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THE RHYACOPHILA OF PENNSYLVANIA, WITH LARVAL DESCRIPTIONS OF R. BANKSI AND R. CARPENTERI (TRICHOPTERA: RHYACOPHILIDAE)

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ABSTRACT

Over 3,000 immature and adult specimens of the genus *Rhyacophila* were collected in Pennsylvania. This collection consists of 17 species most of which are new state records. The larvae of *R. banksi* Ross and *R. carpenteri* Milne were associated by the metamorphotype method. The larva of *banksi* is indistinguishable from known larvae of the other species of the *invaria* subgroup (Schmid, 1970). The larva of *carpenteri* is identical to *R.* sp. 3 (*banksi* ?) of Flint (1962). A revised key to the 23 known larvae of eastern Nearctic *Rhyacophila* is given.

INTRODUCTION

There are 34 eastern Nearctic species of *Rhyacophila*, of which four were described from female types. Since Flint's (1962) key to the larvae of eastern Nearctic *Rhyacophila*, additional larval associations of this group have been given by Smith (1968) for *angelita*, Sherberger and Wallace (1971) for *vuphipes*, and Neves (1977) for *acutiloba* and *carolina*. The larvae of *banksi* and *carpenteri* are described herein, and were associated by the metamorphotype method of Milne (1938).

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Therefore, the larvae of 23 of the 30 species recognized by male genitalia are presently known, leaving *accola*, *appalachia*, *montana*, *mycta*, *otica*, *parantra*, and *teddyi* unassociated.

In the past, little work has been done documenting the occurrence of *Rhyacophila* in Pennsylvania. Hyland (1948), in a list of 29 species of Trichoptera from the state, recorded only one *Rhyacophila—nigri*ta. Ross (1941) mentioned three, *fuscula*, *invaria*, and *nigrita*, and Roback (1975) listed immatures of *fuscula*, and two other tentatively identified taxa.

For this study the adults were collected along streams and springs using light traps and sweeping nets. The larvae and pupae were handpicked from stones and debris submerged in water or collected by a Hess type quantitative sampler.

The majority of specimens examined in this investigation were collected from Pennsylvania. However, a few records from adjacent areas of New Jersey are also included as they provide insight into the distribution of *Rhyacophila* in Pennsylvania. Over 3,000 immature and adult specimens, consisting of 17 species of *Rhyacophila*, were procured, most of which are new state records. The accumulation of these data from 23 counties has contributed to the knowledge of the local distribution, seasonal occurrence, and natural history of several species.

The bibliography of each species listed is not complete, and includes only descriptive references of the larvae and adult males. A list of the *Rhyacophila* (Schmid, 1970) occurring in eastern North America is given, because it includes species which probably later will be recorded from Pennsylvania.

LIST OF EASTERN NEARCTIC RHYACOPHILA

fuscula Group

*† fuscula (Walker 1852) Neuronia † vuphipes Milne (1936)

montana Group

montana Carpenter (1933)

glaberrima Group † glaberrima Ulmer (1907)

carolina Group

*† carolina Banks (1911) fenestra Ross (1938a) kiamichi Ross (1944) † ledra Ross (1939) **VOL. 48**

† otica Etnier and Way (1973) teddyi Ross (1939)

> invaria Group invaria complex

- † banksi Ross (1944)
- † invaria (Walker 1852) Polycentropus parantra Ross (1948) shenandoahensis Flint (1958) *† vibox Milne (1936)
- nigrita complex accola Flint (1972) acutiloba Morse and Ross (1971) appalachia Morse and Ross (1971) † carpenteri Milne (1936) mycta Ross (1941) *† nigrita Banks (1907)
 - lobifera Group † lobifera Betten (1934)

angelita Group angelita Banks (1911)

siberica Group

- amicis Ross (1956) † atrata Banks (1911) † manistee Ross (1938a) * melita Ross (1938a)
- † minor Banks (1924)

torva Group

† torva Hagen (1861)

acropedes Group

acropedes Banks (1914) ignorata Schmid (1974) 9 holotype

ungrouped species

* formosa Banks (1911) 9 holotype mainensis Banks (1911) 9 holotype soror Provancher (1878) 9 holotype

† Species recorded from Pennsylvania.

* Species recorded from New Jersey.

