all species. Male terminalia are again very similar in respect to the shape of segment VIII and the general form of the claspers. However, they differ fairly dramatically in relation to the adornment of VIII and the shape of X. Female terminalia, though identical in P. sonso and P. sp. B, differ dramatically in P. luculenta.

Pycnopsyche gentilis and P. flavata show a great deal of similarity in adult and larval morphology. In the adults, both species share nearly concolored wings, differing in this respect from all other members of the genus. In addition, the males of these species share a very distinctive aedeagal armature, again quite different from other members of the genus. The female genitalia show great similarity especially in the form of the vulvar scale and ventral development of segment IX. Larval morphology for these species is nearly identical with both larvae possessing modified 13th and 16th head setae, being the only members of the genus to display this character. The case structure and habitat preferences are also similar in these two species.

Pycnopsyche aglona and P. limbata appear to be closely related based on evidence available from male and female morphology. The males share similar wing coloration patterns, a membranous junction between the posterodorsal portion of tergite VIII and dorsal segment IX, a similarly shaped segment IX, a massive mesal process on segment X, and similarities in the posterior portions of tergite VIII in lateral view. The morphology of the clasper apices and aedeagal paramere stylets differ, however. In general, the females also show a

great deal of similarity; however, there may be difficulties with my interpretation of the females of P. aglona (see description and associated discussion). Unfortunately, although the larvae of both species have been reared, I have only seen the larva of P. limbata and cannot, therefore, comment on their similarity or lack thereof.

The last group in this genus (P. guttifer, P. rossi, P. divergens, and P. circularis) contains species which differ in nearly as many respects as they share similarities. In the males, all possess similar wing coloration patterns with a fairly extensive base pattern and in addition a light, even sized speckling throughout, typical tibial spur formulae of 1-3-3 (see species descriptions for exceptions and variations), and clasper apices fairly simple morphologically. All except P. guttifer have simple stylets on the parameres of the aedeagus. Within this group P. circularis and P. divergens show great similarities, as do P. guttifer and P. rossi. In addition, species within this group show affinities to other species groups in the genus. Pycnopsyche circularis and P. divergens both show affinities to the P. gentilis group, particularly in the shape of tergite VIII (lateral view) and in the morphology of segment X. Pycnopsyche guttifer shows similarities to the P. limbata group in the posterior portion of VIII being membranous, and more specifically in the multiple stylets of the parameres, shared only with P. aglona in the entire genus. Pycnopsyche rossi shows similarities to the P. scabripennis group members and P. sp. A, especially in the shape of tergite VIII (lateral view). Although difficult to interpret, the females also appear to show a great deal of basic

similarity in the structure of segments IX and X, and the posterior border of the vulvar scale.

Pycnopsyche virginica shows no obvious relationship to any other species in the genus, although it does share its tibial spur formula with the P. lepida group. The male of this species possesses a segment X unlike that of any other male of the genus, its mesal and lateral processes being reduced to rectangular and triangular, sclerotized, setal patches, respectively. The massiveness of the claspers in lateral view also differs from other males in the genus. The female of this species, although very vaguely similar to that of P. sonso and P. sp. B, does not appear to bear any true relationship to other females in the genus. The larva of this species is unknown.

The final species to be considered in terms of relationships is P. sp. A. The male and female of this species show certain relationships to members of other species groups, but none that are clear enough for placement in any particular group. In the males the shape of the lateral processes of VIII and the apices of the claspers of this species show affinities to the P. scabripennis complex. The distinct tapering of tergite VIII posteriorly, in dorsal view, is reminiscent of that of P. rossi. Unlike either the P. scabripennis complex or P. rossi, however, the wings of P. sp. A have a vastly reduced coloration pattern. Also unlike the members of the P. scabripennis complex, the scent glands of the fifth abdominal segment are not unusually large and the external openings are not modified into large, anteriorly directed horns. The female of P. sp. A shows a definite relationship to females of the P. scabripennis complex in

the morphology of segments IX and X in lateral view, but does not fit closely based on characters such as wing coloration pattern and the morphology of the posterior border of the vulvar scale. The larvae of this species appear to match those of the P. scabripennis complex closely in both morphology and case structure. Because of the difficulty of clearly placing this species in an available group, I am including it here as an incertae sedis until such time that a clearer idea of its relationship can be formulated.

CHAPTER XI

SUMMARY

Nineteen species are recognized for the genus. Descriptions and/or discussions are provided for the males and females of all species. Illustrations are included for all species except the female of P. sp. B which is identical to that of P. sonso. The P. scabripennis complex is revised and P. antica, P. conspersa, and P. scabripennis s.s. are recognized as distinct species. Pycnopsyche minima and P. perplexa are, however, retained in synonymy. Revision of the P. lepida group has resulted in the retention of all species; however, some doubt remains as to the distinctness of P. indiana. Pycnopsyche virginica remains recognized but is removed from the P. lepida group. Two new species are recognized in the genus (herein described as P. sp. A and P. sp. B), but will be given names in another publication. Separate keys to males and females, including all known species, are provided.

Extensive rearings of larvae brings to a total of sixteen the number of associations for the genus. Descriptions or discussions have been provided for all of these species. Because of the conservativeness of larval morphology, it was found that many of the larvae could not be accurately identified beyond species groups. No keys are provided for the larvae, as it was feared that such keys might lead to a false sense of security concerning larval recognition.

Distribution records for members of the genus have been

updated using records from both published and unpublished sources. The ranges of a number of species have been found to be much more extensive than previously thought. In some instances this new information has forced a reevaluation of thoughts on habitat requirements for the involved species.

A preliminary discussion of phylogenetic relationships has resulted in a different grouping of species from previously recognized schemes for the genus.

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APPENDICES

APPENDIX A

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APPENDIX B

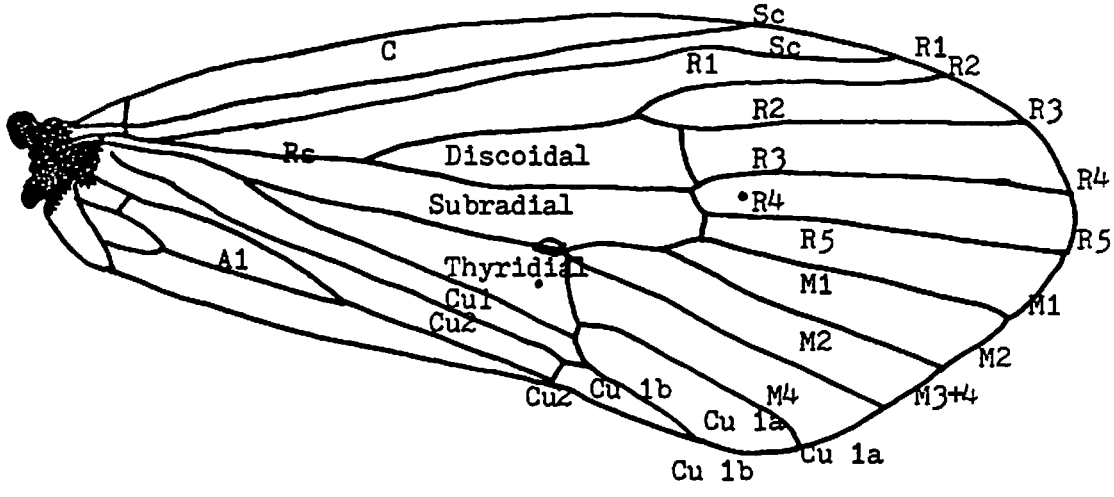


Figure 1. Generalized forewing of Pycnopsyche sp. with veins and cells labelled.

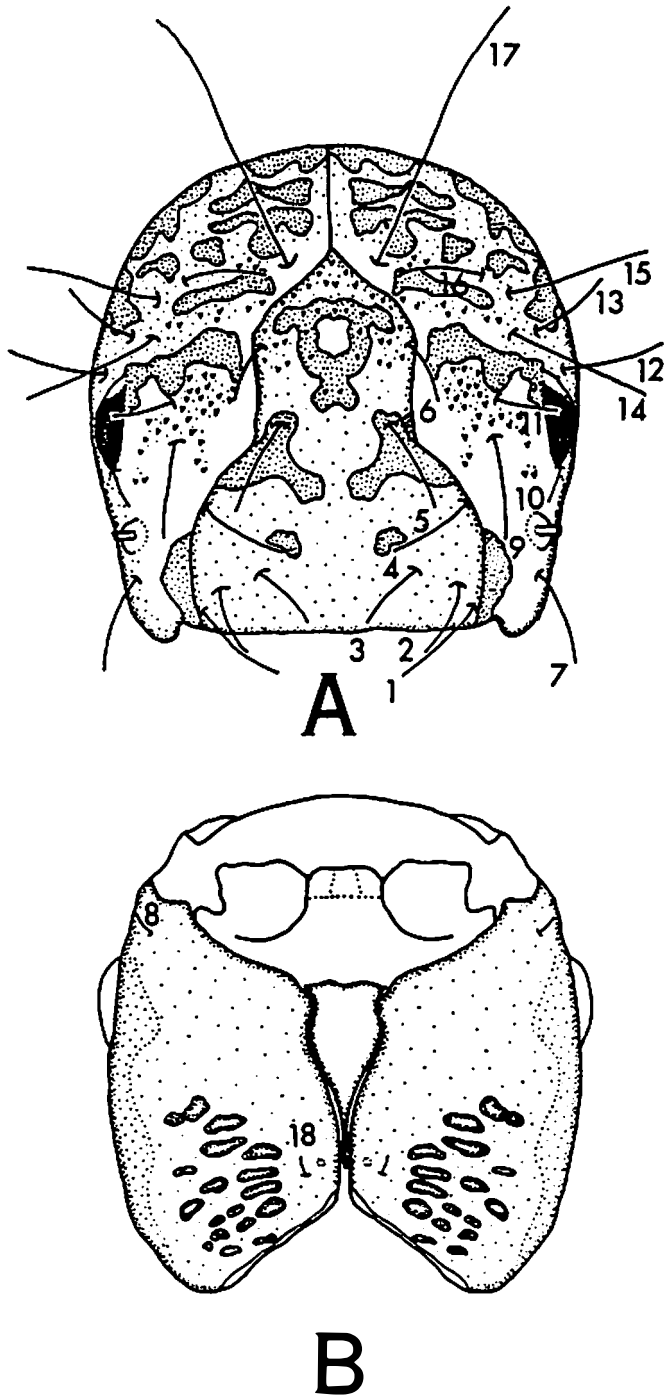


Figure 2. Generalized larval head of Pycnopsyche sp. showing major head setae. A. Dorsal. B. Ventral.

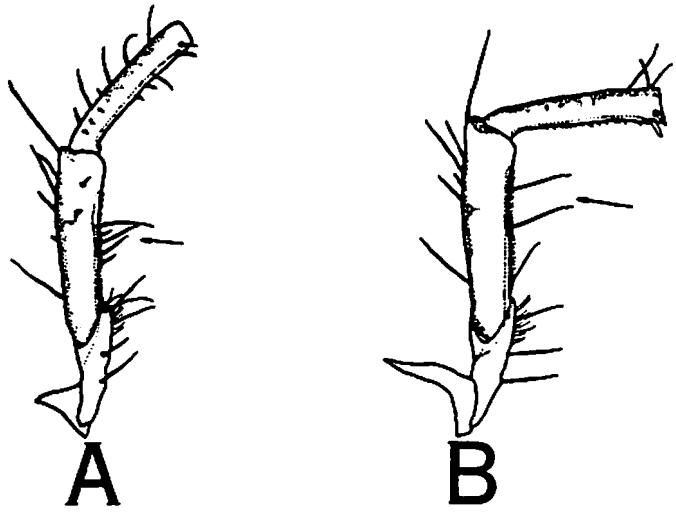


Figure 3. Possible character states of major ventral femoral setae of larval metathoracic leg. A. Greater than two setae (arrow). B. Two setae (arrow).

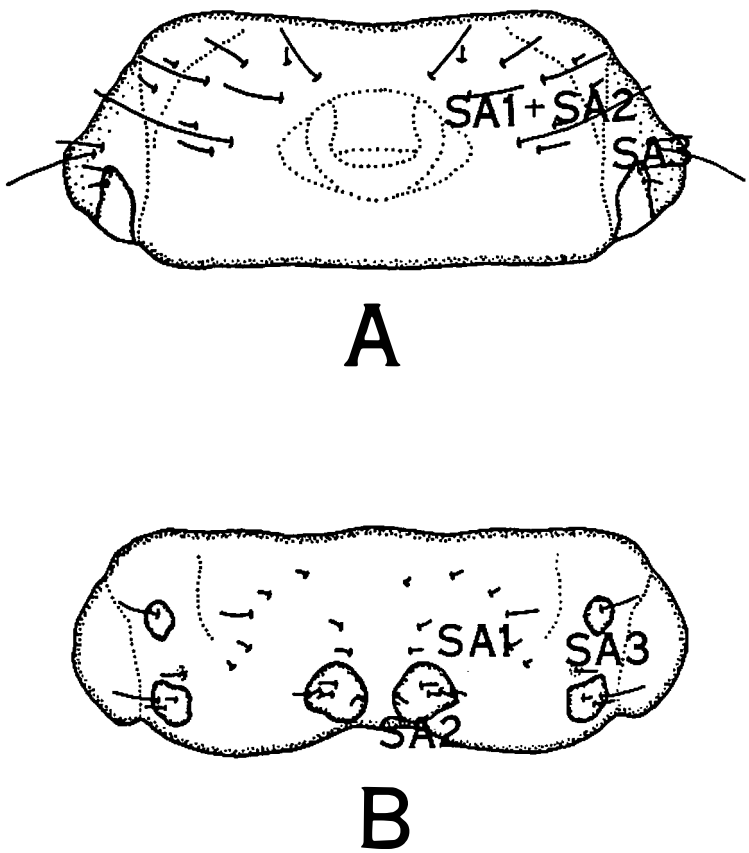


Figure 4. First abdominal segment of Pycnopsyche larva showing location of setal areas. A. Dorsal. B. Ventral.

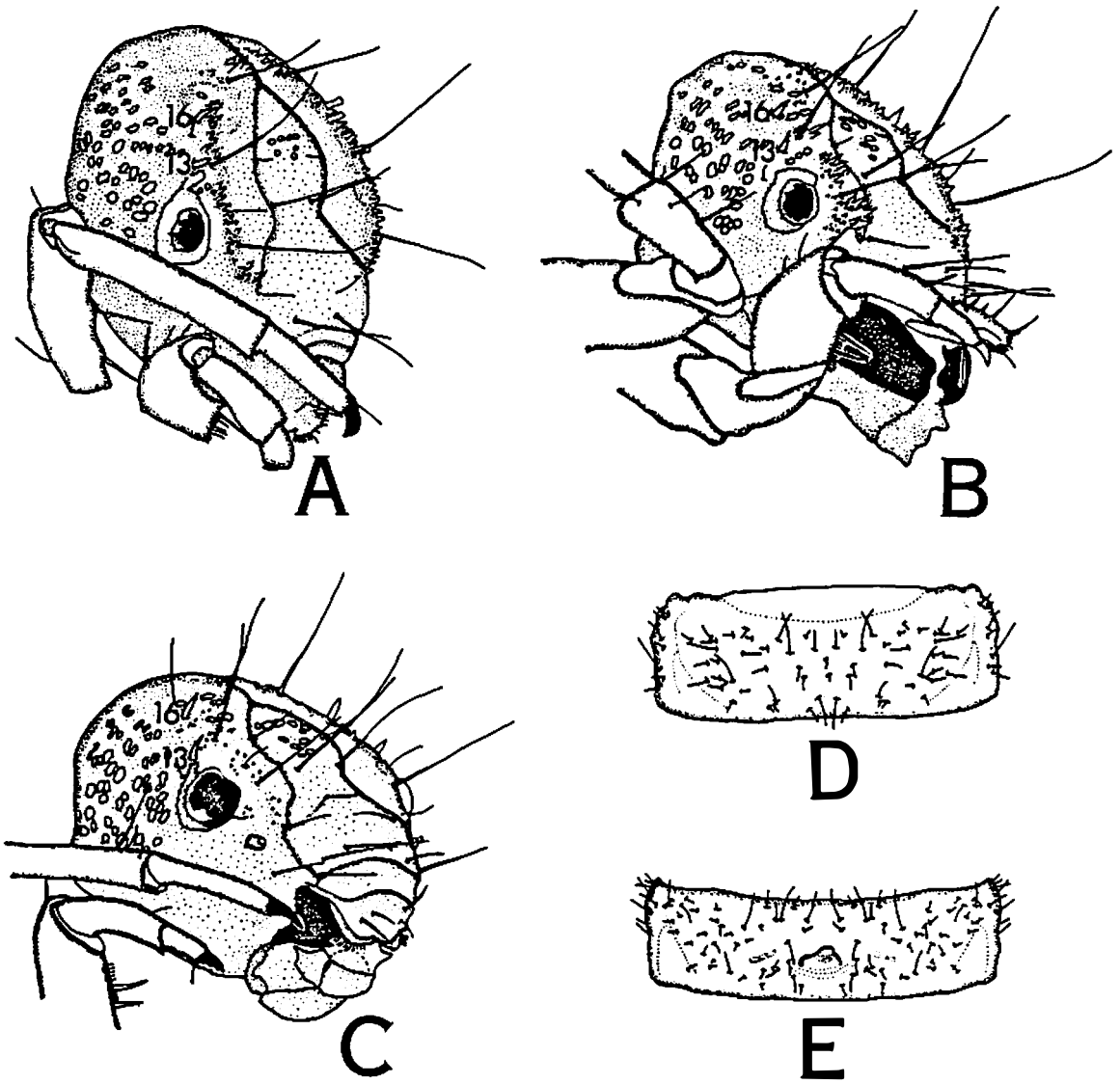


Figure 5. Larval heads and dorsum of first abdominal segments of Pycnopsyche gentilis and Pycnopsyche flavata. A. Head of P. flavata. B. Head of P. gentilis, southern. C. Head of P. gentilis, northern. D. First abdominal segment, P. gentilis. E. First abdominal segment, P. flavata.

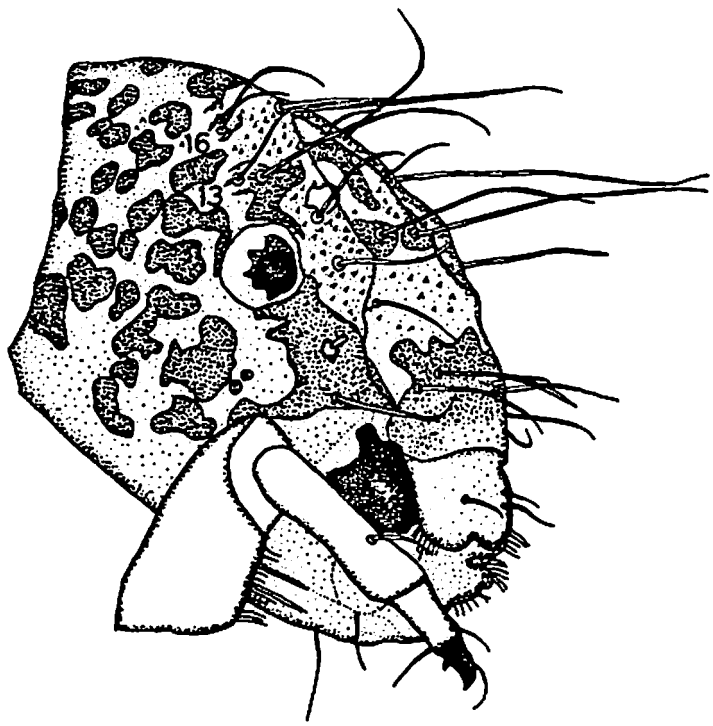


Figure 6. Head of Pycnopsyche larva showing hairlike setae 13 and 16.

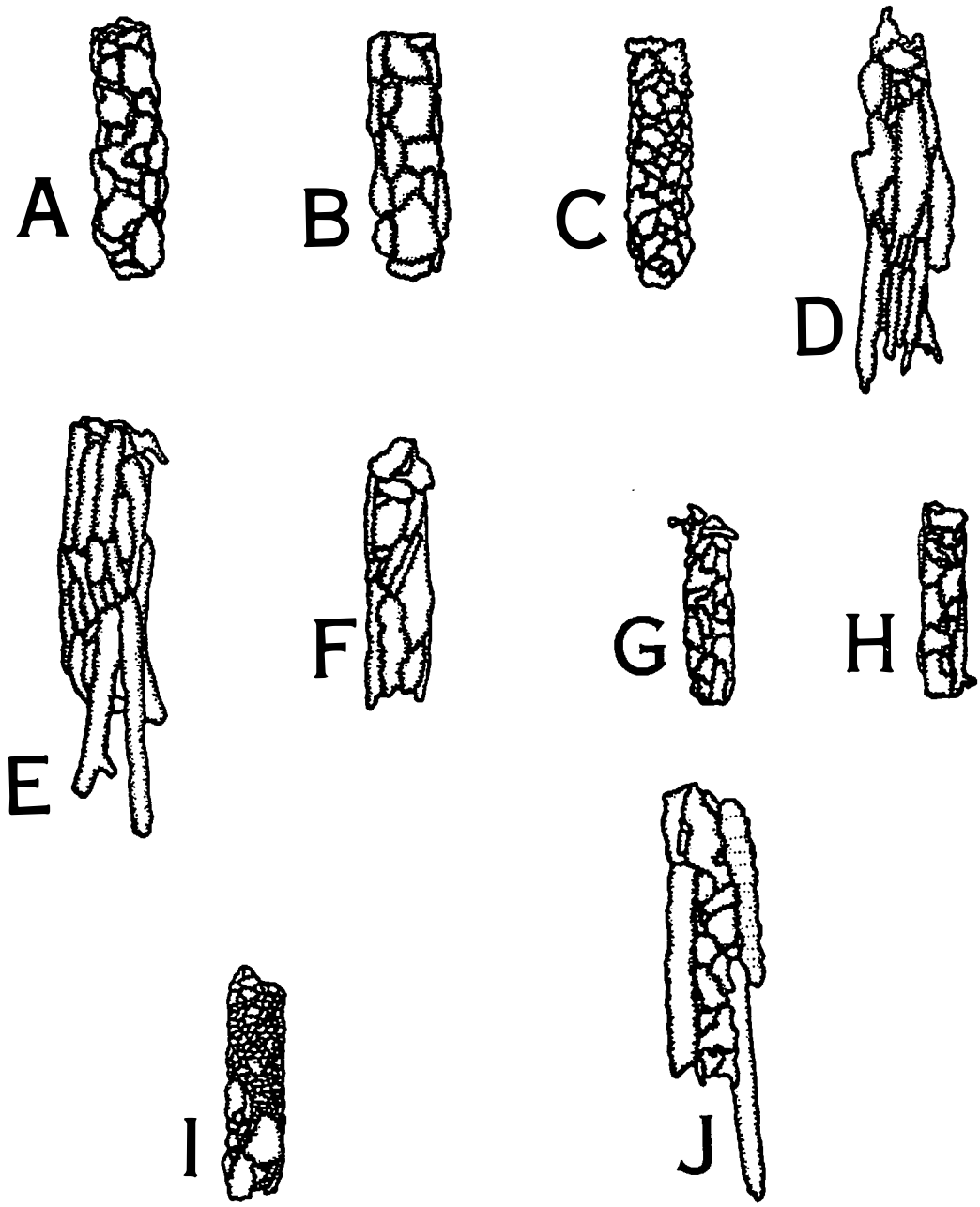


Figure 7. Larval case types in the genus Pycnopsyche. A-C. P. gentilis. D. P. guttifer. E. P. sp. A. F. P. antica. G. P. conspersa. H. P. limbata. I. P. lepida. J. P. luculenta.

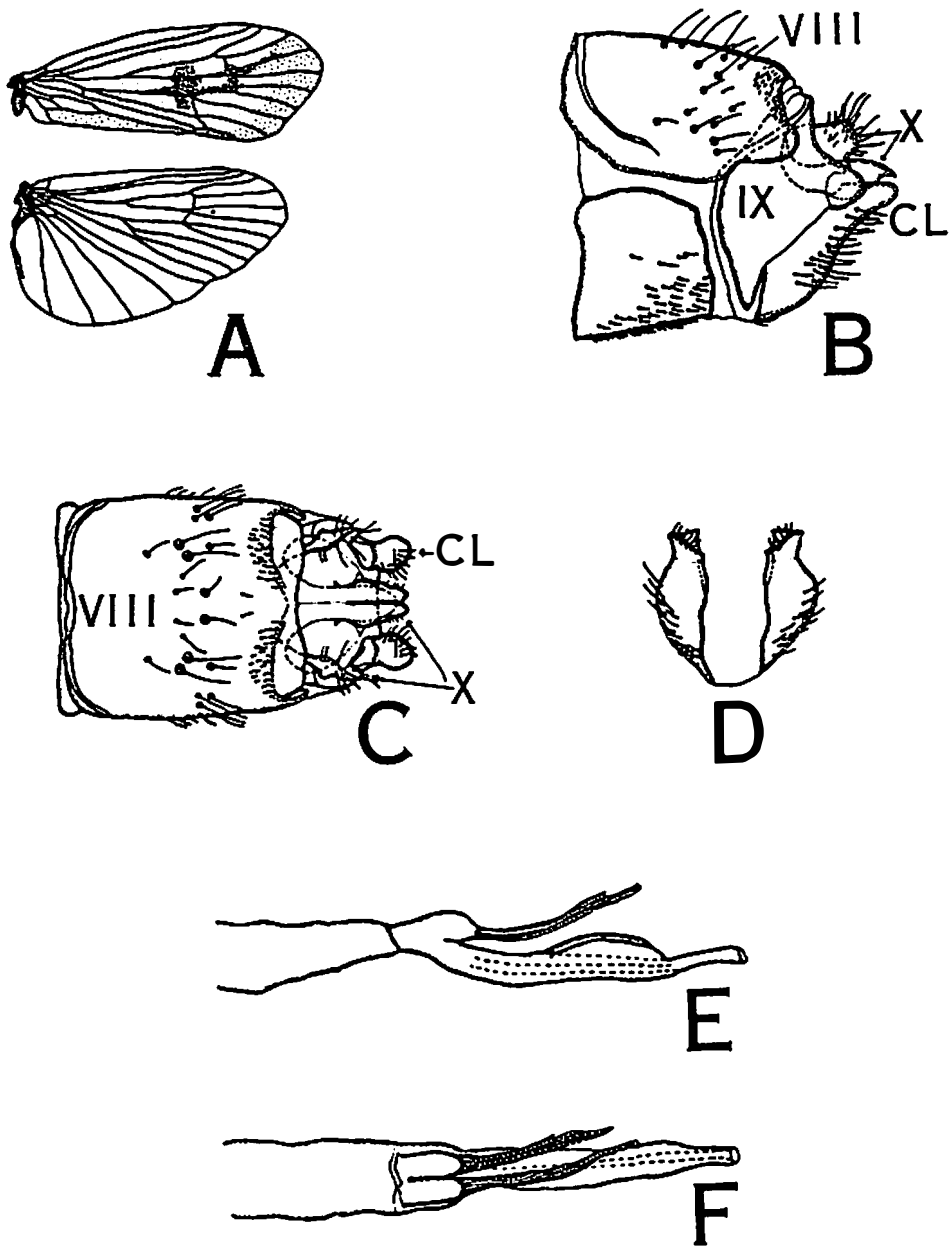
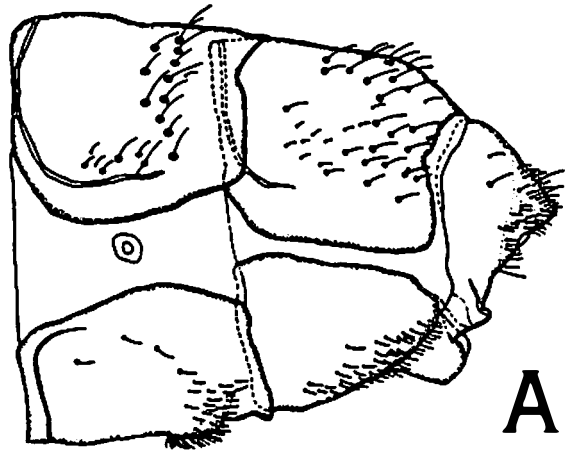
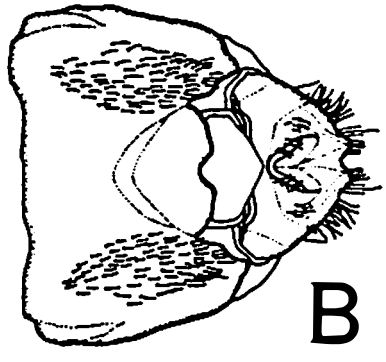


Figure 8. Wings and genitalia of male Pycnopsyche aglona. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view. VIII-segment eight. IX-segment nine. X-segment ten. CL-clasper.





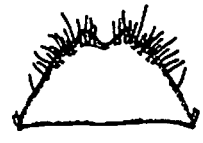


Figure 9. Genitalia of female Pycnopsyche aglona. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

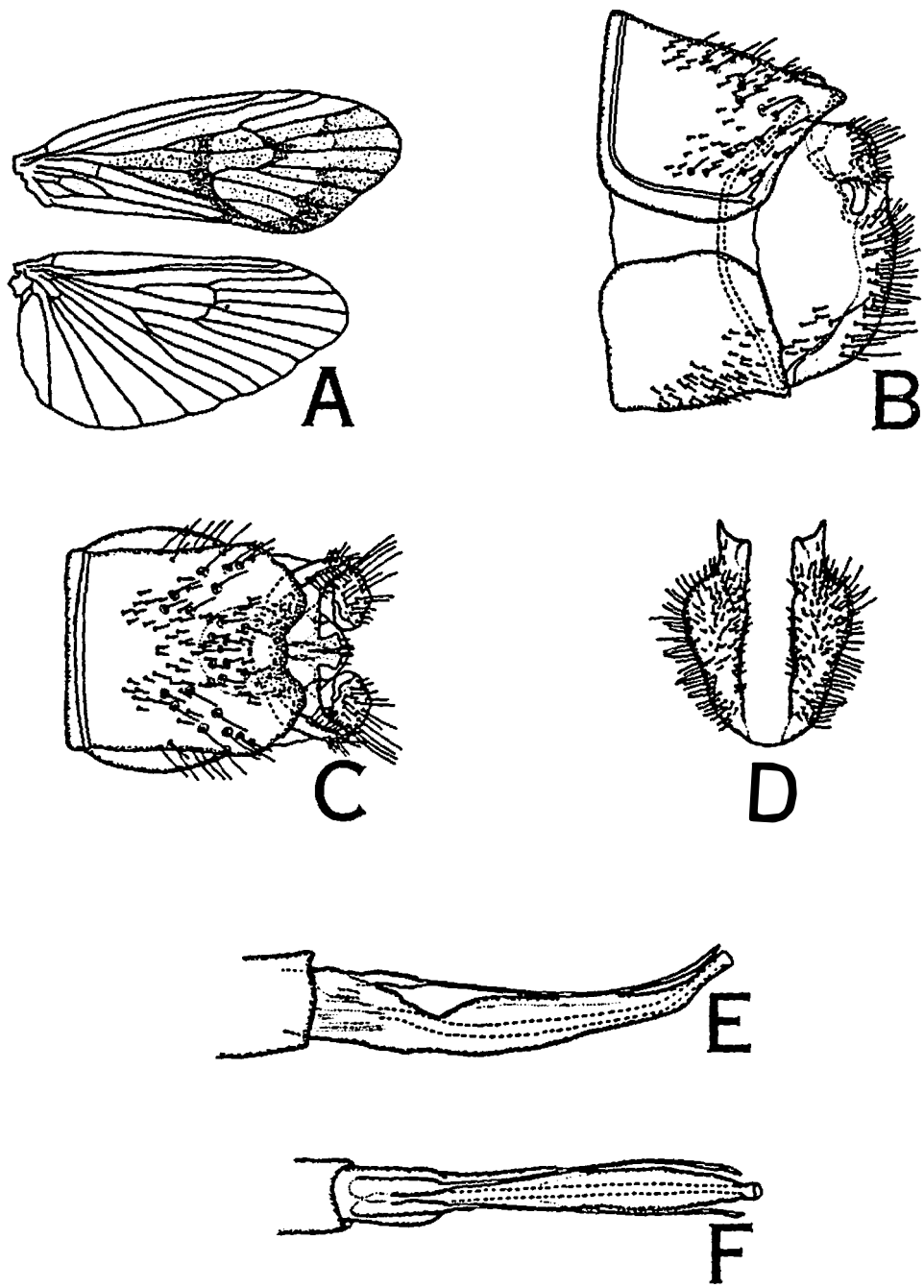


Figure 10. Wings and genitalia of male Pycnopsyche circularis. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

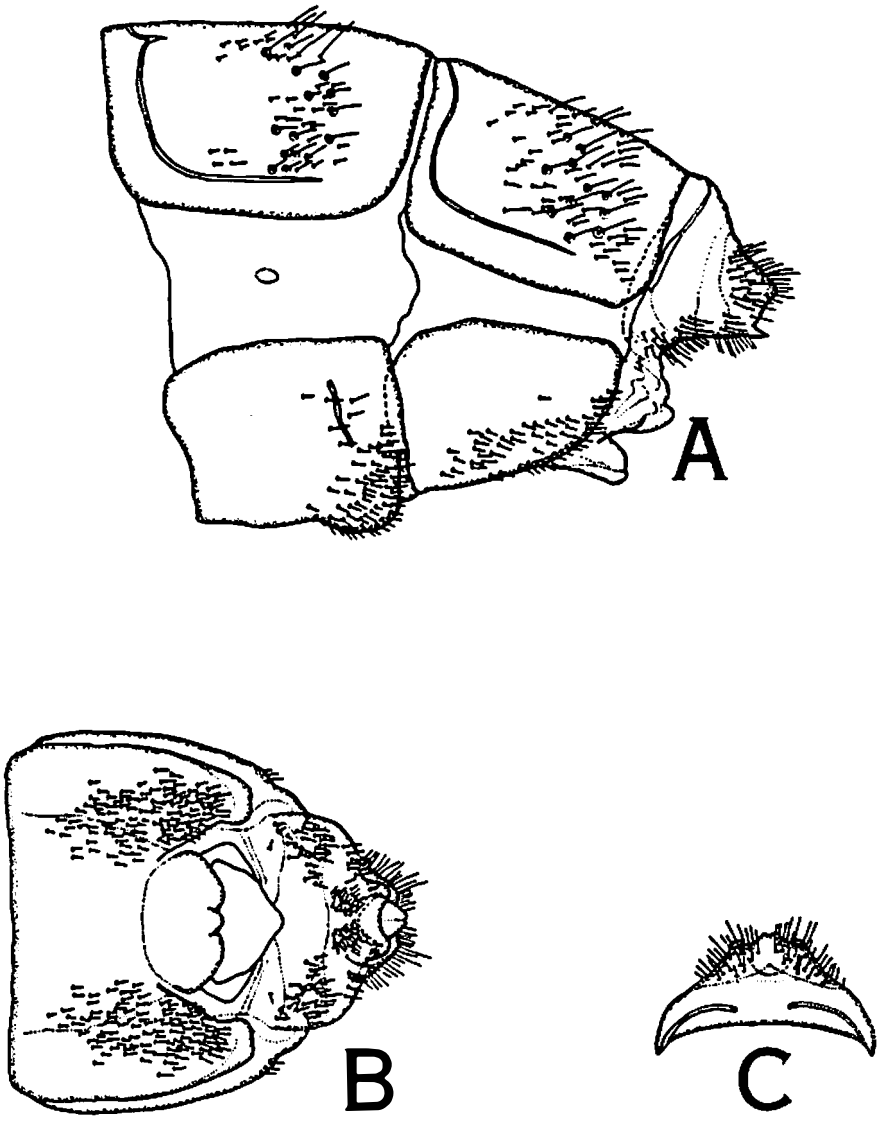


Figure 11. Genitalia of female Pycnopsyche circularis. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

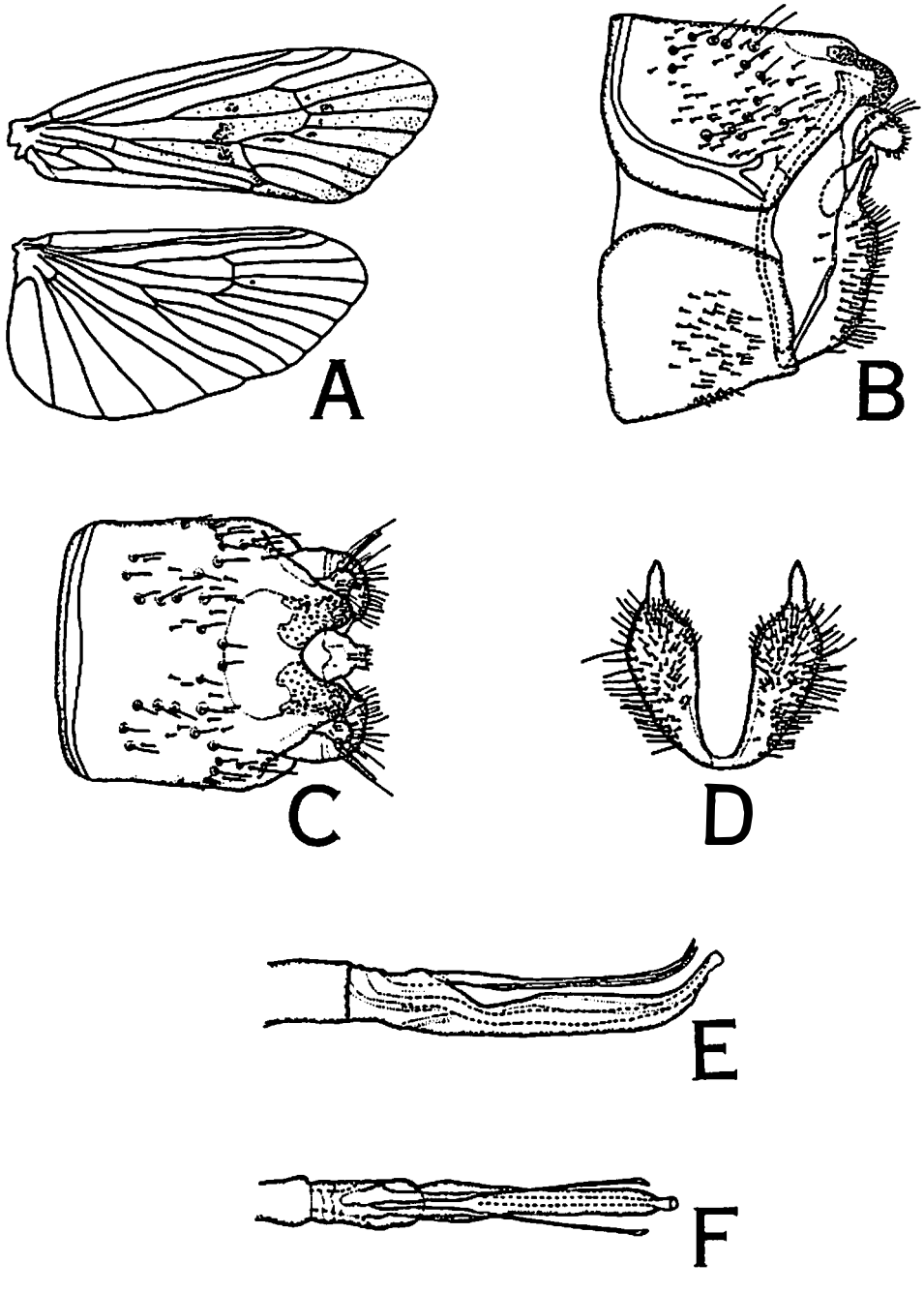


Figure 12. Wings and genitalia of male Pycnopsyche divergens. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

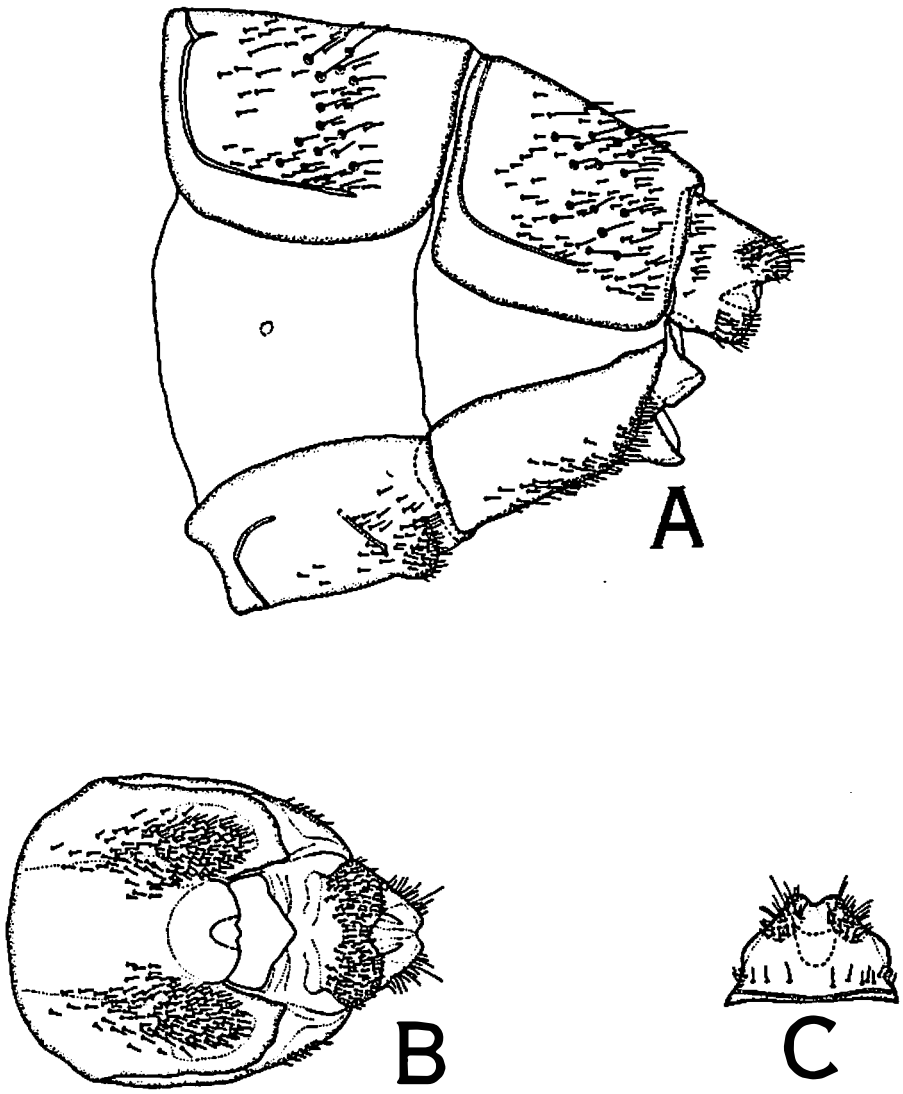


Figure 13. Genitalia of female Pycnopsyche divergens. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