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KEY TO EASTERN NEARCTIC *RHYACOPHILA* LARVAE (modified from Flint, 1962)

(Larvae of accola, appalachia, montana, mycta, otica, parantra, and teddyi unknown)

1.	Anal proleg with an apicolateral spur (Flint, 1962: Fig. 1b) 2
	Anal proleg without such a spur (Flint, 1962: Fig. 2b) 7
2(1).	Apicolateral spur of proleg short and sharply decurved (Flint, 1962:
	Fig. 6b) 3
	Spur long and evenly curved (Flint, 1962: Fig. 1b) 5
3(2).	Body segments with alternating light and dark bands melita
	Body segments not contrastingly banded 4
4(3).	Frontoclypeus with dark "H" pattern (Sherberger and Wallace, 1971:
	Fig. 1) vuphipes
	Frontoclypeus not patterned as above amicis
5(2).	Frontoclypeus with dark transverse bands forming a "W" pattern
	(Flint, 1962: Fig. 1c) fuscula
	Frontoclypeus without such a pattern
6(5).	Head uniformly colored (Flint, 1962: Fig. 4c) atrata
	Head with a dark transverse band posteriorly (Flint, 1962: Fig.
-	6c) angelita
7(1).	Abdomen bearing many branched gills acropedes
0(7)	Abdomen without gills
8(7).	Anal proleg with a free basoventral hook (Flint, 1962: Fig. 2b)9
	Anal proleg without a free basoventral hook (Flint, 1962: Fig. 8b,d)
0(0)	12
9(8).	Anal claw without ventral teeth (Flint, 1962; Fig. 5d) 10
10(0)	Anal claw with ventral leeth (Finit, 1962; Fig. 20)
10(9).	(Elipt 1062: Fig. 5a)
	Head slightly longer than wide with lateral margins curved (Flint
	1962: Fig. 5c) manistee
11(9)	Frontoclyneus with a dark "V" nattern (Flint 1962: Fig. 2c): mandi-
11(2).	bles edentate (Flint 1962: Fig. 2a)
	Frontoclypeus not patterned as above: mandibles toothed apically
	(Flint, 1962: Fig. 11b) lobifera
12(8).	Second segment of maxillary palps subequal to first (Ross, 1944: Fig.
	114) glaberrima
	Second segment of maxillary palps longer than first (Fig. 4d here-
	in) 13
13(12).	Anal claw without ventral teeth (Flint, 1962: Fig. 11d), carolina
	Group 14
	Anal claw with ventral teeth (Flint, 1962: Fig. 8b), invaria Group 16
14(13).	Head with distinct pattern of infuscations and muscle scars (Flint,
	1962: Fig. 10b) fenestra and ledra
	Head nearly concolorous 15

15(14).	Head slightly darkened posteriorly (Flint, 1962: Fig. 11a), (Arkansas
	and Oklahoma) kiamichi
	Head uniformly golden brown (Flint, 1962: Fig. 11c; Fig. 4a herein),
	(Appalachian and Piedmont regions) carolina
16(13).	Head and pronotum nearly black with a conspicuous pattern of pale
	muscle scars and spots (Flint, 1962: Fig. 9b) acutiloba
	Head not marked as above 17
17(16).	Head narrowing on posterior half (Flint, 1962: Fig. 10a; Fig. 8a
	herein) carpenteri
	Head either parallel sided or broadening posteriorly 18
18(17).	Head nearly parallel sided (Flint, 1962: Fig. 9a) nigrita
	Head distinctly broadening posteriorly (Flint, 1962: Fig. 8a, c; Fig. 6a
	herein)-invaria subgroup: banksi, invaria, shenandoahensis and vi-
	box

THE *RHYACOPHILA* OF PENNSYLVANIA *fuscula* Group *Rhyacophila fuscula* (Walker)

Neuronia fuscula Walker 1852.

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Rhyacophila fuscula (Walker) Ross, 1944 (male and female genitalia, larva). Flint, 1962 (larva). Schmid, 1970 (male and female genitalia). Wiggins, 1977 (larva).

There is no other species of *Rhyacophila* from North America as frequently documented in the literature as *fuscula*. It is known from nearly every state and province in the Appalachian Mountains and the surrounding Great Lakes regions. Being a montane species, it is very widespread in the Pennsylvania highlands (Fig. 1). Both Flint (1962) and Roback (1975) discovered it to be the most common species of *Rhyacophila* in their collections of immatures from the East. However, from the material examined it appears to be no more widespread than *carolina* in the Alleghenies of Pennsylvania and much less common at elevations below 460 m.