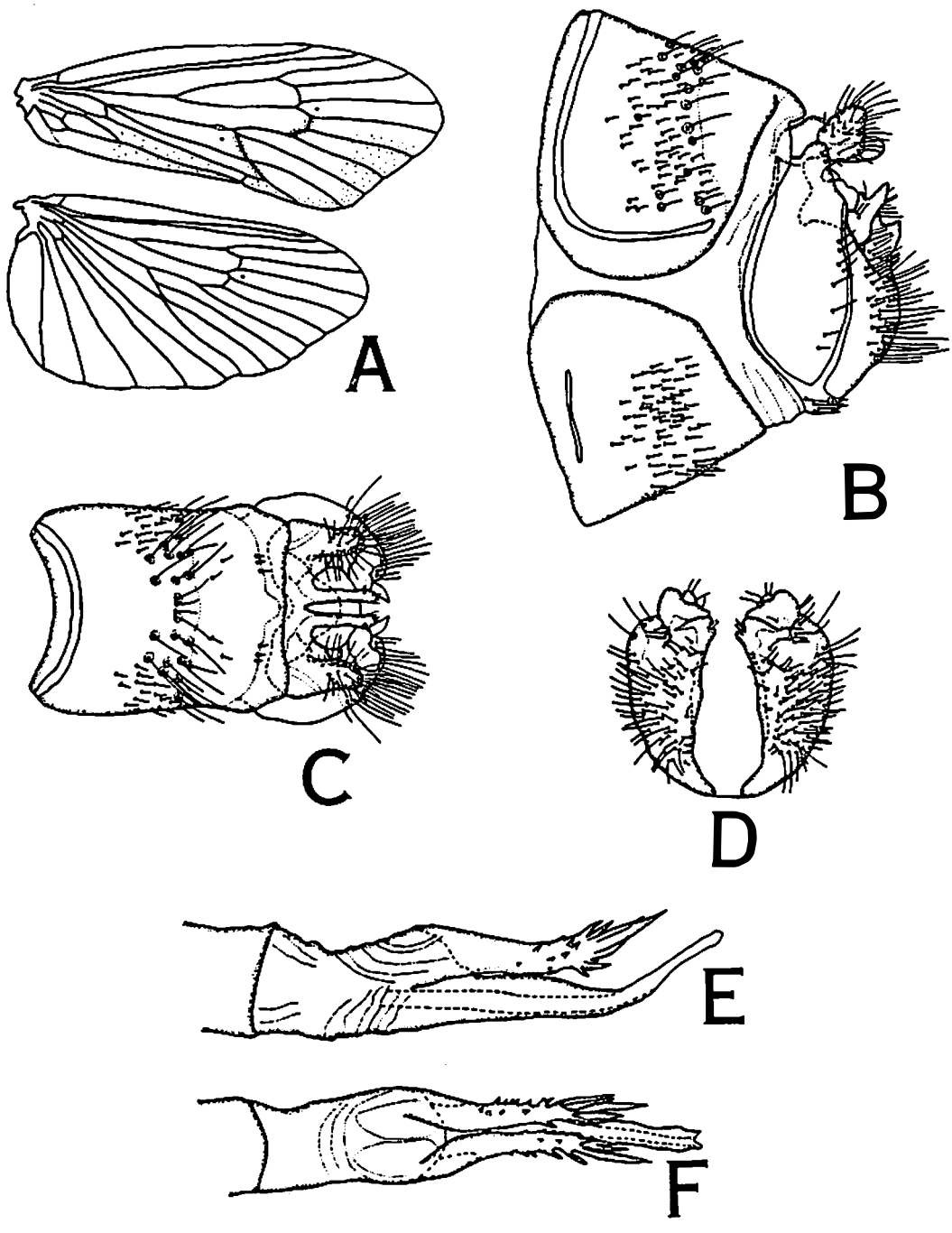


Figure 14. Wings and genitalia of male Pycnopsyche flavata. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. C. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

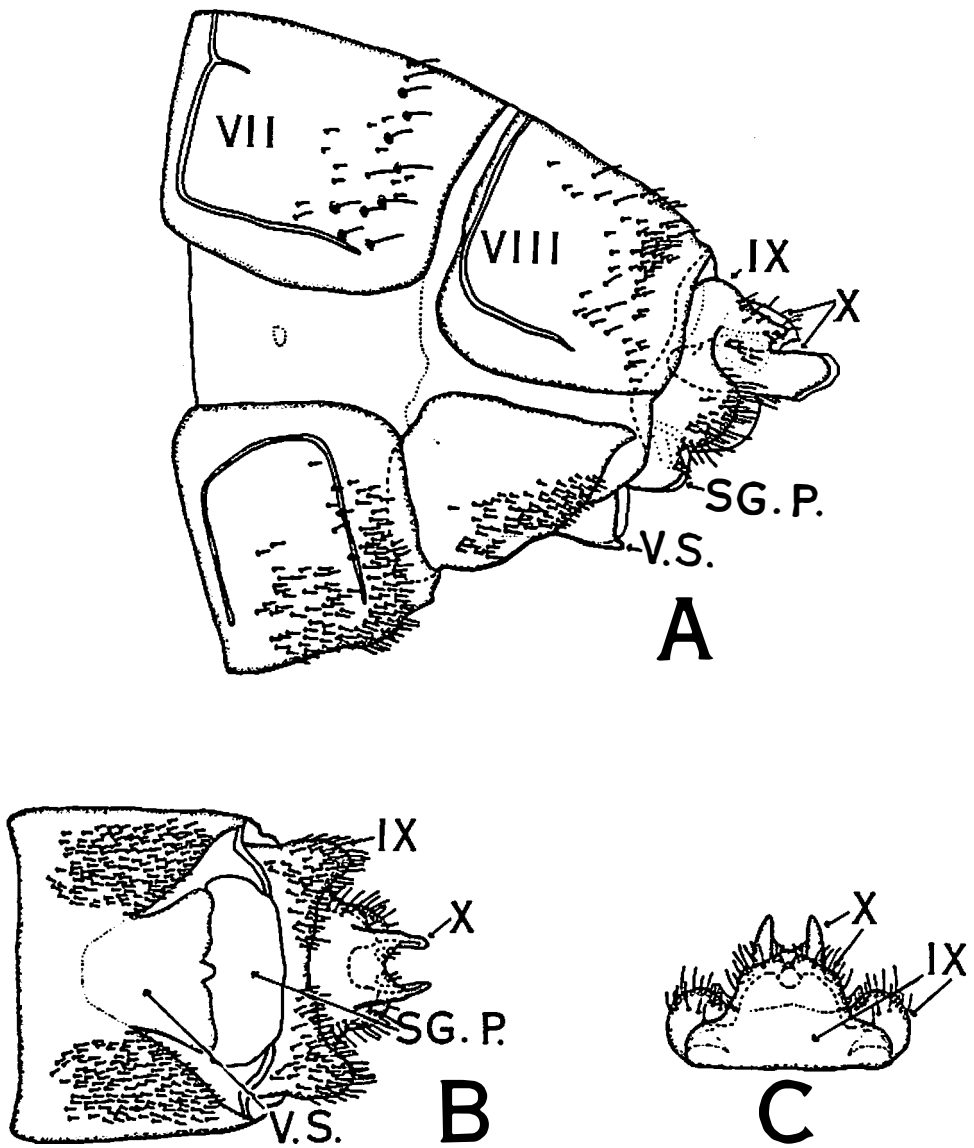


Figure 15. Genitalia of female Pycnopsyche flavata. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X. VII-segment seven. VIII-segment eight. IX-segment nine. X-segment ten. SG.P.-supragenital plate. V.S.-vulvar scale.

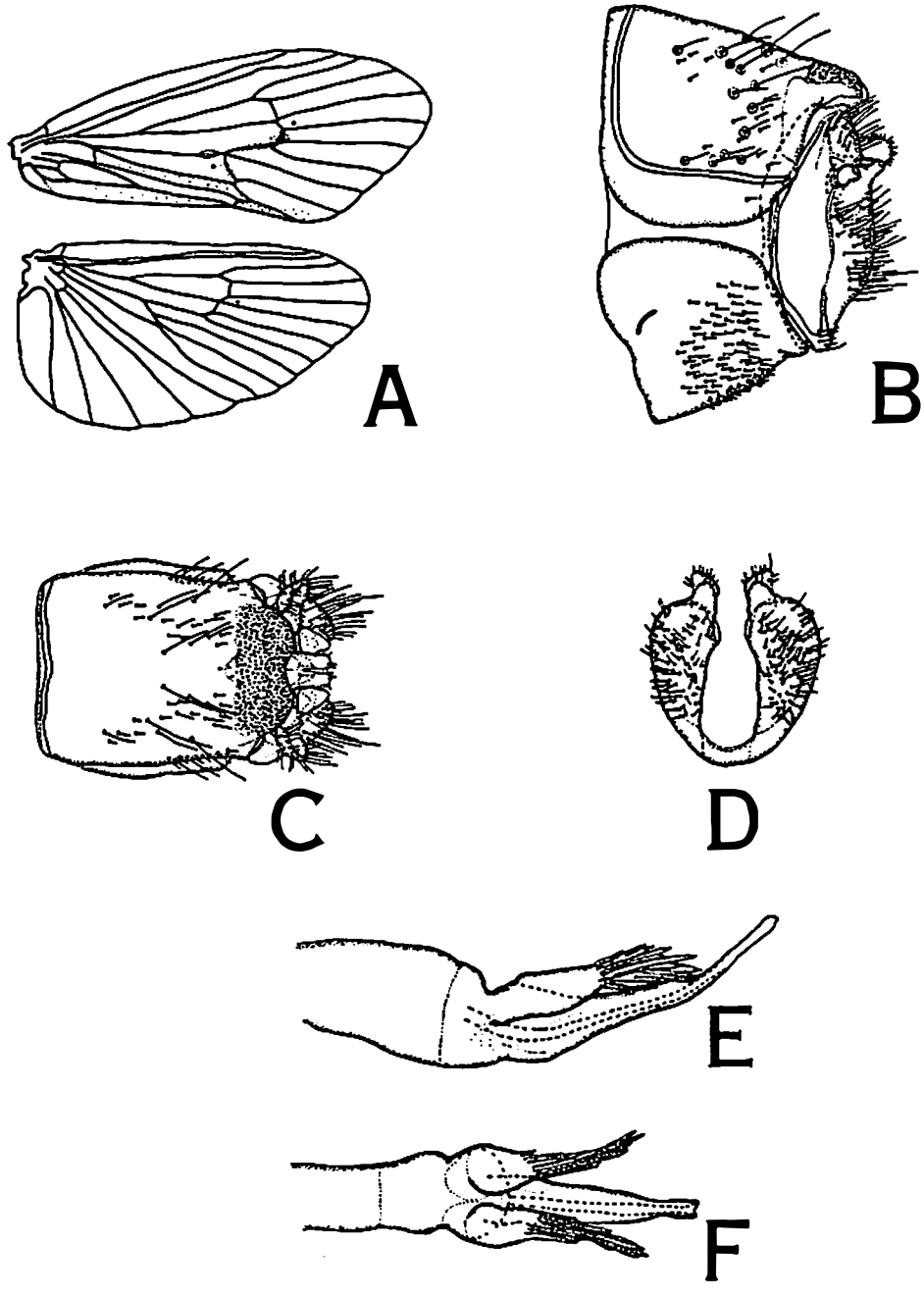


Figure 16. Wings and genitalia of male Pycnopsyche gentilis. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

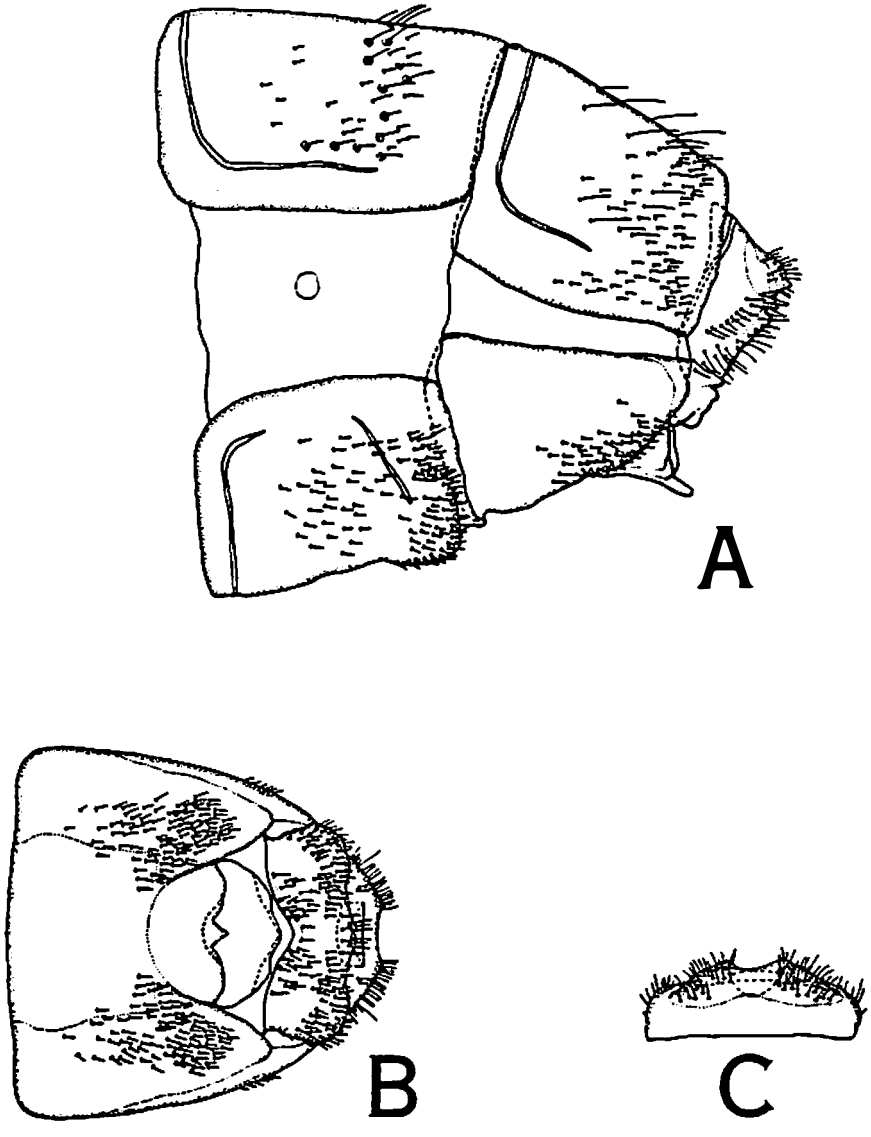


Figure 17. Genitalia of female Pycnopsyche gentilis. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

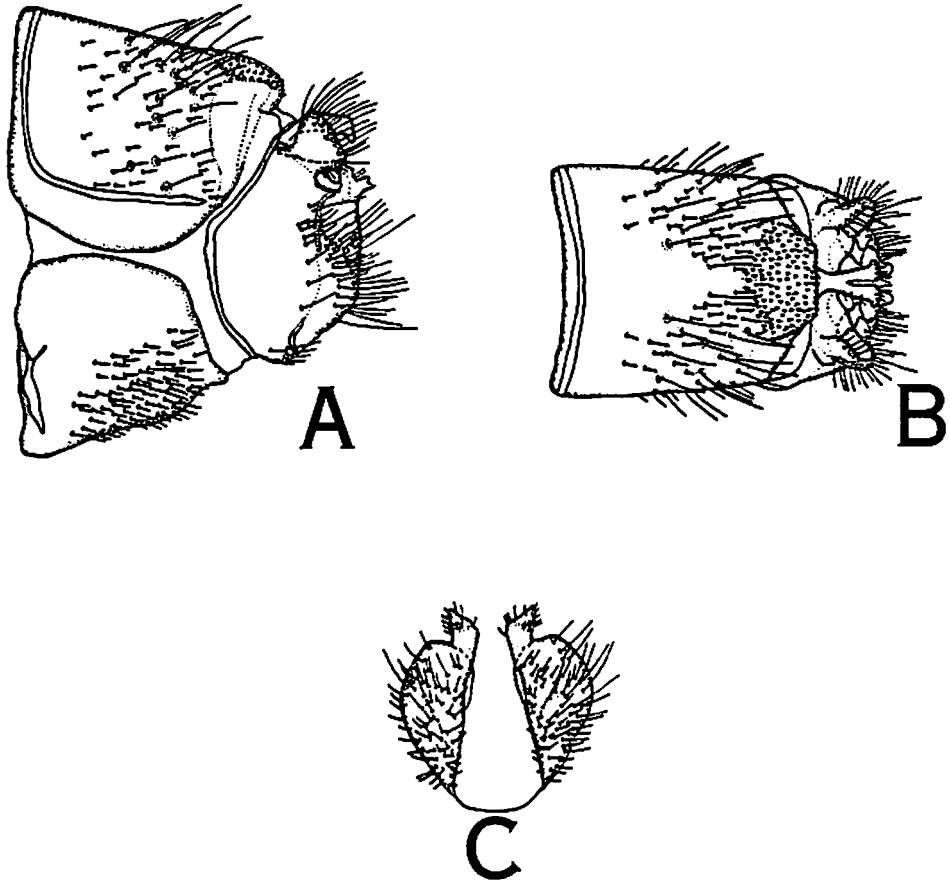


Figure 18. Genitalia of variant male of Pycnopsyche gentilis.
A. Lateral view of abdominal segments VIII, IX, and X.
B. Dorsal view of abdominal segments VIII, IX, and X.
C. Posterior view of claspers.

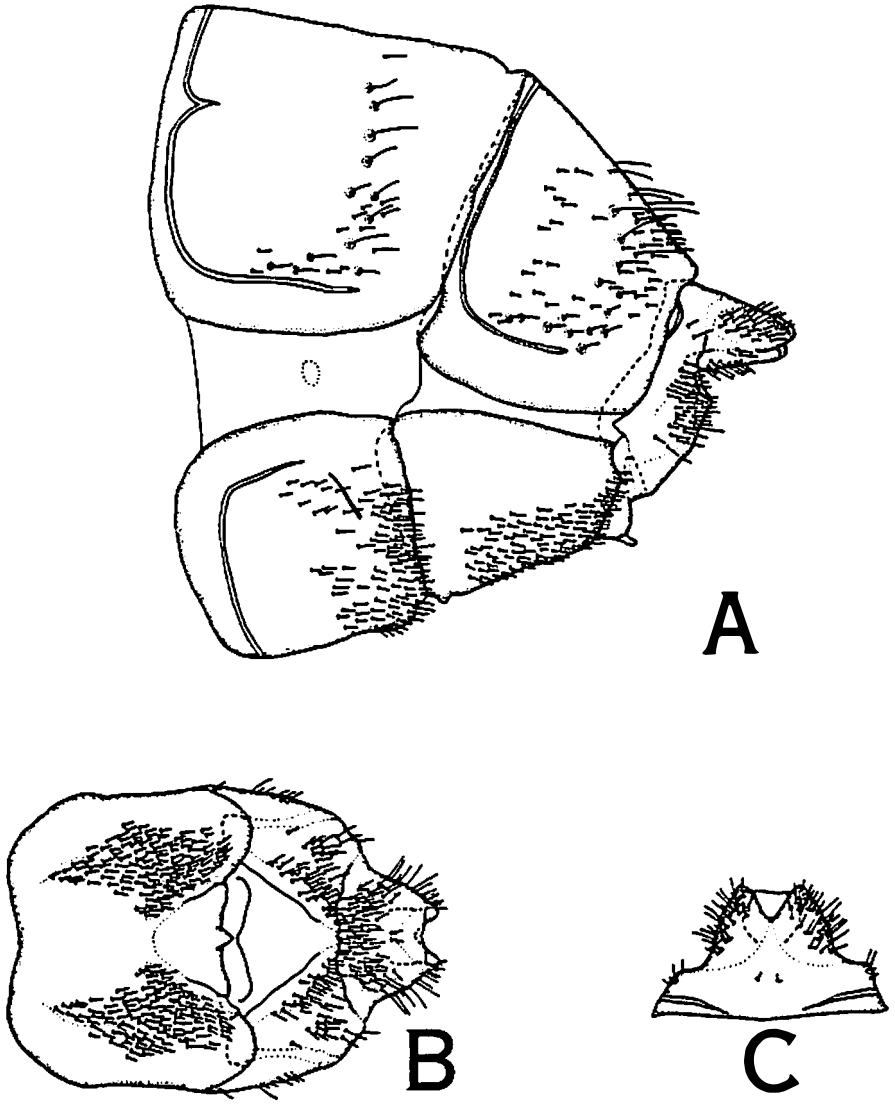


Figure 19. Genitalia of variant female of Pycnopsyche gentilis.
A. Lateral view of abdominal segments VII, VIII, IX, and X.
B. Ventral view of abdominal segments VIII, IX, and X.
C. Dorsal view of abdominal segments IX and X.

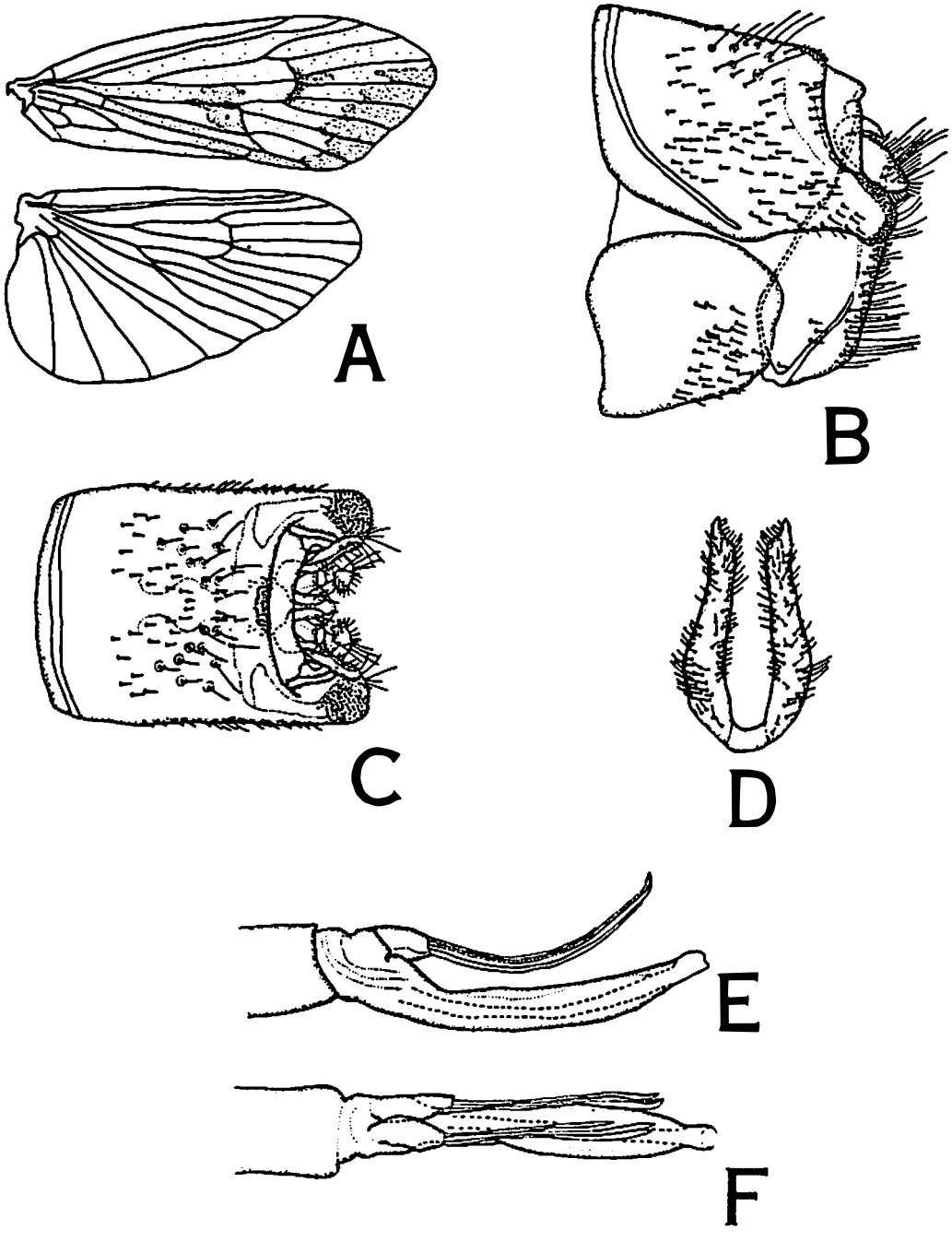


Figure 20. Wings and genitalia of male Pycnopsyche guttifer. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

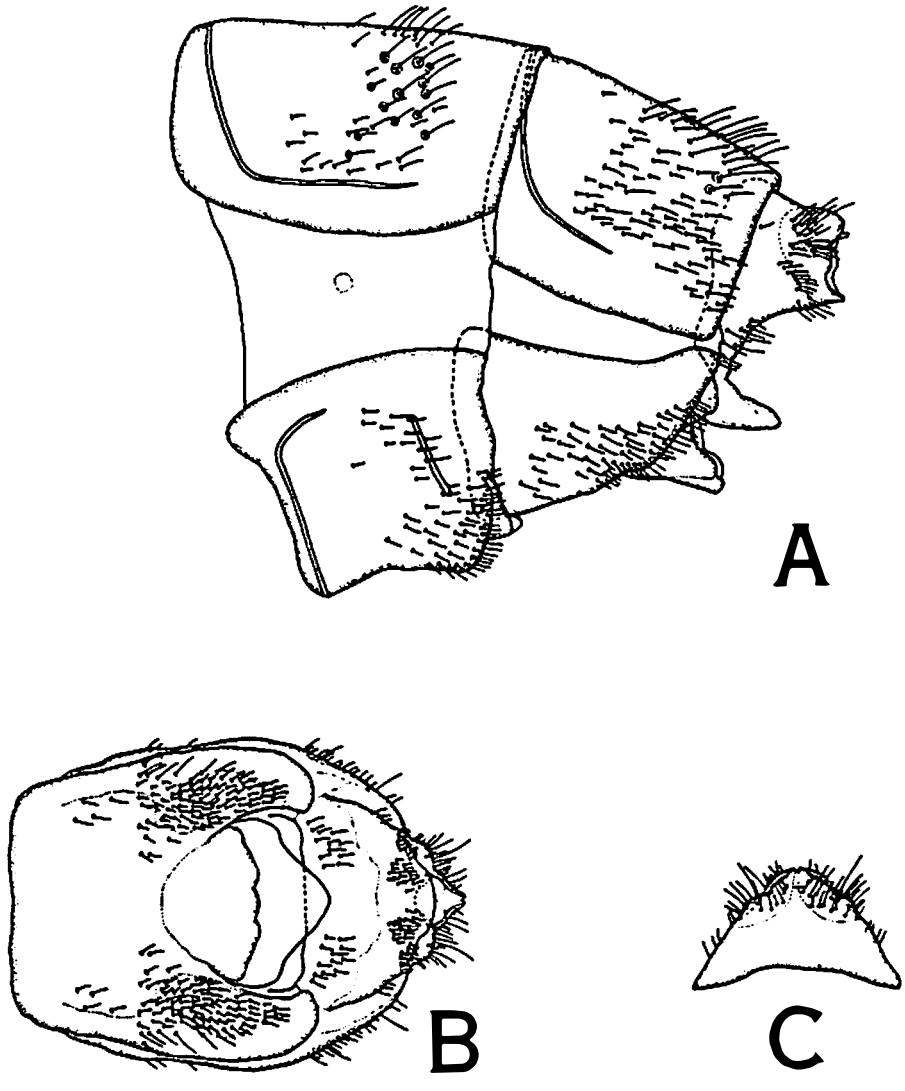


Figure 21. Genitalia of female Pycnopsyche guttifer. A. Lateral view of abdominal segments VII, VIII, IX, and X. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

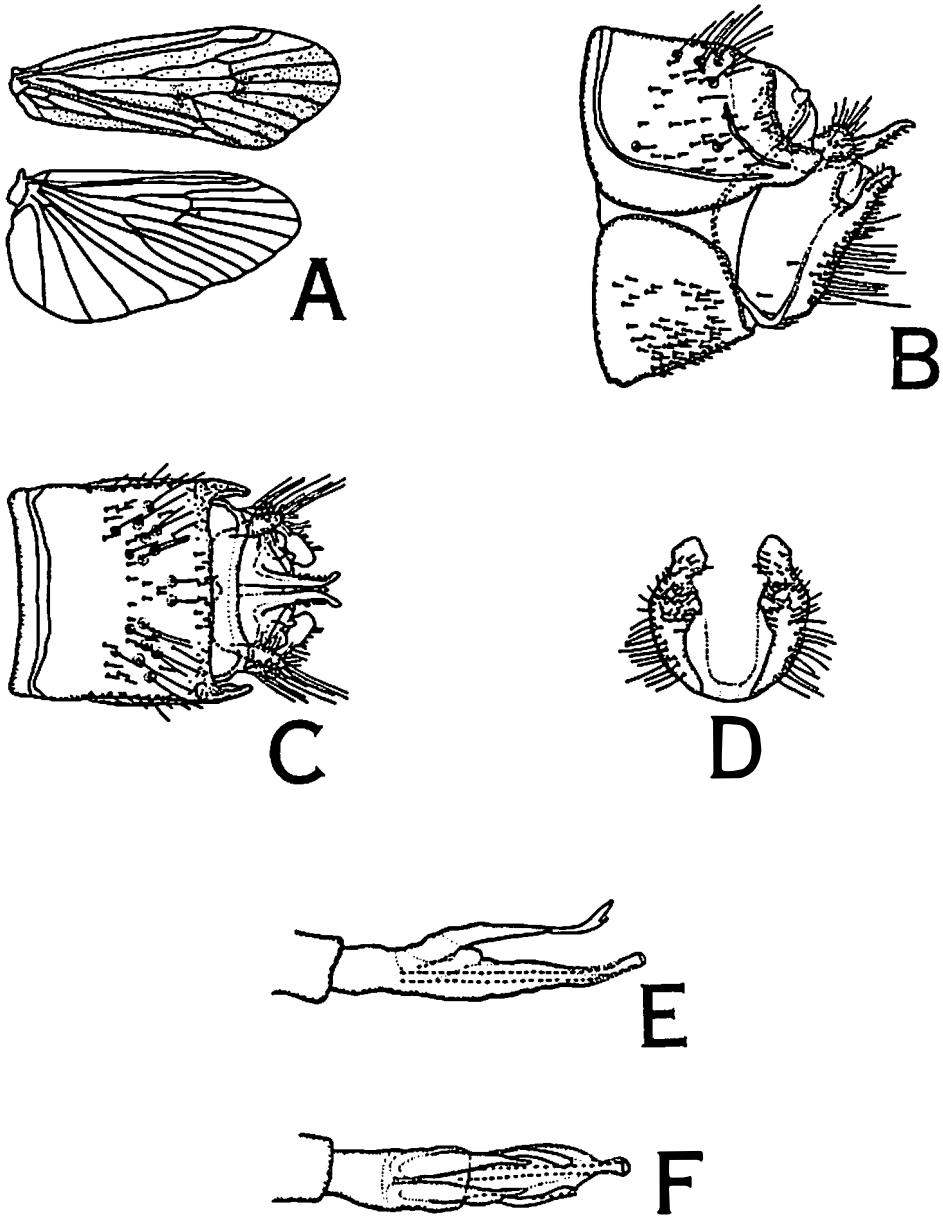


Figure 22. Wings and genitalia of male Pycnopsyche limbata. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

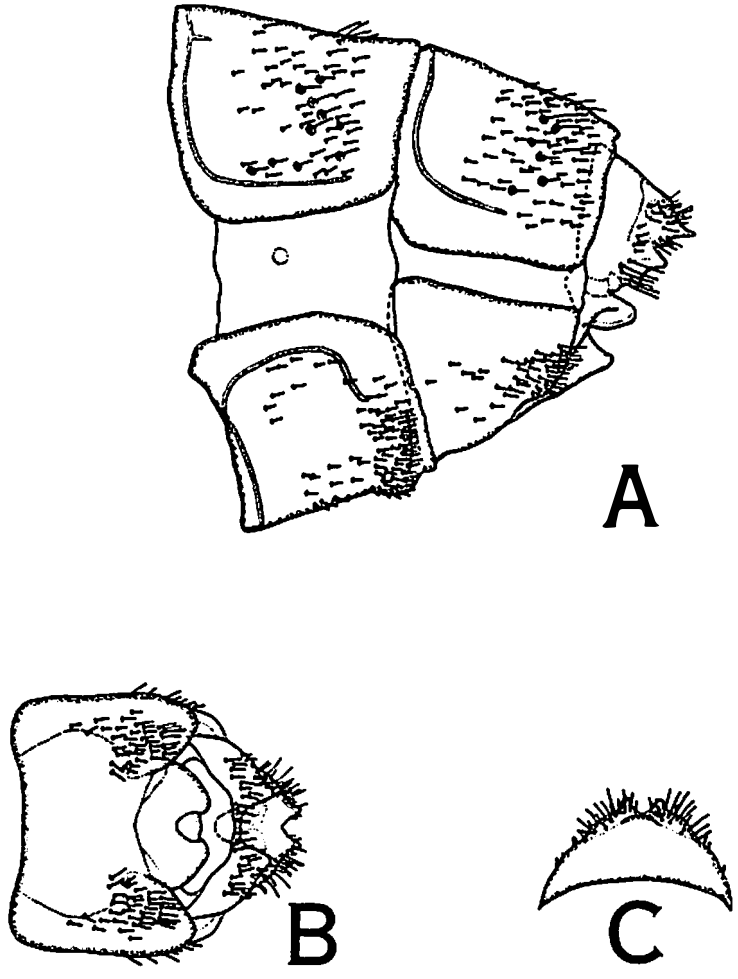


Figure 23. Genitalia of female Pycnopsyche limbata. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

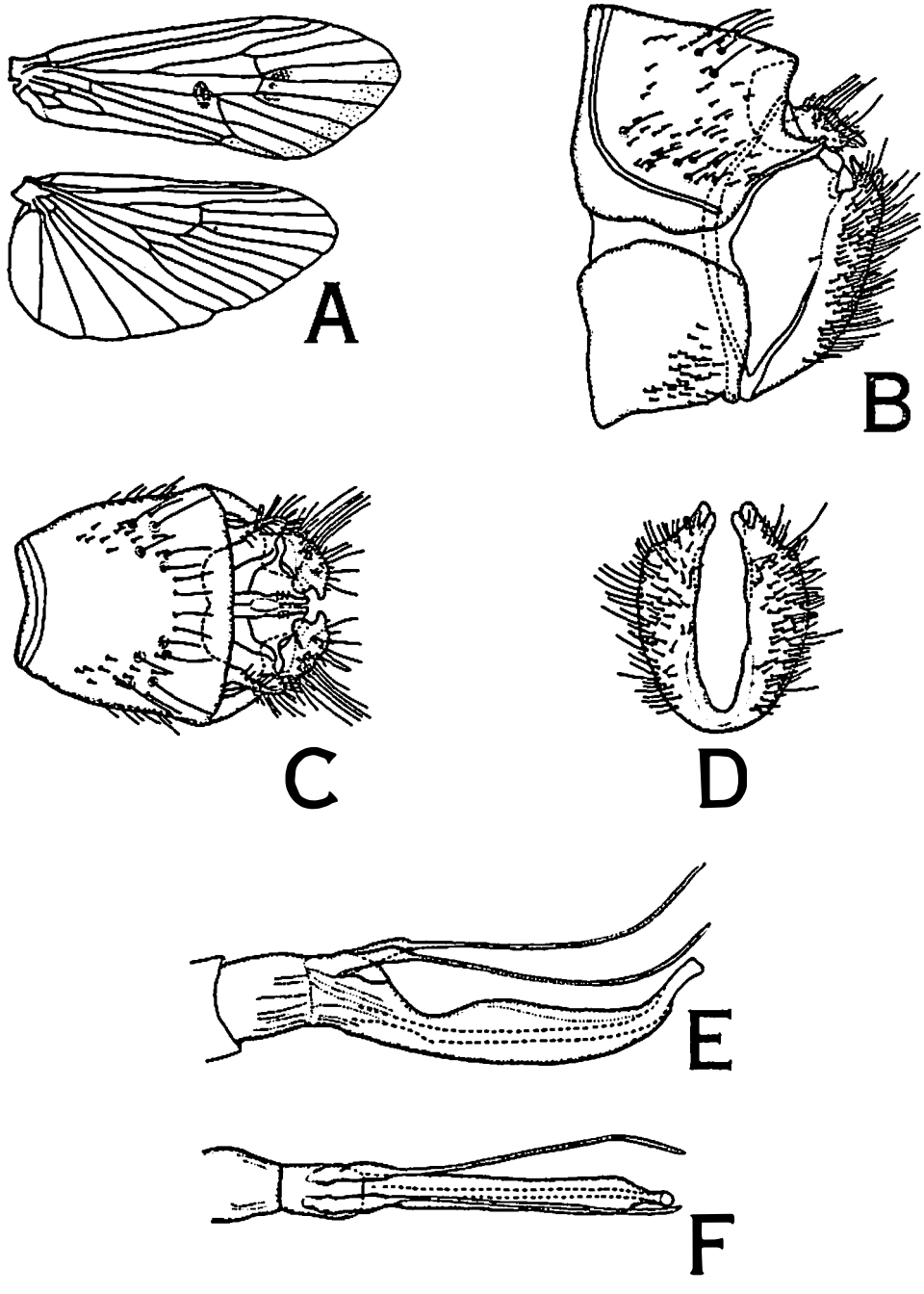


Figure 24. Wings and genitalia of male Pycnopsyche luculenta. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

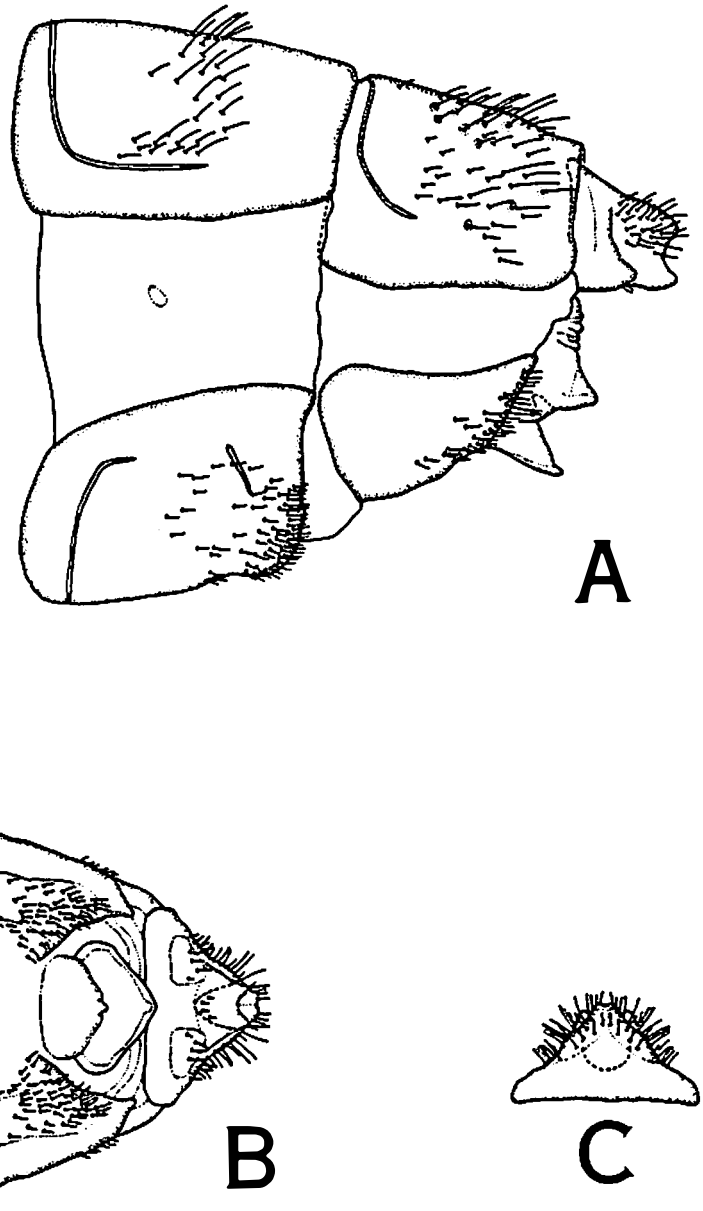


Figure 25. Genitalia of female Pycnopsyche luculenta. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

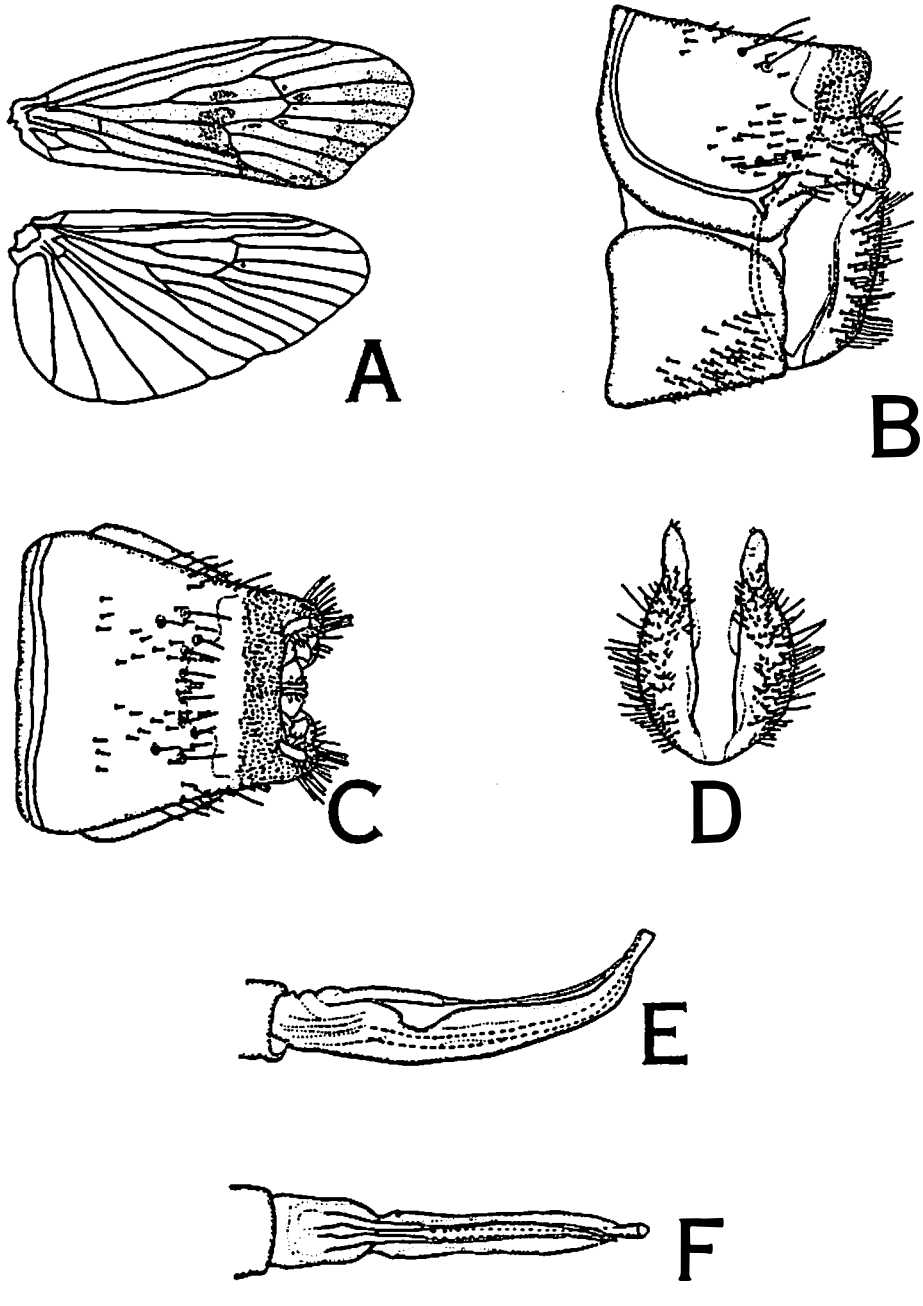


Figure 26. Wings and genitalia of male Pycnopsyche rossi. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