The larvae were often collected from swiftly flowing riffles of pristine mountain streams, ranging from approximately 1.5 to 12 m in width. In the brook (3 to 6 m wide) issuing from Maul Spring, a constant temperature, well-oxygenated spring (9°C \pm 1°C), larvae were never taken near the source, but only at distant reaches where water temperature regimes fluctuated diurnally. These observations suggest that the larvae of *fuscula* prefer a eurythermic environment. Seasonally, larvae were collected in the spring and adults throughout the summer.

Material examined.—PENNSYLVANIA. Elk County: Ridgway, South Branch Island Run, 30 May 1977, 1 larva. Fayette County: Seven Springs, Back Run, 2 June 1977, 1 \Im . Franklin County: Turnpike between Blue and Kittatinny Mountains, 12 April 1977, 1 larva; 18 May 1977, 3 larvae. Forest County: Kellettville, Ross Run, 5 June 1976, 5 larvae; 27–28 August 1976, 3 \Im \Im ; Marienville Sportsmens Club, Spring Creek, 3–4 July

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Fig. 1.—Distribution of the species of Rhyacophila of the fuscula group in Pennsylvania.

1976, 1 larva, 4 \Im \Im , 1 \Im ; 28–29 August 1976, 1 \Im ; Tionesta Station, Hunters Creek, 5 June 1976, 3 larvae, 1 3, 1 9; 25 July 1976, 1 9; 28 August 1976, 4 33, 1 9. Fulton County: McConnellsburg, Aughwick Creek, 30 June 1977, 2 larvae, 3 88. Lancaster County: New Holland Watershed Area, 4 June 1977, 2 larvae. Pike County: Milford, Sawkill Creek, 1 May 1977, 1 larva. Potter County: Harmontown, south branch of Genesee River, near Route 449, 2 July 1978, 3 larvae, 1 &. Somerset County: Kooser State Park, 7–8 June 1976, 4 & &; 22–23 June 1976, 1 &, 1 &; 20–21 August 1976, 1 ♂; 25–26 September 1976, 1 ♂; Laurel Hill State Park, Jones Mill Run, 7–8 June 1976, 1 &; 22-23 June 1976, 10 & d, 4 99. Venango County: Utica, French Creek, 30 June 1976, 1 2. Westmoreland County: Linn Run State Park, 20-21 August 1976, 13 33, 5 \Im \Im ; Laughintown, Furnace Run, 15 May 1976, 2 larvae; 7–8 June 1976, 4 \Im \Im , 2 \Im \Im ; 14-15 July 1976, 13 ♂♂, 3 ♀♀; 20-21 August 1976, 18 ♂♂, 10 ♀♀; 25-26 September 1976, 2 & d, 2 99; Rector, Powdermill Nature Reserve, Maul Spring, 31 May 1976, 1 δ; 19–20 June 1975, 1 δ, 3 ♀♀; 16–17 July, 1975, 3 δδ; 13–14 August 1975, 10 δδ, 23 ♀♀; 10-11 September 1975, 1 ♂, 4 ♀♀; 27 February 1976, 3 larvae. New JERSEY. Sussex County: North of Highpoint State Park near Route 23, Clove Run, 16 April 1977, 9 larvae; 19 May 1977, 2 larvae, 1 prepupa.

Rhyacophila vuphipes Milne

Rhyacophila vuphipes Milne, 1936 (male genitalia). Ross, 1956 (male genitalia). Schmid, 1970 (male genitalia). Roback, 1975 (larva).

Rhyacophila vuphiphes Sherberger and Wallace, 1971 (lapsus), (larva).

This species is known from the eastern slopes of the Appalachian Mountains of the middle and southern Atlantic coastal states. It is reported here for the first time from Pennsylvania, while other records exist from Georgia, New York, North Carolina, South Carolina, and

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Fig. 2.—Distribution of the species of *Rhyacophila* of the *lobifera*, *glaberrima*, and *torva* groups.

Tennessee. Its most northern occurrence is in Quebec (Roy and Harper, 1975). However, it is more frequently collected in the southern Appalachian Piedmont region.