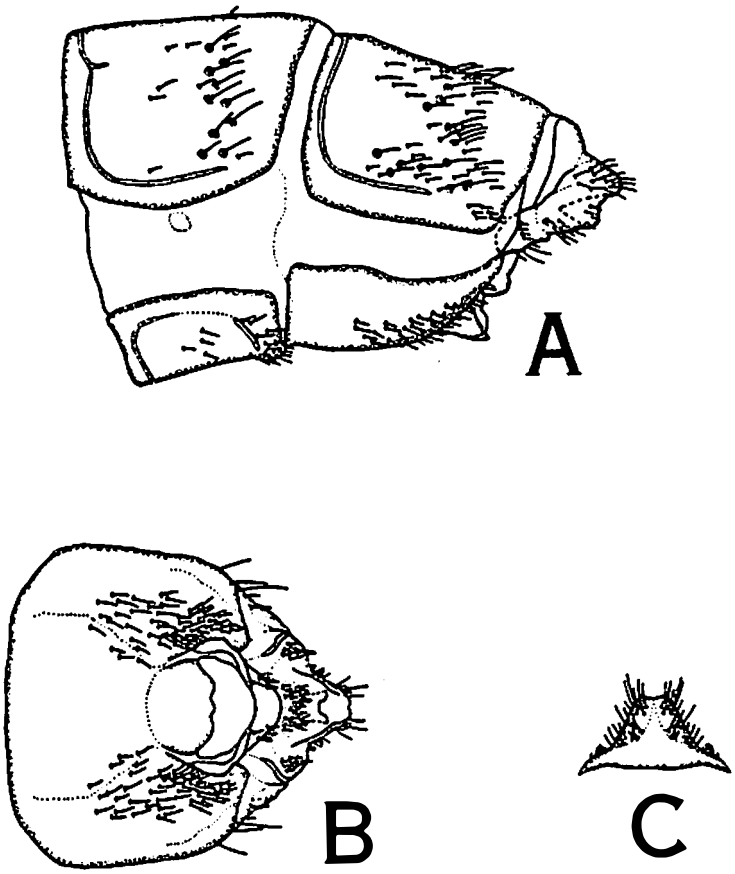


Figure 27. Genitalia of female Pycnopsyche rossi. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

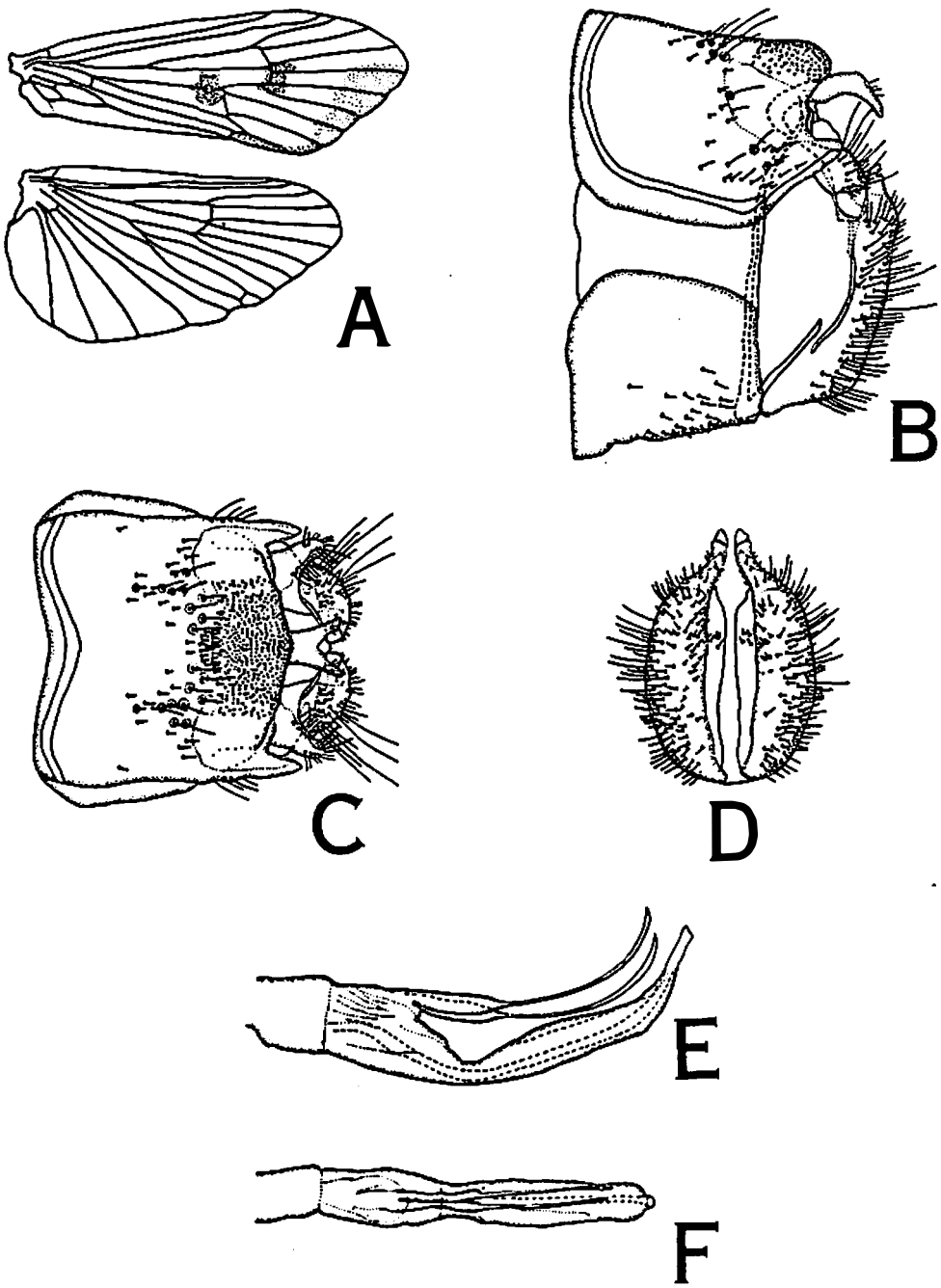


Figure 28. Wings and genitalia of male Pycnopsyche sonso. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

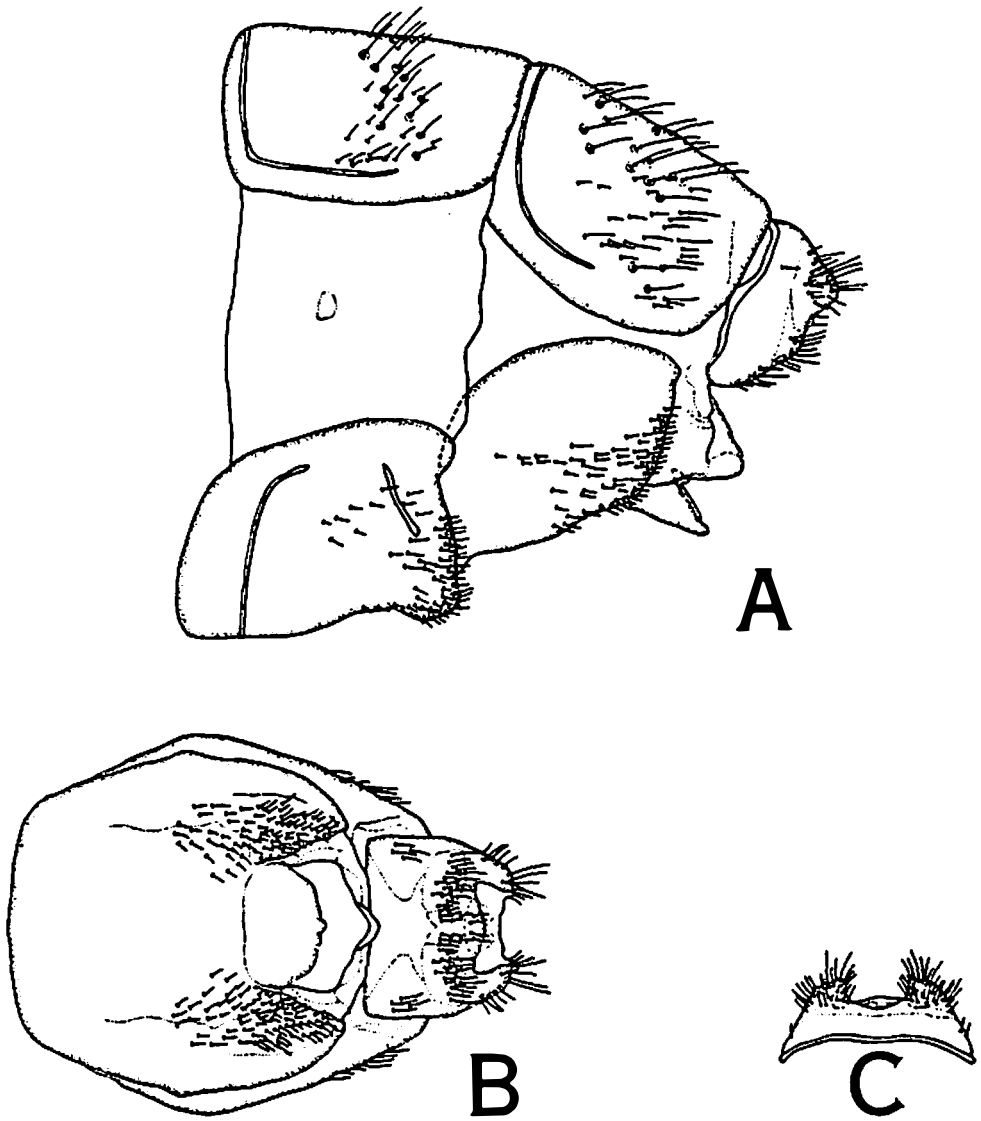


Figure 29. Genitalia of female Pycnopsyche sonso. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

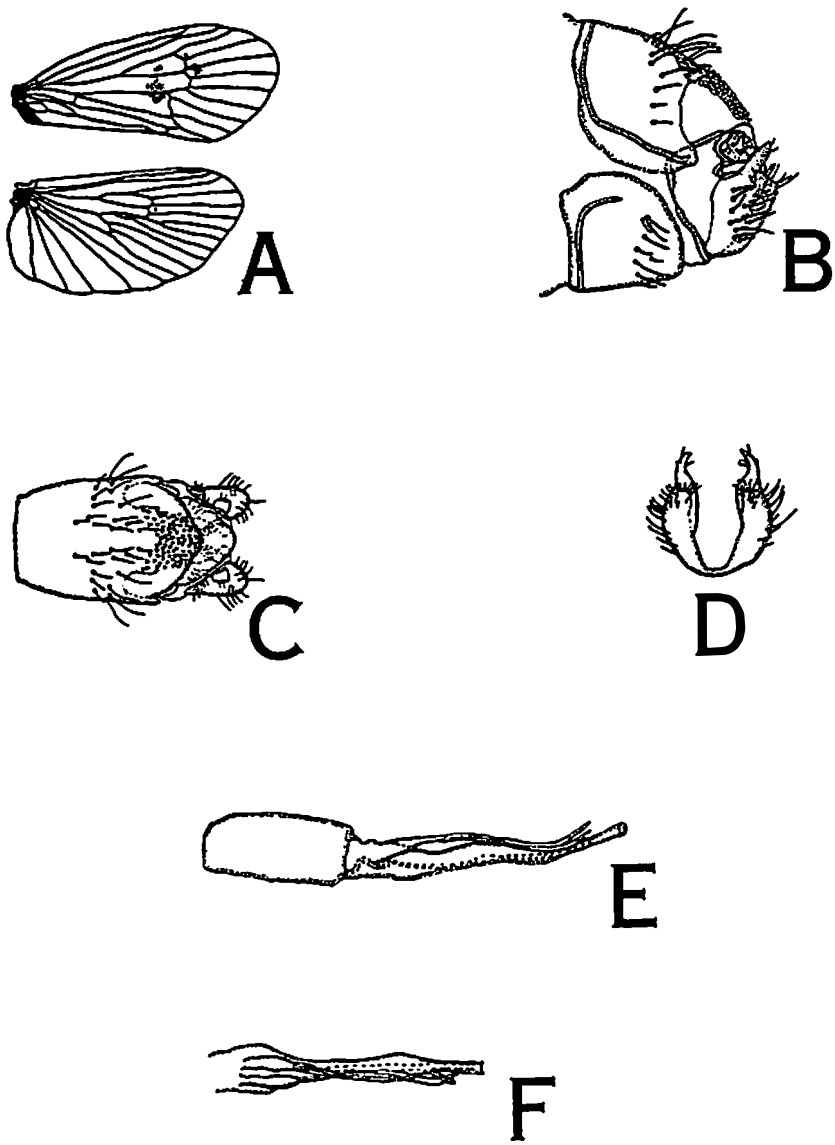


Figure 30. Wings and genitalia of male Pycnopsyche virginica. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

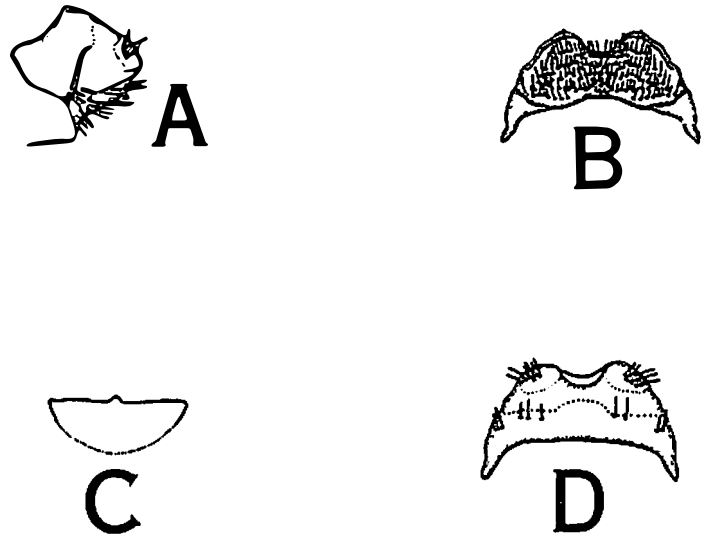


Figure 31. Genitalia of female Pycnopsyche virginica. A. Lateral view of abdominal segments IX and X. B. Ventral view of abdominal segments IX and X. C. Dorsal view of abdominal segments IX and X. D. Ventral view of vulvar scale.

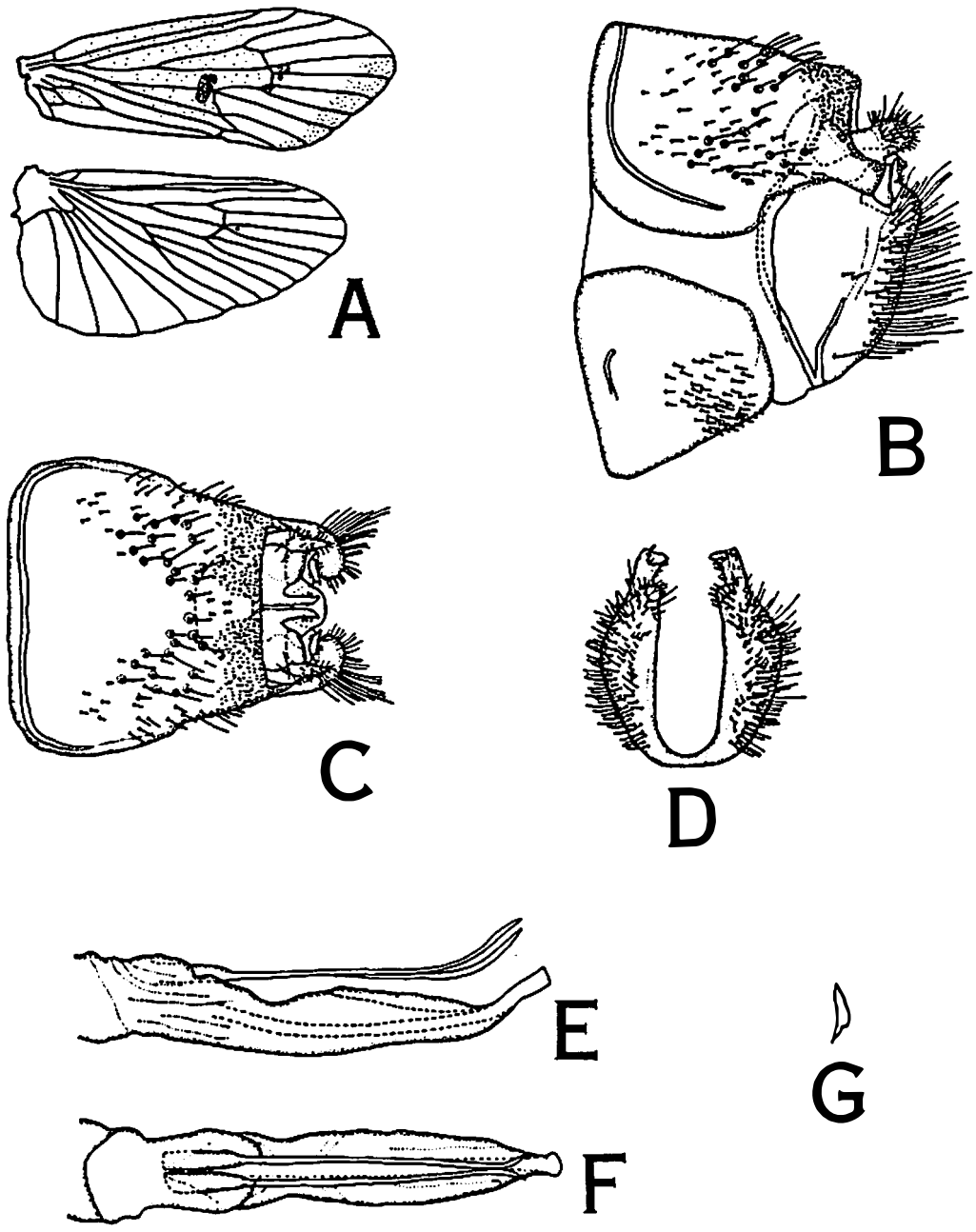


Figure 32. Wings and genitalia of male Pycnopsyche sp. A. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view. G. Horn of abdominal scent gland opening of fifth segment, ventral view.

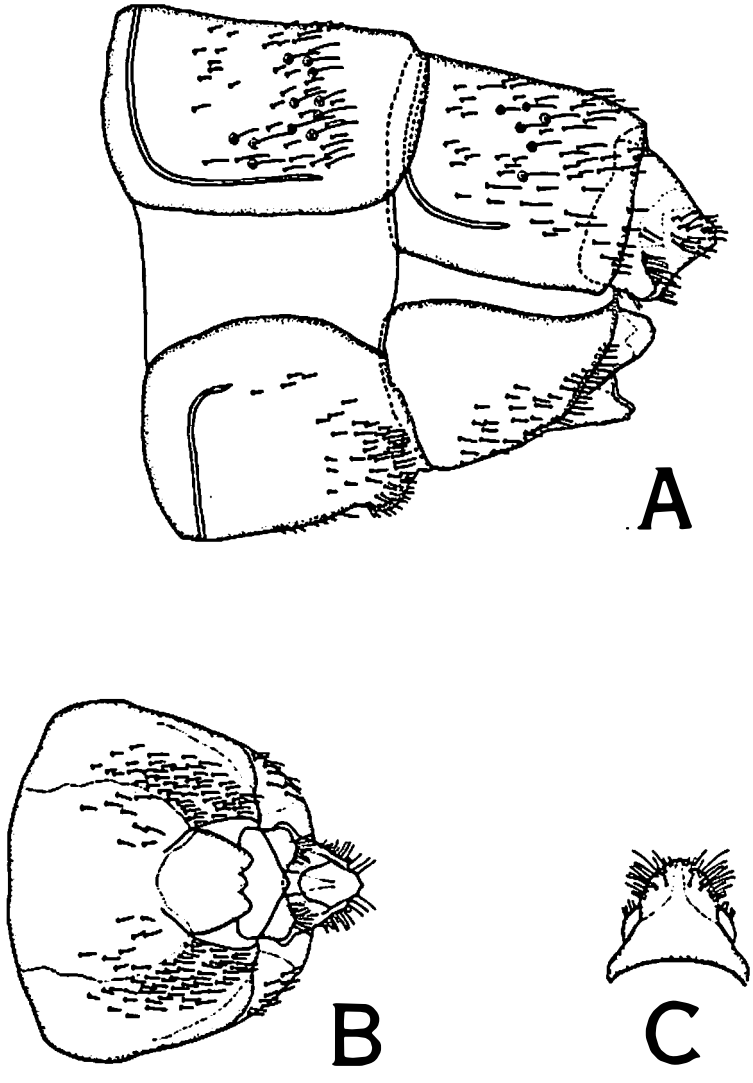


Figure 33. Genitalia of female Pycnopsyche sp. A. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

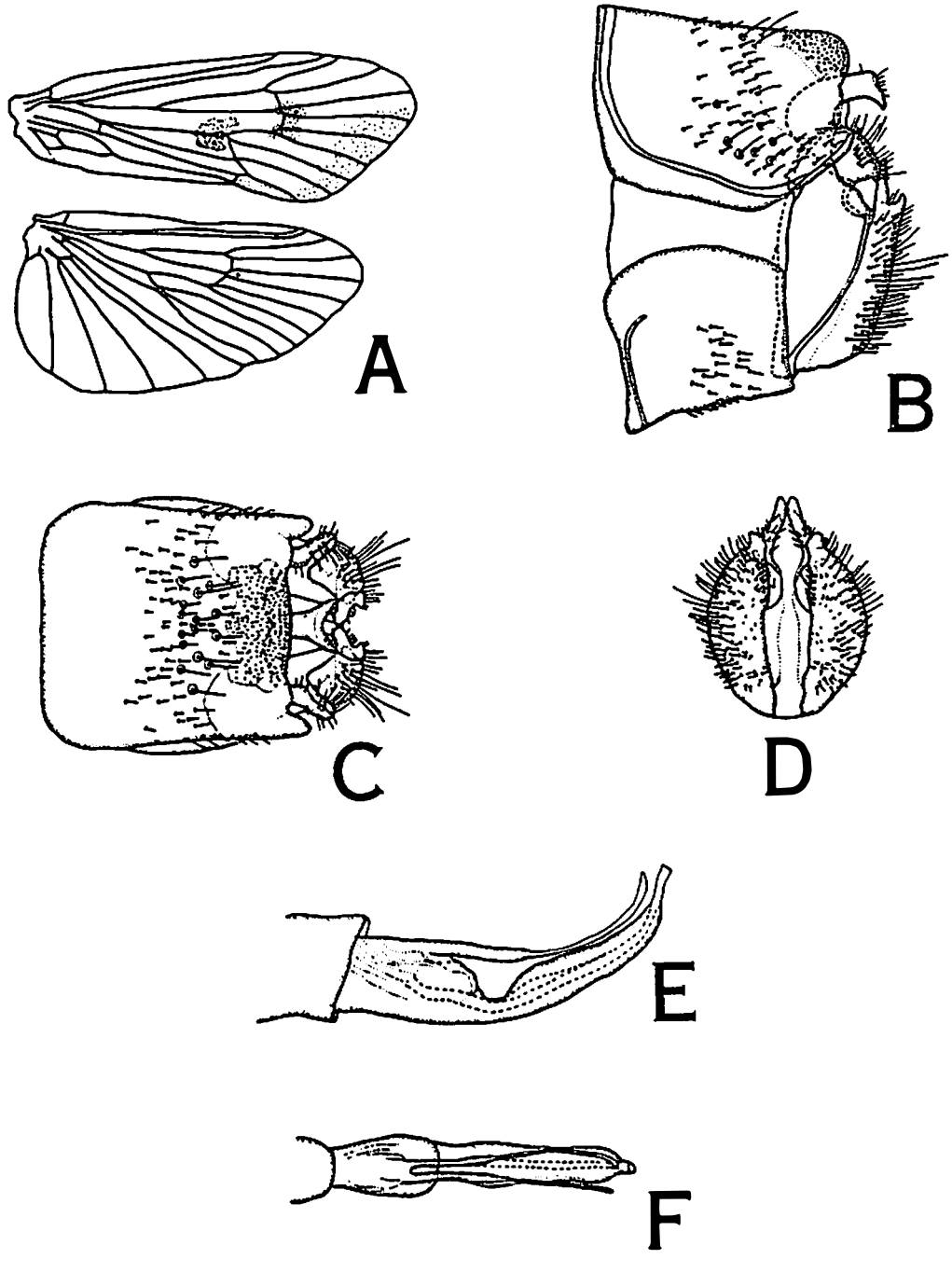


Figure 34. Wings and genitalia of male Pycnopsyche sp. B. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

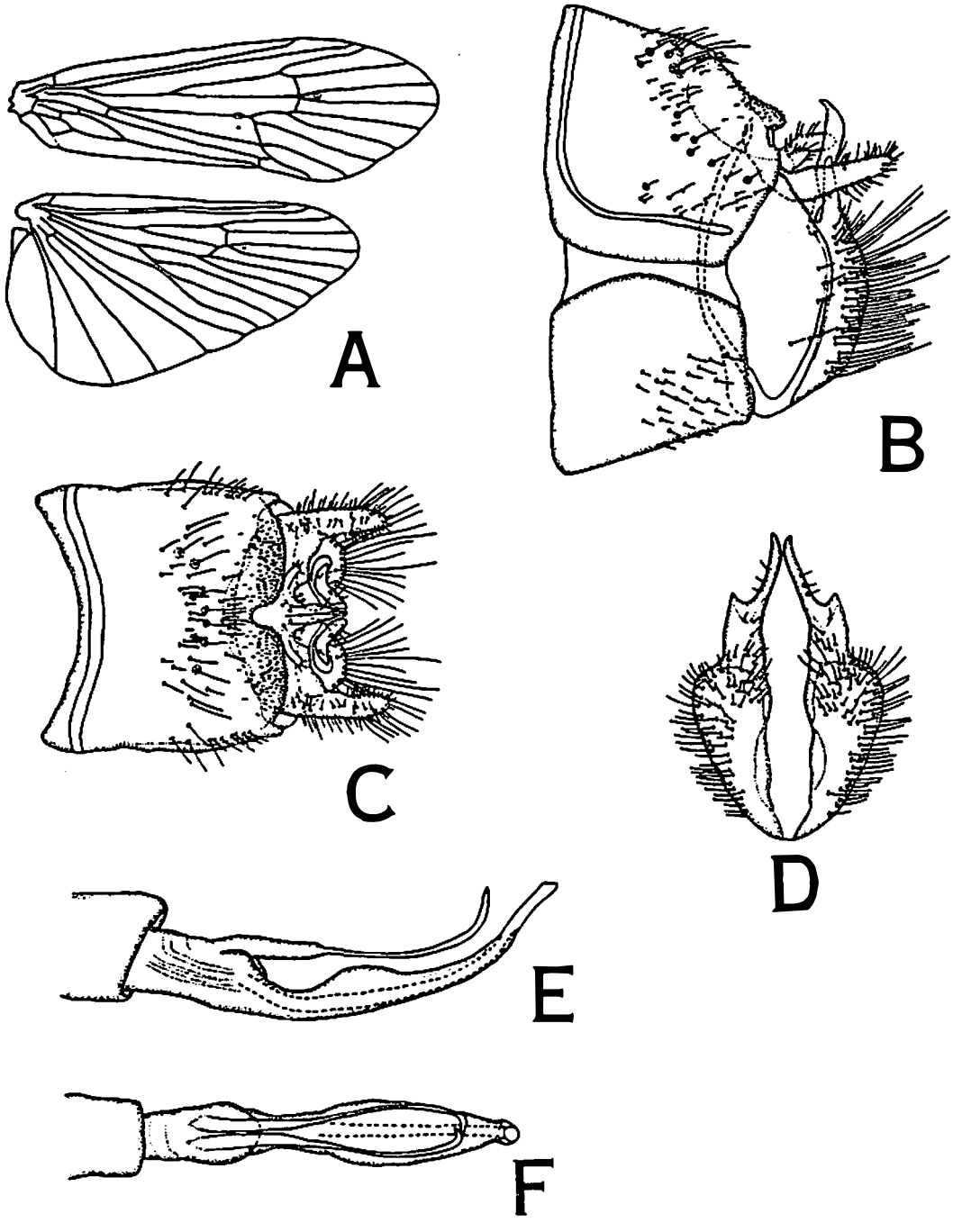


Figure 35. Wings and genitalia of male Pycnopsyche lepida. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

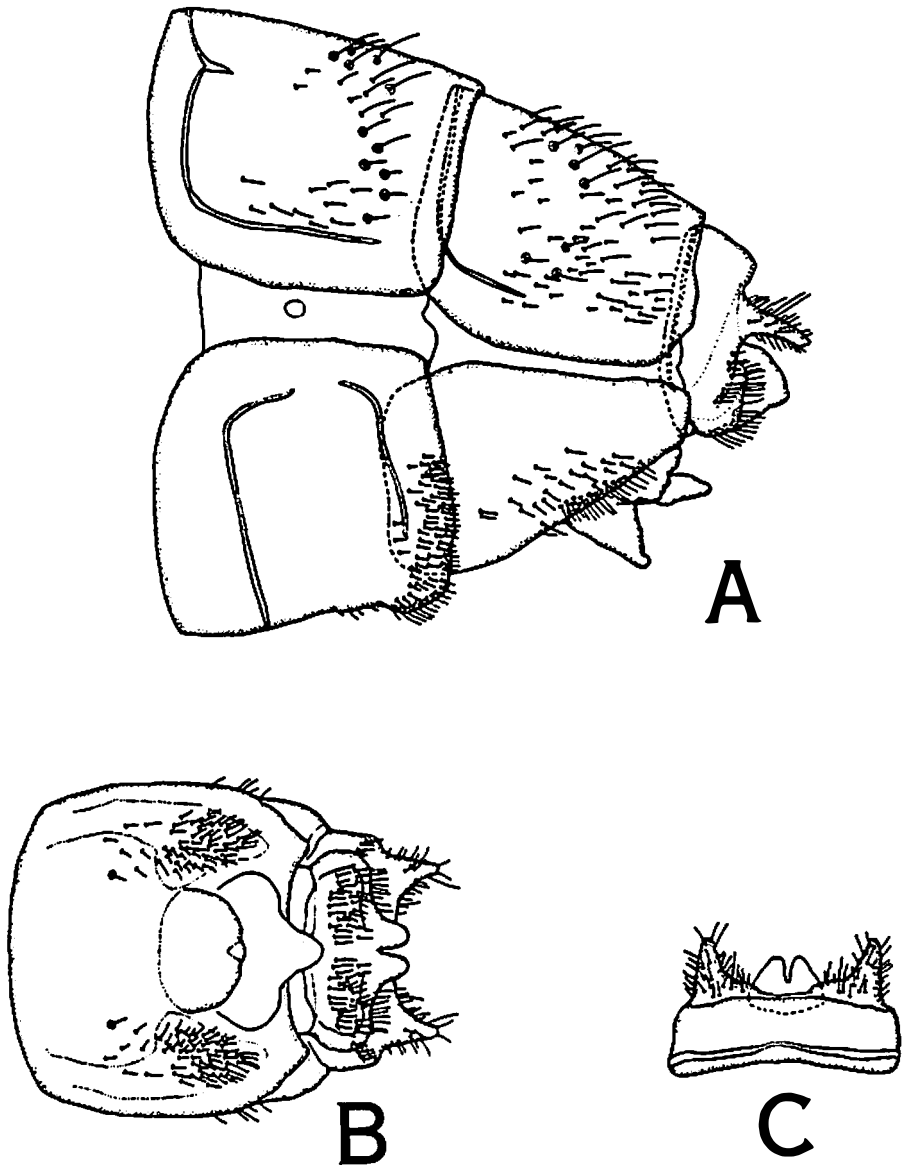


Figure 36. Genitalia of female Pycnopsyche lepida. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

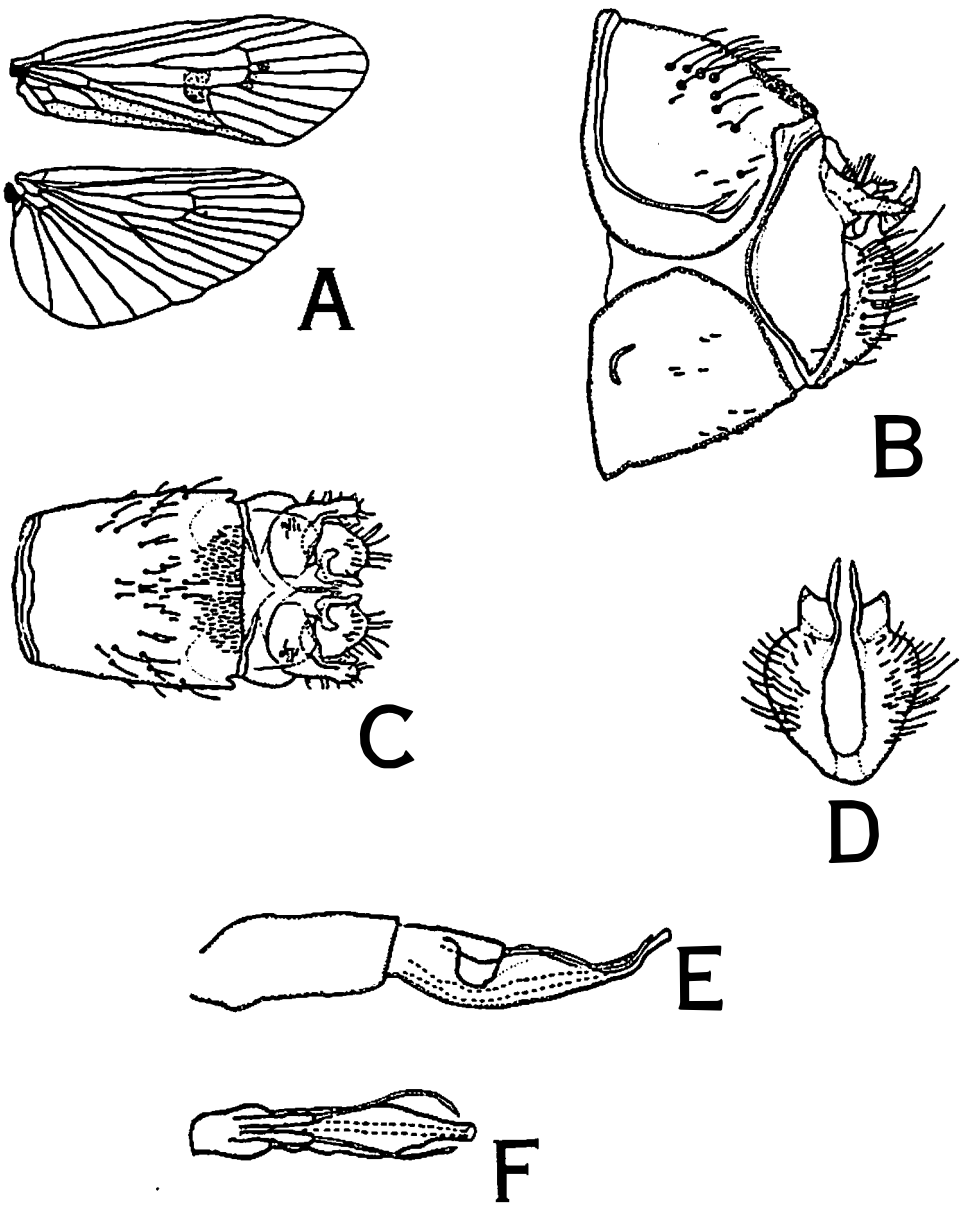


Figure 37. Wings and genitalia of male Pycnopsyche indiana. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

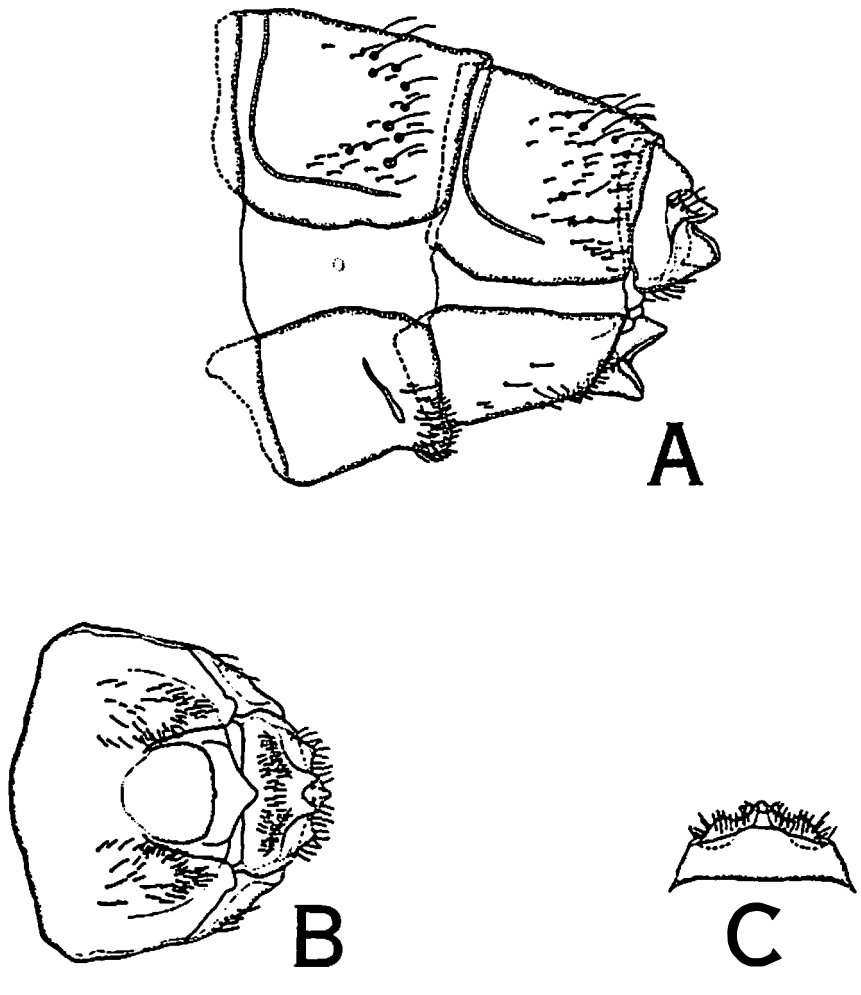


Figure 38. Genitalia of female Pycnopsyche indiana. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

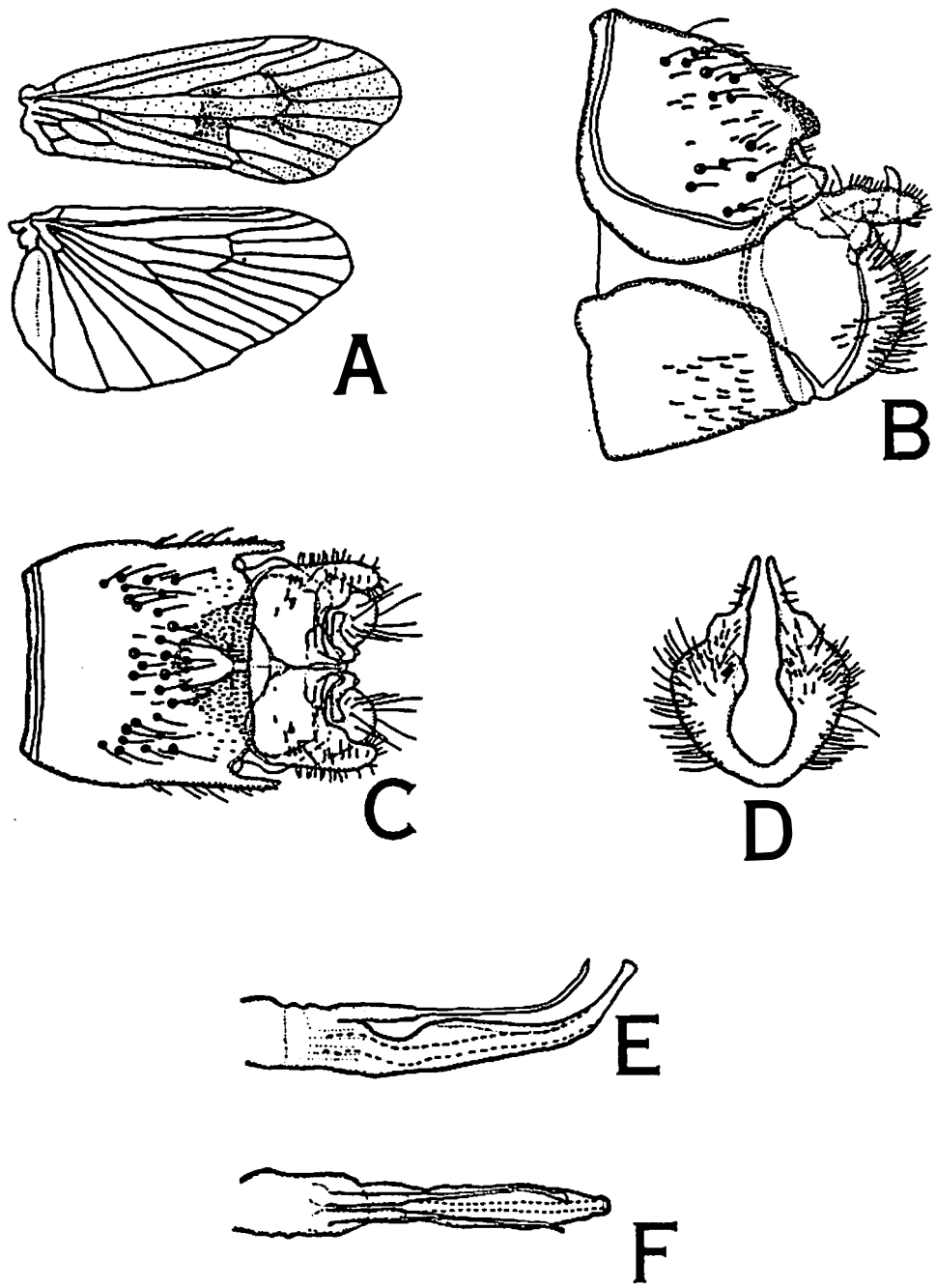


Figure 39. Wings and genitalia of male Pycnopsyche subfasciata. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view.