In Pennsylvania only one larva was collected from the riffle of a large meandering stream approximately 15 m in width (Fig. 1). Immatures may be collected in the early summer, and adults are on the wing from August to September.

Material examined.—PENNSYLVANIA. Cumberland County: Boiling Springs, Yellow Breeches Creek, 12 June 1976, 1 larva; 17–18 September 1976, 2 33.

glaberrima Group Rhyacophila glaberrima Ulmer

Rhyacophila glaberrima Ulmer, 1907 (male genitalia). Ross, 1944 (male and female genitalia, larva). Ross, 1956 (male genitalia). Flint, 1962 (larva). Schmid, 1970 (male genitalia). Roback, 1975 (larva).

This species, the only member of the *glaberrima* group, is widely distributed throughout eastern and central North America. It is recorded for the first time from Pennsylvania, where it was collected commonly from the central and western highlands (Fig. 2). Other state and provincial records include Georgia, Illinois, Massachusetts, New Hampshire, New York, North Carolina, Nova Scotia, Quebec, Tennessee, and Virginia. In Pennsylvania larvae were found in small





Fig. 3.—Distribution of the species of *Rhyacophila* of the *carolina* group in Pennsylvania.

streams and springs. Immatures may be collected in the spring and summer, and adults in the late summer and early autumn.

Material examined.—PENNSYLVANIA. Clearfield County: S. B. Elliott State Park, Lick Run, 30 May 1977, 7 larvae, 1 prepupa; 1 August 1977, 3 & pupae; 1 June 1978, 1 larva. Fulton County: Emmaville, Chestnut Bridge Hollow, 5 & δ , 5 φ φ ; 29 May 1977, 1 larva; 1 July 1977, 1 larva, 1 prepupa. Washington County: Amity, small spring near Ten Mile Creek, 15 August 1976, 1 &. Westmoreland County: Laurel Hill Summit, Spruce Run, 21–22 August 1976, 2 & δ ; Linn Run State Park, 20–21 August 1976, 3 δ , 1 φ ; Laughintown, Furnace Run, 14–15 July 1976, 1 δ ; 20–21 August 1976, 14 δ δ , 8 φ φ ; Rector, Powdermill Nature Reserve, Maul Spring, 16–17 July 1975, 2 δ δ ; 13–14 August 1975, 14 δ δ , 6 φ φ ; 10–11 September 1975, 3 δ δ , 5 φ φ ; 6 June 1977, 2 larvae; 20 July 1977, 1 prepupa.

carolina Group Rhyacophila carolina Banks

Rhyacophila carolina Banks, 1911 (male genitalia). Ross, 1938b (male genitalia). Schmid, 1970 (male genitalia). Neves, 1977 (R. sp. 5 Flint, 1962, larva is carolina).
Rhyacophila sp. 5 (carolina ?), Flint, 1962 (larva).

Rhyacophila carolina was the most commonly collected species in this study, occurring throughout the western slopes of the Ohio River Valley, the central ridge and valley system of the Alleghenies, and the rolling foothills of the southeastern Piedmont (Fig. 3). It is also known from Kentucky, Maine, Massachusetts, New Hampshire, New York, North Carolina, Quebec, South Carolina, and Tennessee.



Fig. 4.—*Rhyacophila carolina*, larva: A = head and pronotum, dorsal view; B = anal proleg, lateral view; C = mandibles, dorsal view; D = maxillary palpus (MP).

Description of larva (Fig. 4).—Overall length of mature larva 16 mm. Head: Distinctly narrowing anteriorly; coloration variable; in some specimens golden brown, immaculate; in others, slightly darker with faint muscle scars; right mandible with three apical teeth, middle tooth slightly longer than dorsal tooth and much longer than ventral tooth. Left mandible with two apical teeth subequal in length. Abdomen: Anal proleg with very short basoventral and apicolateral processes, the latter barely noticeable; anal claw with no ventral teeth. Neves (1977) has associated this species with the larval form, R. sp. 5 of Flint (1962). It is the authors' opinion that the larval forms of R. sp. 6 and R. sp. 7 of Roback (1975) are both carolina.