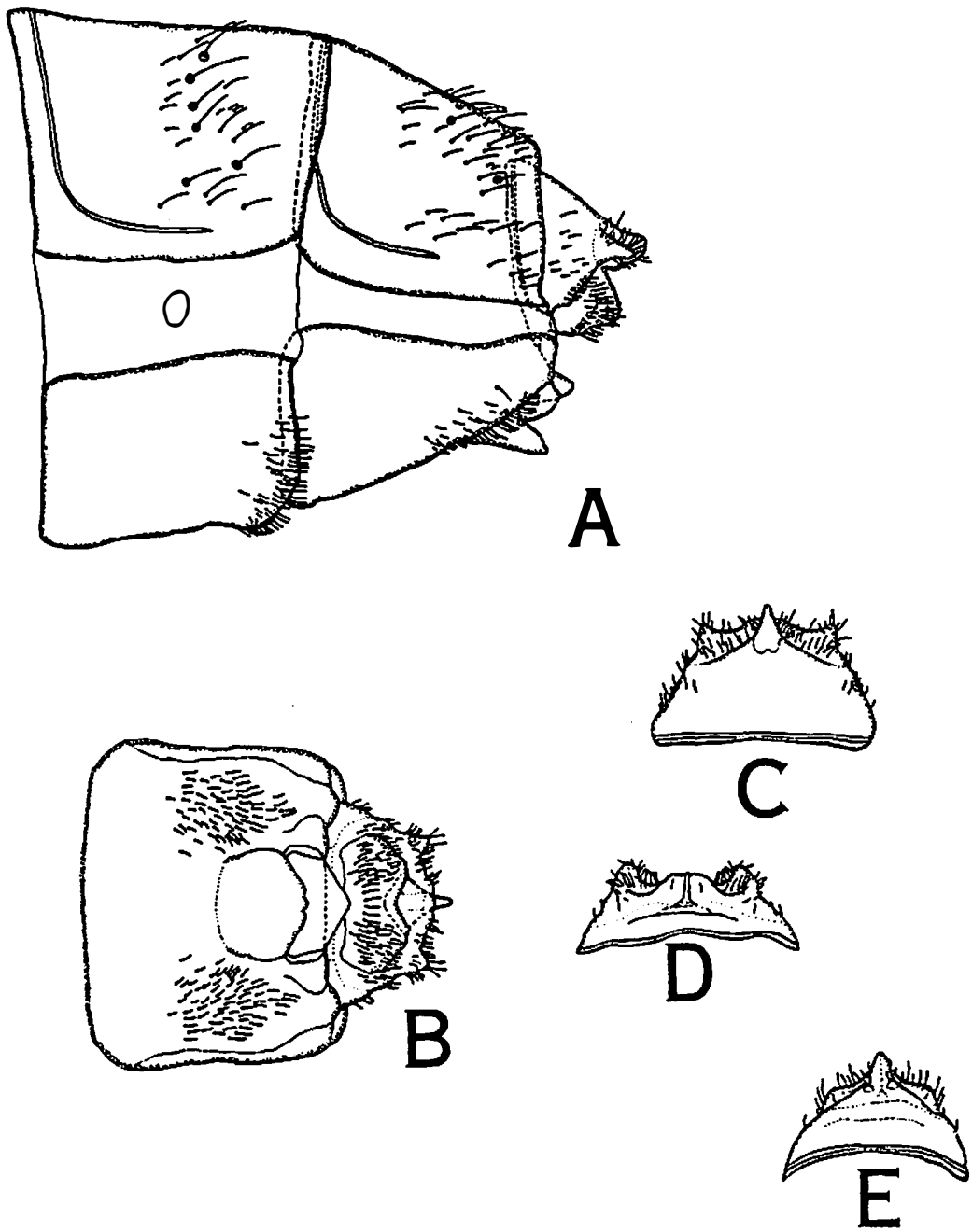


Figure 40. Genitalia of female Pycnopsyche subfasciata. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C-D. Dorsal view of abdominal segments IX and X, showing variation.

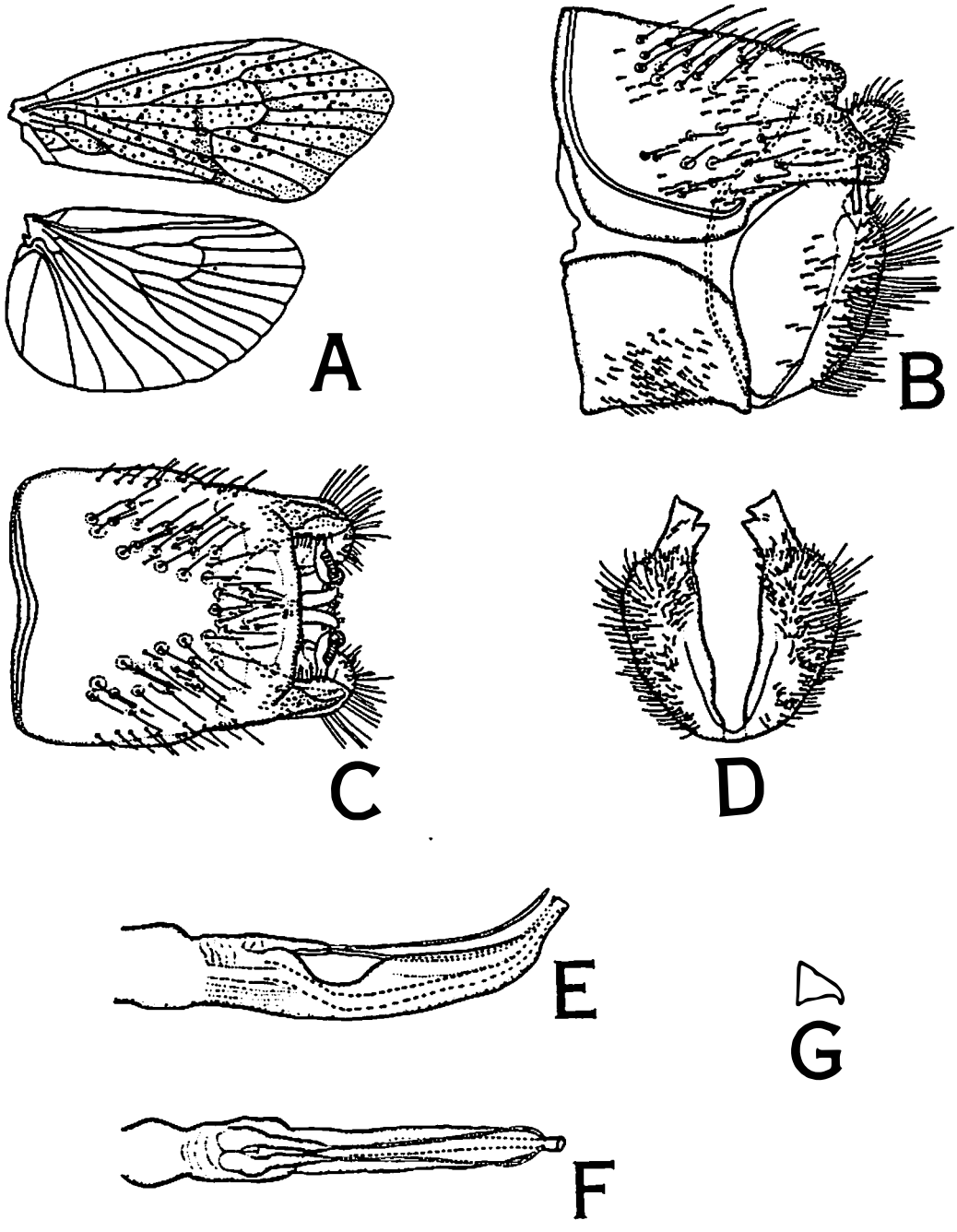


Figure 41. Wings and genitalia of male Pycnopsyche antica. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view. G. Horn of abdominal scent gland opening on fifth segment, ventral view.

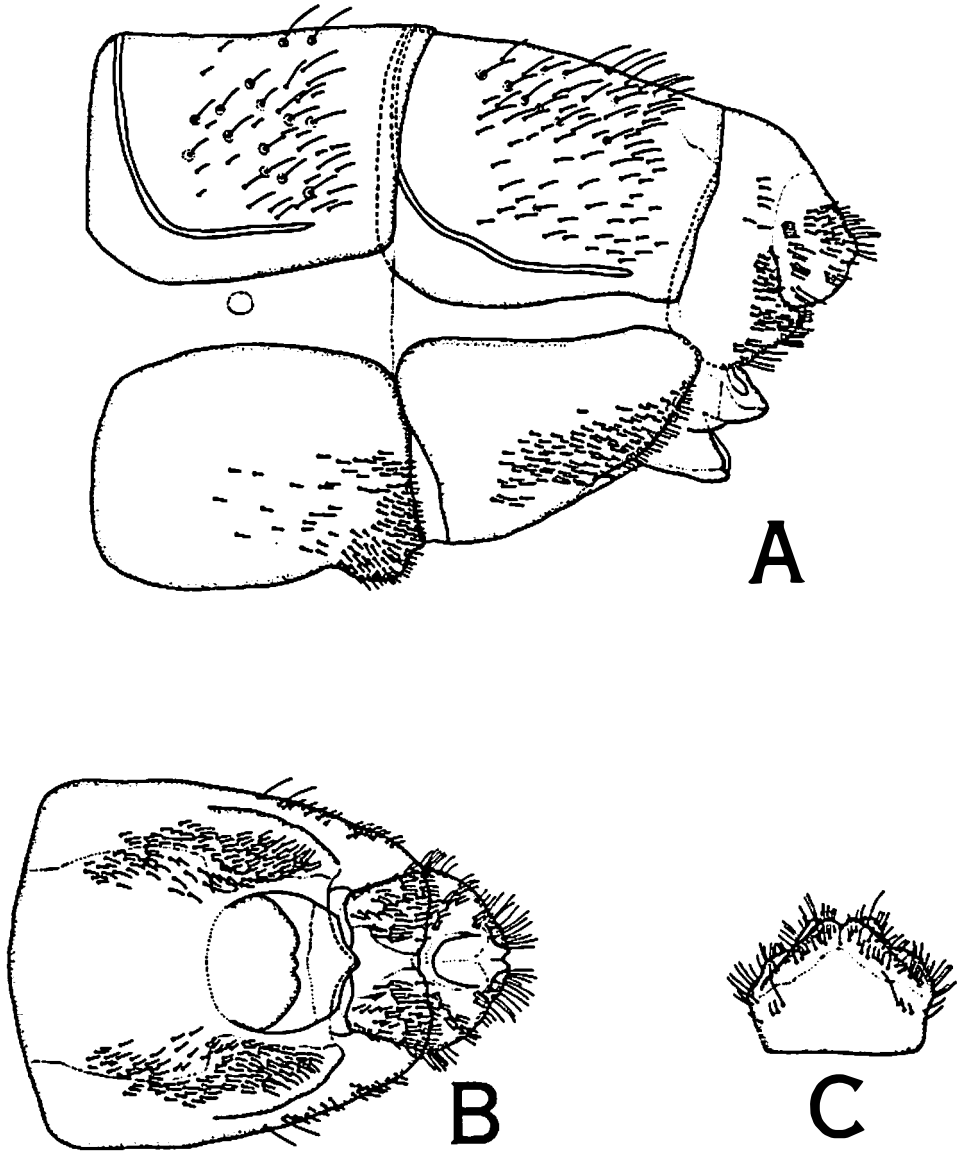


Figure 42. Genitalia of female Pycnopsyche antica. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

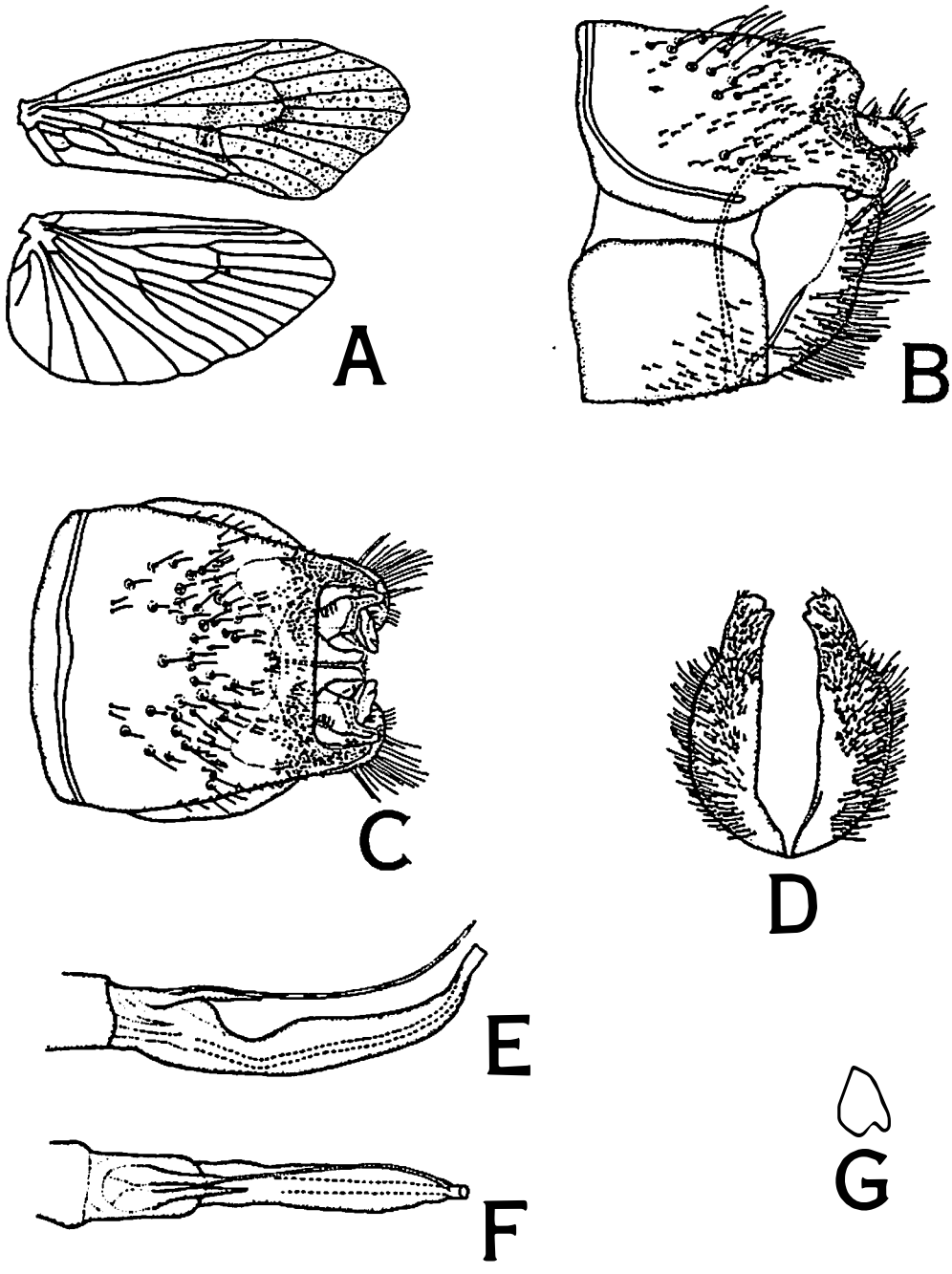


Figure 43. Wings and genitalia of male Pycnopsyche scabripennis. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers. E. Aedeagus, lateral view. F. Aedeagus, dorsal view. G. Horn of abdominal scent gland opening on fifth segment, ventral view.

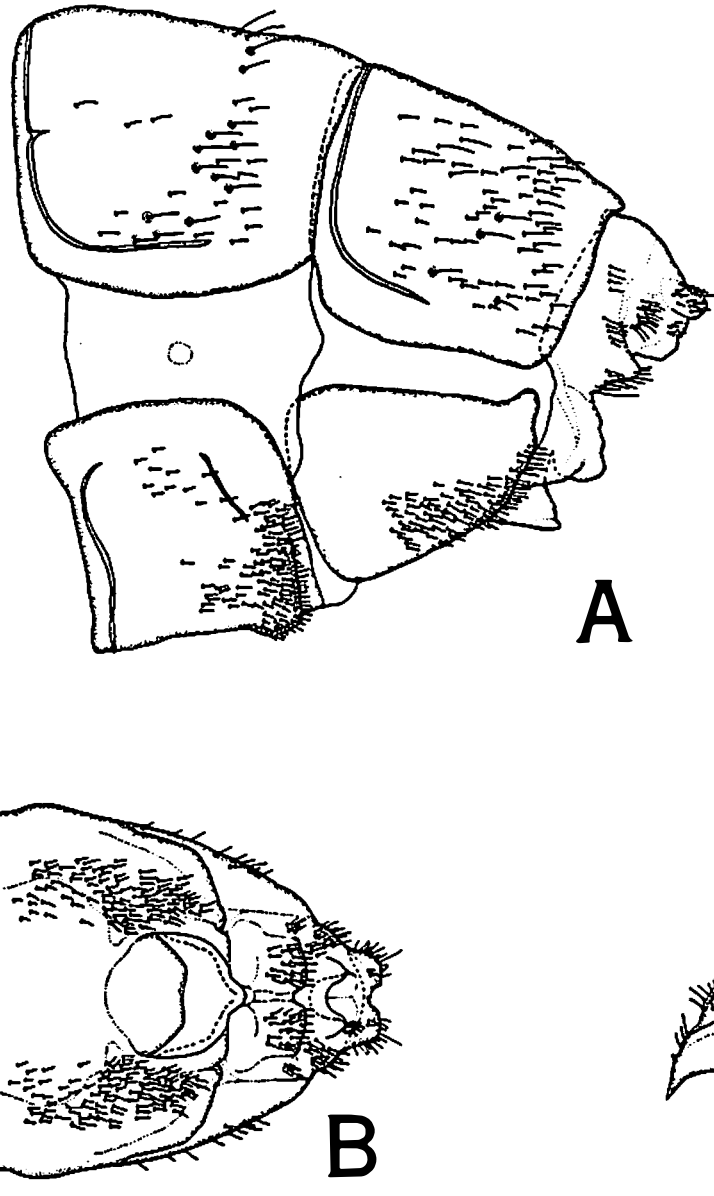


Figure 44. Genitalia of female Pycnopsyche scabripennis. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

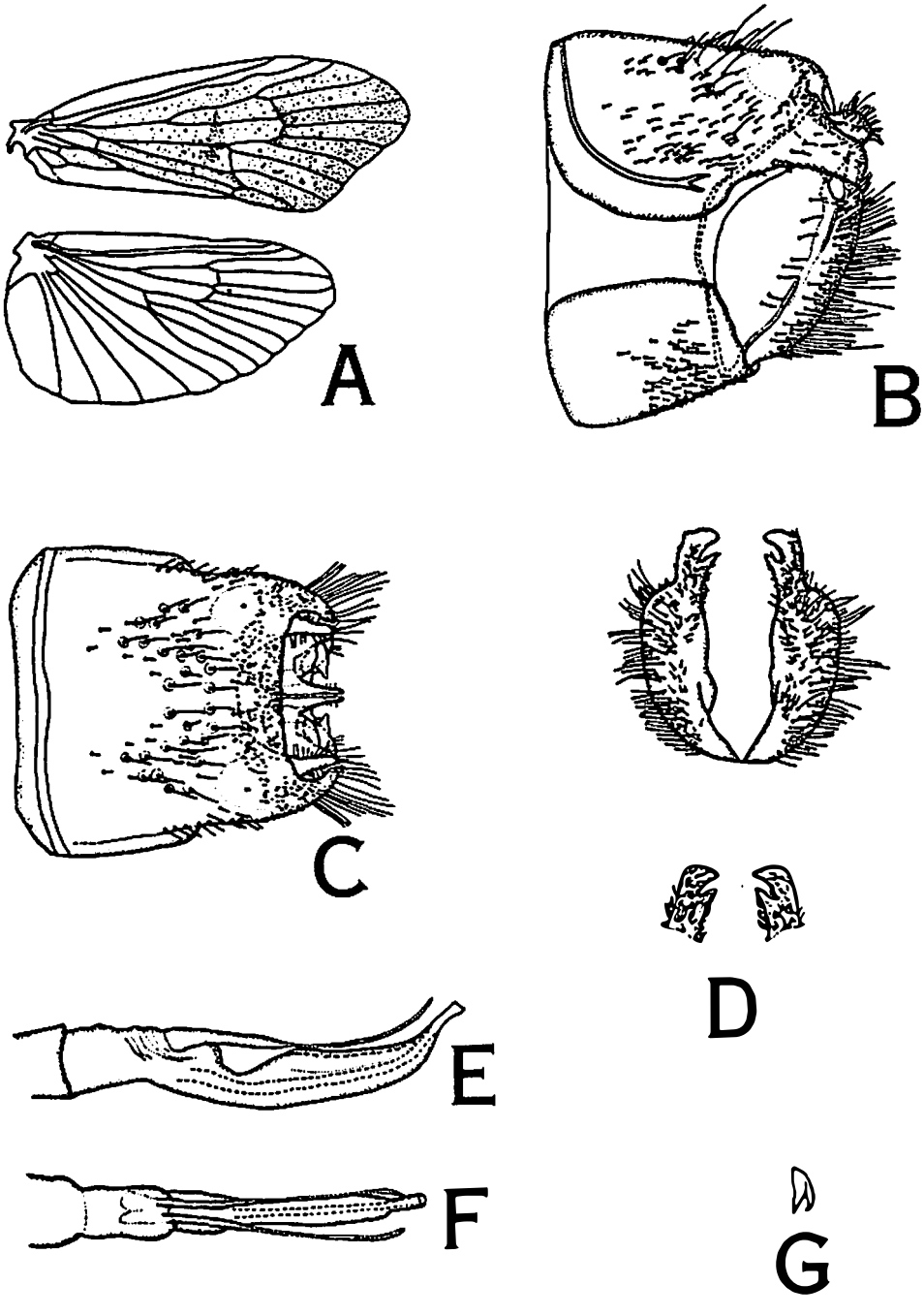


Figure 45. Wings and genitalia of male Pycnopsyche conspersa. A. Forewing and hindwing. B. Lateral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments VIII, IX, and X. D. Posterior view of claspers, showing variation of tips. E. Aedeagus, lateral view. F. Aedeagus, dorsal view. G. Horn of abdominal scent gland opening on fifth segment, ventral view.

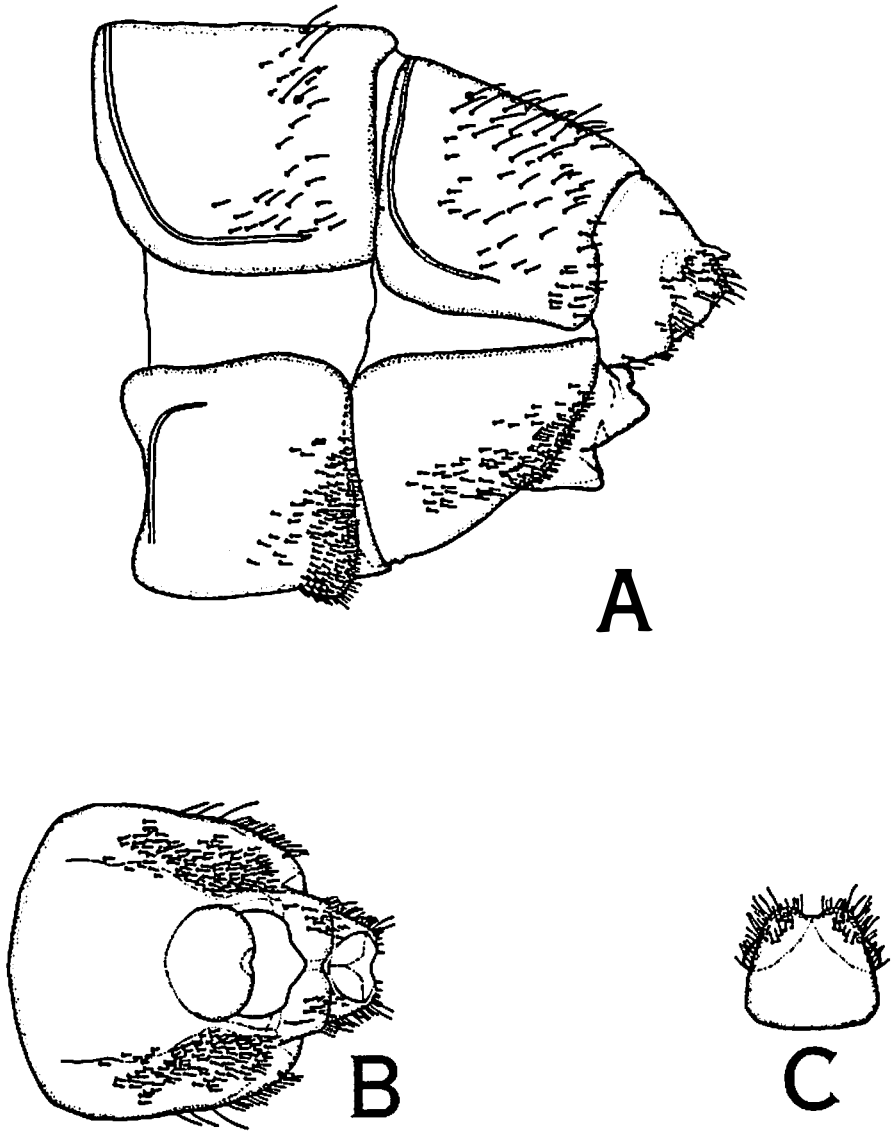


Figure 46. Genitalia of female Pycnopsyche conspersa. A. Lateral view of abdominal segments VII, VIII, IX, and X. B. Ventral view of abdominal segments VIII, IX, and X. C. Dorsal view of abdominal segments IX and X.

Figure 47. Distribution of Pycnopsyche aglona in North America.

Figure 48. Distribution of Pycnopsyche antica in North America.

Figure 49. Distribution of Pycnopsyche circularis in North America.

Figure 50. Distribution of Pycnopsyche conspersa in North America.

Figure 51. Distribution of Pycnopsyche divergens in North America.

Figure 52. Distribution of Pycnopsyche flavata in North America.

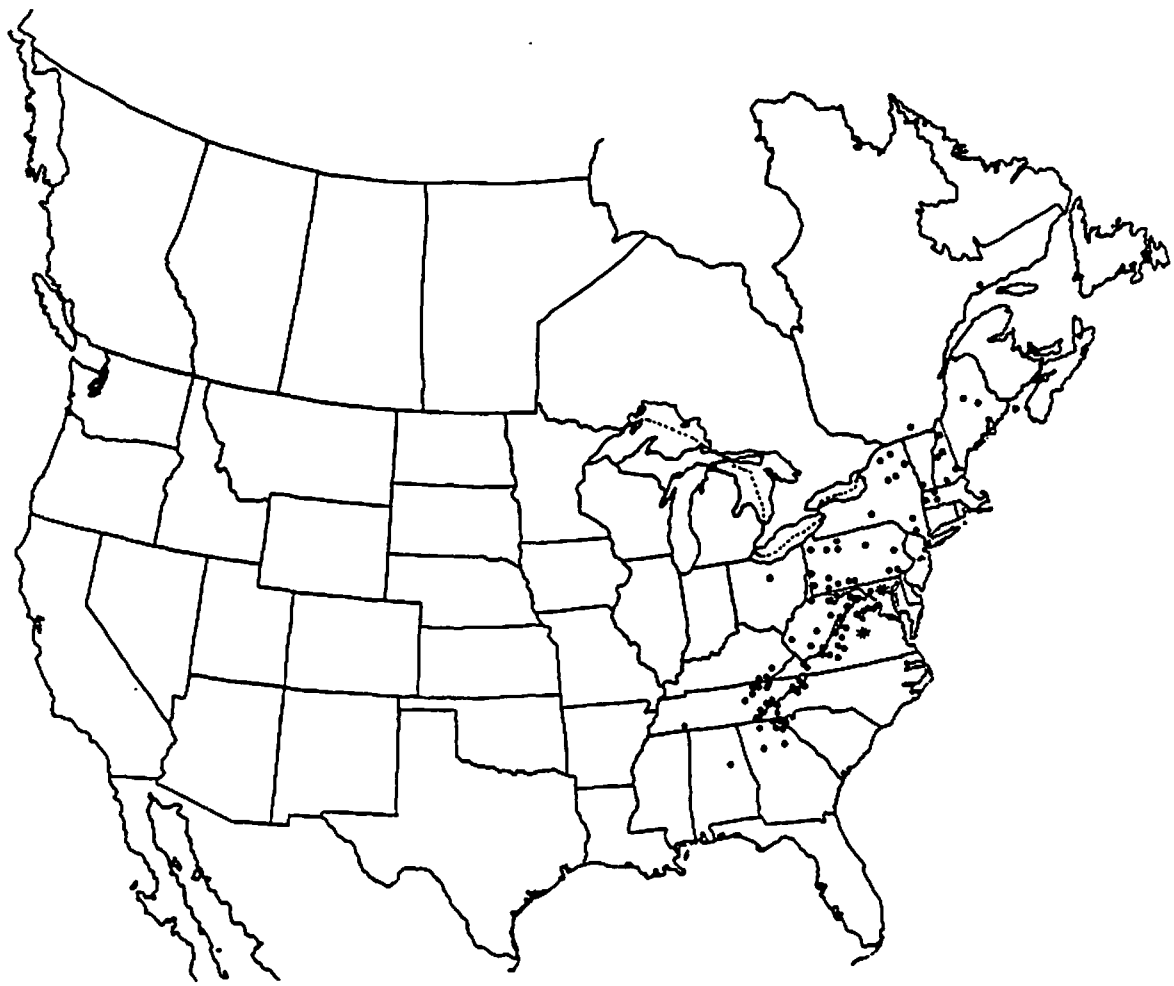


Figure 53. Distribution of Pycnopsyche gentilis in North America.

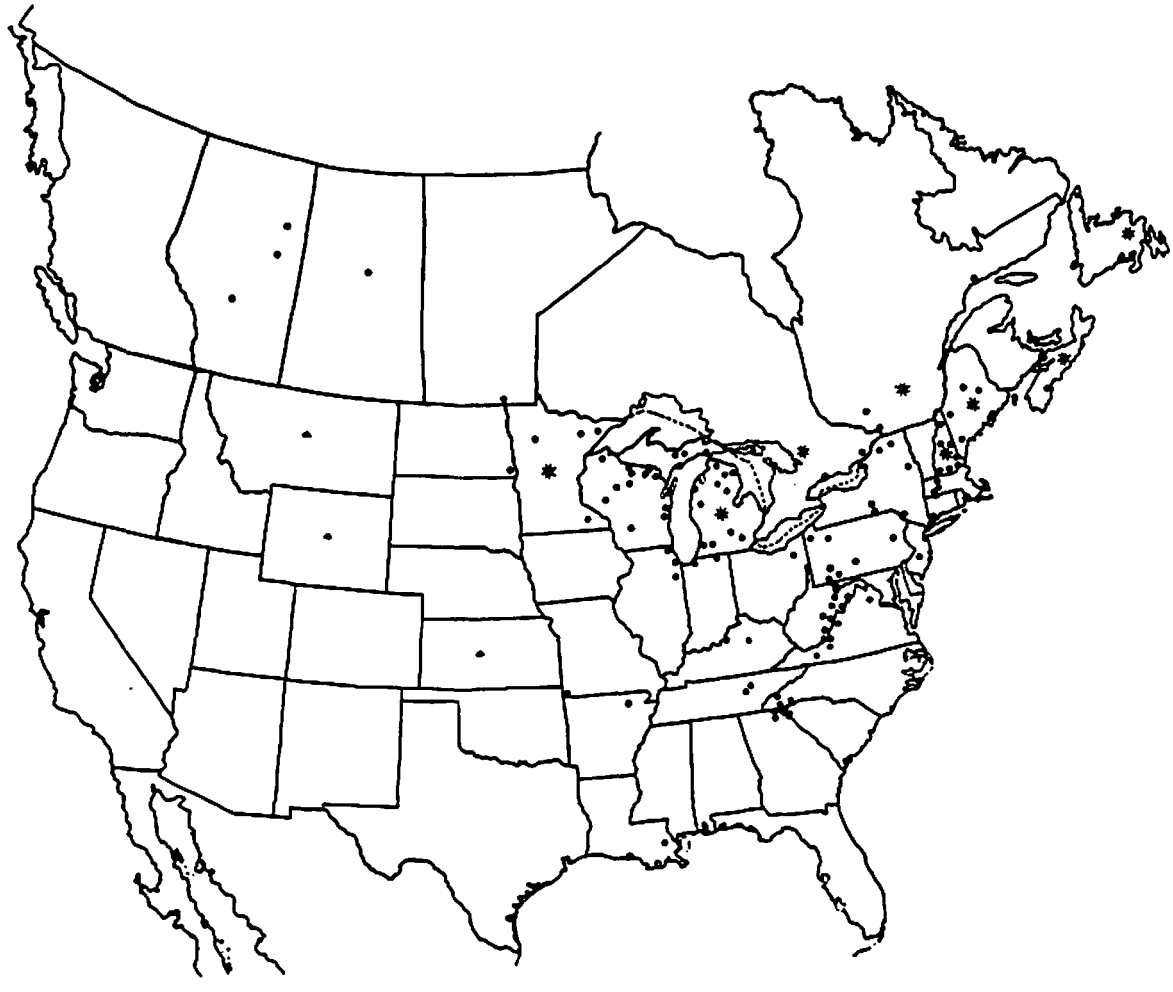


Figure 54. Distribution of Pycnopsyche guttifer in North America.

Figure 55. Distribution of Pycnopsyche sp. A in North America.

Figure 56. Distribution of Pycnopsyche indiana in North America.

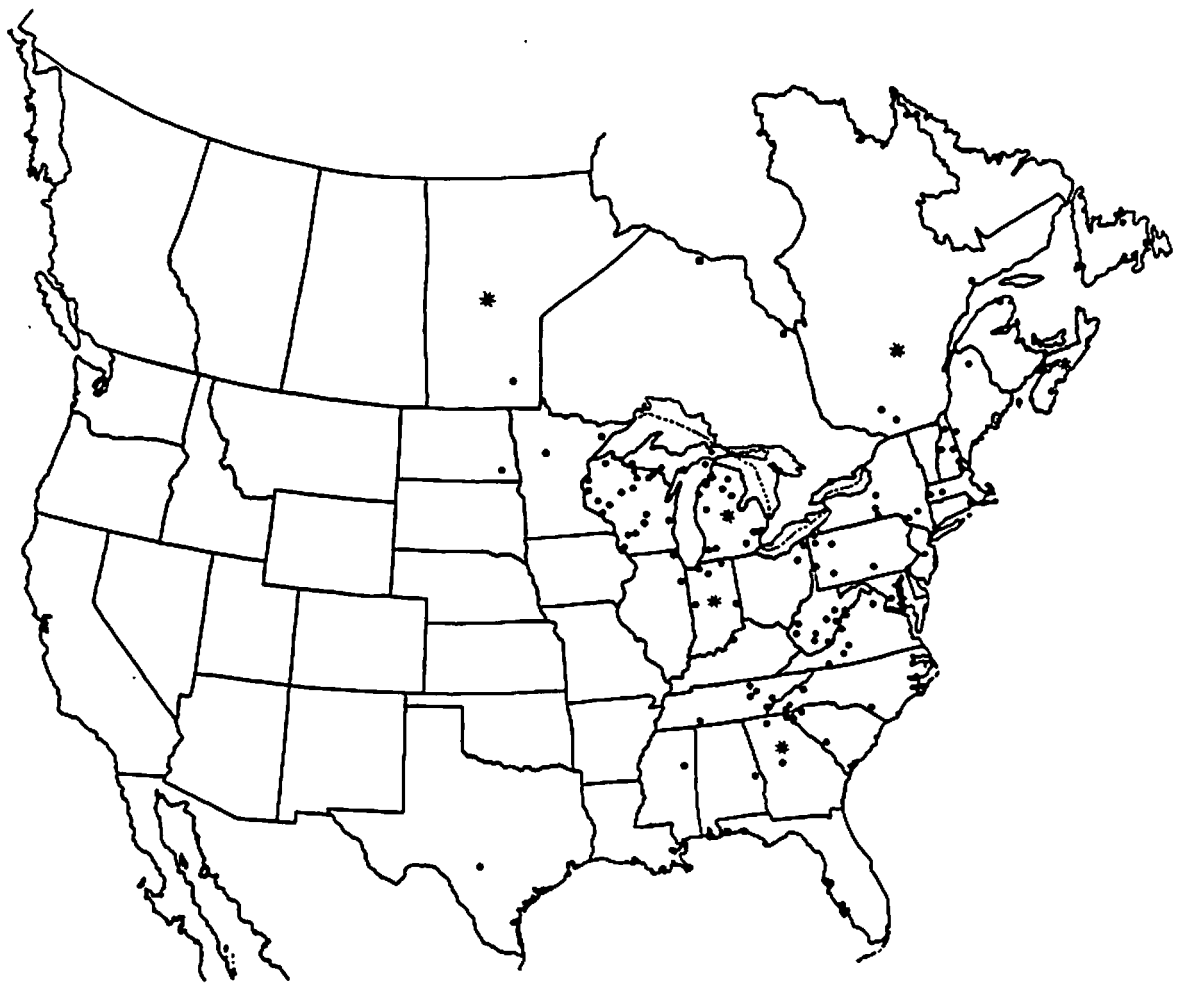


Figure 57. Distribution of Pycnopsyche lepida in North America.

Figure 58. Distribution of Pycnopsyche limbata in North America.

Figure 59. Distribution of Pycnopsyche luculenta in North America.

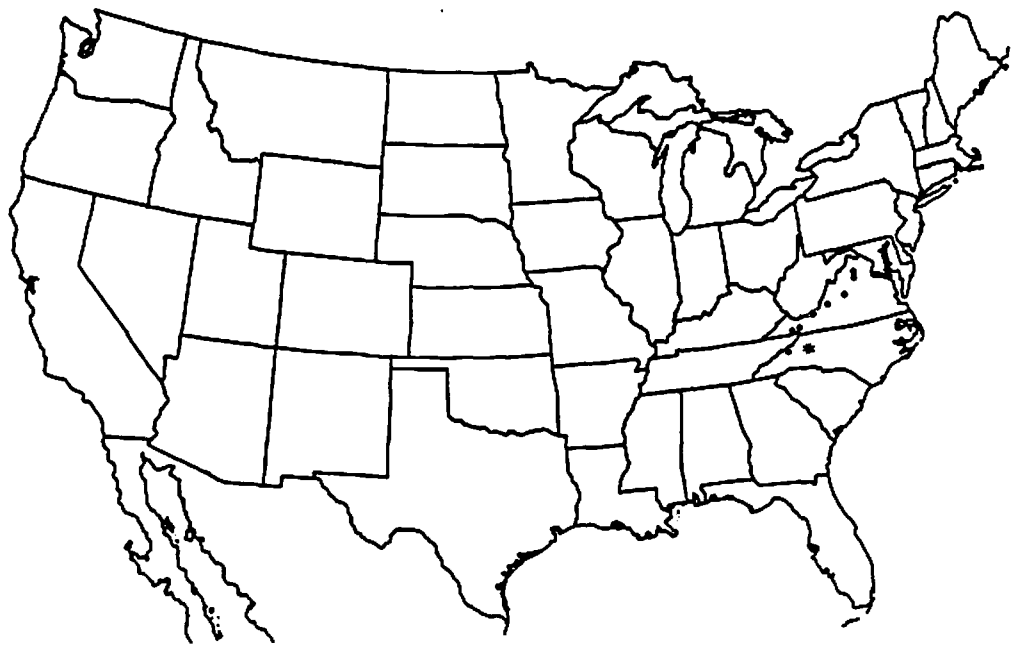


Figure 60. Distribution of Pycnopsyche sp. B in North America.

Figure 61. Distribution of Pycnopsyche rossi in North America.

Figure 62. Distribution of Pycnopsyche scabripennis s.l. in North America.

Figure 63. Distribution of Pycnopsyche scabripennis s.s. in North America.

Figure 64. Distribution of Pycnopsyche sonso in North America.

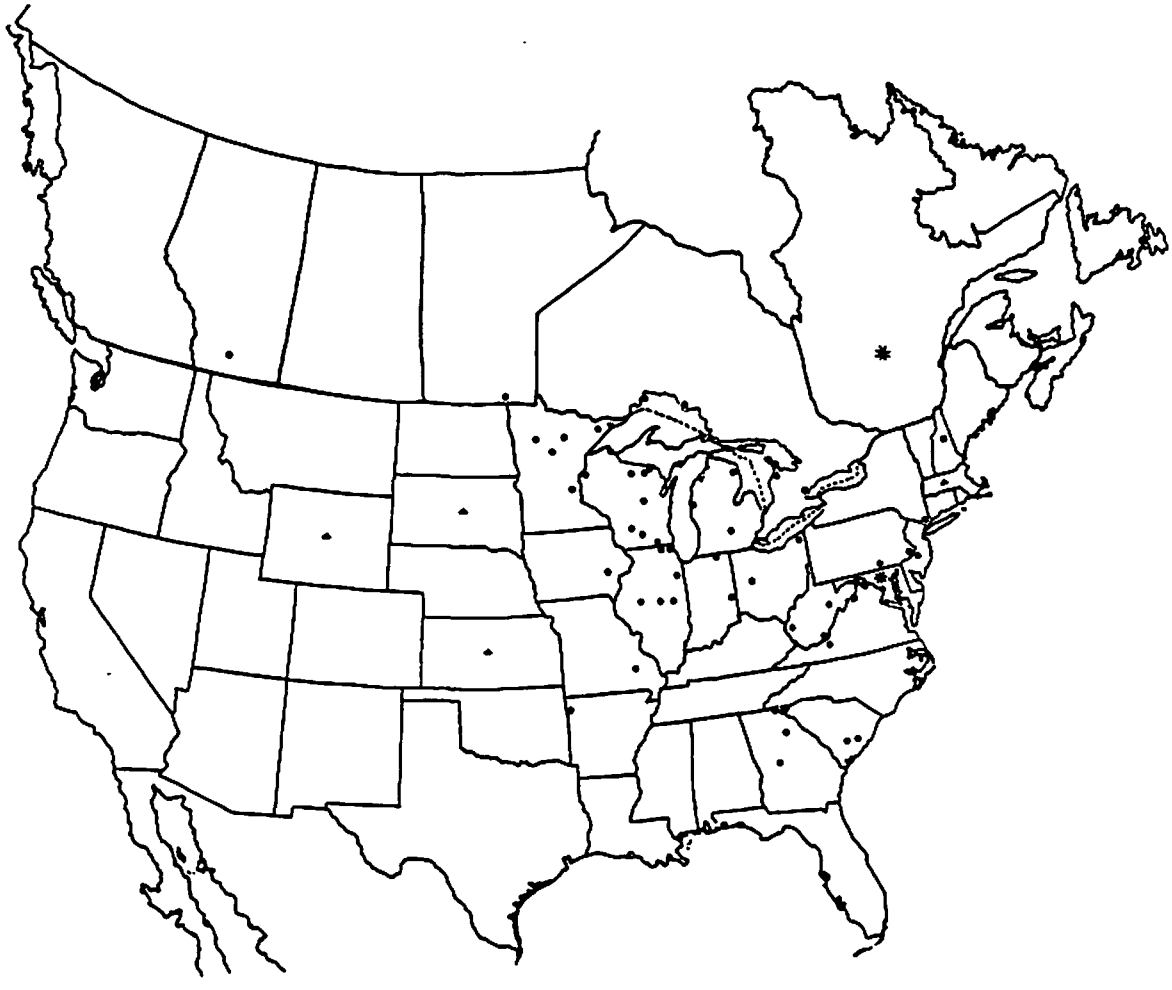


Figure 65. Distribution of Pycnopsyche subfasciata in North America.

Figure 66. Distribution of Pycnopsyche virginica in North America.

VITA

John A. Wojtowicz was born in Lackawanna, N.Y. on 30 October 1950. He attended St. Francis of Assisi Parochial School from 1956-1964. In 1964 he entered Frontier Central High School in Hamburg, N.Y. from which he graduated in 1968. In 1968 he entered the State University of New York College of Environmental Science and Forestry in Syracuse, graduating in 1972 with a B.S. cum laude in Forest Zoology. After graduating he entered the graduate program in Zoology at the University of Arkansas at Fayetteville in 1972. He left Fayetteville in 1975 to begin a temporary job with the U.S. Fish and Wildlife Service in Arkadelphia, Arkansas. After this job ended he began work with the U.S.D.A. in Baton Rouge, Louisiana. He completed his M.S. in Zoology in 1976 during his stay with the U.S.D.A. In 1976 he left his job with the U.S.D.A. to begin work on a PhD in the Dept. of Zoology at the University of Tennessee at Knoxville. He is presently employed by the State of Tennessee, Dept. of Public Health, Division of Water Quality Control as a Pollution Biologist. He is an associate member of Sigma Xi, the Scientific Research Society of North America, and a member of the Entomological Society of Washington, the Entomological Society of America, and the North American Benthological Society.