Habitat.—Many larvae were collected from small pristine streams 0.6 to 4.8 mm in width. Occasionally, immatures were also found in springs. Mature larvae were collected from February to August, prepupae from February to May, pupae from May to August, and adults from April to October. These observations make it difficult to determine either if most mature larvae discovered in the late summer pupate and emerge in the autumn, or if some may overwinter as pupae. These overwintering pupae may be part of a second generation that emerge in the spring, or there may be two cohorts involved.

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Material examined.—PENNSYLVANIA. Beaver County: Raccoon Creek State Park, stream at the marina, 18–19 July 1976, 1 &, 1 Q. Chester County: Atglen, Glen Run, 21 March 1977, 4 larvae, 4 prepupae; 11 April 1977, 6 larvae, 6 prepupae; 24 April 1977, 1 larva, 2 prepupae; 7 May 1977, 1 larva, 7 prepupae, 2 3 pupae, 6 33, 1 9; 17 May 1977, 10 33, 4 9 9; 6–7 June 1977, 18 33, 20 9 9; 18–19 June 1977, 41 33, 9 9 9; 23– 26 June 1977, 1 larva, 1 ♂ pupa, 25 ♂♂, 15 ♀♀; 12-14 July 1977, 5 ♂♂; 25 October 1977, 1 &, 1 9; Atglen, Spring Grove Dairy, 6 March 1977, 2 larvae; 21 March 1977, 9 prepupae; 8 May 1977, 7 3 pupae, 7 9 pupae; 12 July 1977, 8 3 pupae, 8 9 pupae, 1 9; 27 February 1978, 3 larvae, 1 prepupa. Clearfield County: S. B. Elliott State Park, Lick Run, 30 May 1977, 7 larvae, 1 prepupa; 1 August 1977, 3 & pupae. Cumberland County: Mount Holly Springs, Whisky Spring, 1 July 1977, 2 & &. Elk County: Ridgway, spring near Route 949, 23 June 1977, 1 larva. Fayette County: Seven Springs, Neals Run Spring, 2 June 1977, 1 3. Franklin County: Turnpike between Blue and Kittatinny Mountains, Trout Run, 12 June 1976, 1 &, 1 9. Forest County: Kellettville, Ross Run, 18 June 1976, 1 larva; 23-28 August 1976, 3 さき, 5 ♀♀; 8-9 October 1976, 2 さき; Marienville Sportsmens Club, Spring Creek, 28–29 August 1976, 9 ♂♂, 6 ♀♀; Tionesta Station, 25 July 1976, 1 9. Fulton County, Emmaville, Chestnut Bridge Hollow, 23-24 July 1976, 5 & d, 2 99; 31 July 1976, 16 & d, 3 99; 15-16 September 1976, 1 d, 1 9; 1 July 1977, 1 & pupa, 1 &; 29 July 1977, 1 & pupa; McConnellsburgh, Aughwick Creek, 30 June 1977, 22 & &, 1 9. Lancaster County: Christiana, Pine Creek, 18-19 September 1976, 5 $\mathcal{S}\mathcal{S}$, 4 $\mathcal{Q}\mathcal{Q}$; New Holland Watershed Area, 4–5 April 1977, 2 larvae, 2 ささ; 26-27 June 1977, 1 ざ; 16-17 July 1977, 17 ざさ, 1 ♀; 5 October 1977, 1 ざ; 23 March 1978, 4 prepupae. Pike County: Metamoras, Bushkill Creek, 12 June 1977, 1 J. Somerset County: Kooser State Park, 22-23 June 1976, 1 J; Laurel Hill State Park, Jones Mill Run, 7–8 June 1976, 2 ささ, 1 ♀; 22–23 June 1976, 2 ささ, 1 ♀. Warren County: Cobham, Rams Horn Spring, 24–25 July 1976, 1 &; 18 April 1977, 1 prepupa. Washington County: Amity, small spring near Ten Mile Creek, 10 June 1976, 4 3 3, 3 ♀♀; 16 June 1976, 5 33, 3 99; 15 August 1976, 1 9. Westmoreland County: Laurel Hill Summit, Spruce Run, 12 June 1976, 1 larva; 14–15 July 1976, 1 larva, 35 ♂ ♂ , 8 ♀ ♀; 21–22 August 1977, 1 larva, 18 33; Linn Run State Park, 30 July 1976, 1 3; 20-21 August 1976, 5 33, 4 99; Laughintown, Furnace Run, 7-8 June 1976, 3 33; 14-15 July 1976, 14 ♂♂, 5 ♀♀; 20-21 August 1976, 16 ♂♂, 5 ♀♀; Rector, Powdermill Nature Reserve, Maul Spring, 19-20 June 1975, 1 &; 16-17 July 1975, 3 & d, 3 ♀♀; 13-14 August 1975, 13 & &, 35 ♀ ♀; 10-11 September 1975, 1 &. New JERSEY. Sussex County: Stokes State Forest, stream near Sawmill Road, 30 April 1977, 1 prepupa; 11 June 1977, 1 larva.

Rhyacophila ledra Ross

Rhyacophila ledra Ross, 1939 (male genitalia). Ross, 1944 (male genitalia, larva). Ross, 1956 (male genitalia). Flint, 1962 (larva). Schmid, 1970 (male genitalia).

This species has been recorded previously from Georgia, Illinois, North Carolina, Ohio, and Tennessee. It is not common in Pennsylvania, from which it is recorded for the first time (Fig. 3). Its overall distribution apparently entails the Ohio River Valley and the southern Appalachian Mountains. There are insufficient data available to conclude what is the definitive aquatic habitat of this species. Ross (1944) collected a few mature pupae in May from a small temporary stream. Adults have been collected on the wing in June.

Material examined.—PENNSYLVANIA. Armstrong County: Vandergrift, Carnahan Run, 1 June 1977, 1 &. Westmoreland County: Rector, Powdermill Nature Reserve, Powdermill Run, 19–20 June 1975, 1 &; Maul Spring, 23–24 June 1977, 1 &, 1 \Im .



Fig. 5.—Distribution of the species of *Rhyacophila* of the *invaria* subgroup in Penn-sylvania.

Rhyacophila otica Etnier and Way

Rhyacophila otica Etnier and Way, 1973 (male genitalia). Rhyacophila pennsylvanica Sykora and Weaver, 1976, N. syn.

This species previously recorded from Tennessee by Etnier and Way (1973) is relatively uncommon in Pennsylvania where only a few adult specimens have been collected at an ultraviolet light trap (Fig. 3). The immature stages of this species remain unknown.

Material examined.—PENNSYLVANIA. Fulton County: Emmaville, Chestnut Bridge Hollow, 23–24 July 1976, 1 ♂, 1 ♀. Westmoreland County: Rector, Powdermill Nature Reserve, Maul Spring, 14–15 July 1975, 1 ♂; Powdermill Run, 14–15 July 1975, 2 ♂♂.

invaria Group

This group is composed of two subgroups, the *invaria* subgroup and the *nigrita* subgroup (Schmid, 1970) both of which are restricted to eastern Nearctica.

invaria Subgroup Rhyacophila banksi Ross

Rhyacophila banksi Ross, 1944 (male and female genitalia). Rhyacophila sp. 3 (carpenteri ?), Flint, 1962.

This interesting species was found to be rather common in the Appalachians of western Pennsylvania (Fig. 5). Other state records include New Hampshire, Tennessee, and Vermont.



Fig. 6.—*Rhyacophila banksi*, larva: A = head and pronotum, dorsal view; B = anal proleg, lateral view; C = mandibles, dorsal view; D = maxillary palpus (MP).

Description of larva (Fig. 6).—Overall length 16 mm. *Head*: Coloration variable; in some, golden brown, in others dark brown with an irregular row of pale muscle scars extended on each side of the front and the coronal suture, muscle scars faintly distinguishable on the frontocephalis, lateral and posterior portions lighter; right mandible with three apical teeth, mesal tooth longest; left mandible with two apical teeth, ventral tooth longer; maxillary palpi with second segment twice as long as the first. *Abdomen*: Proleg with basoventral and apicolateral processes, neither free of membrane; claw with one large ventral tooth and sometimes a smaller tooth.

Flint (Roback, 1975) was of the opinion that "it is impossible to separate the larvae of R. *invaria*, R. *shenandoahensis*, and R. *vibox*." Likewise, we are unable to distinguish the larvae of R. *banksi* from these three species.

Discussion.—These species, besides sharing a hypothetical common ancestor and many synapomorphic characters, also appear to inhabit similar aquatic environments, specifically small streams and springs. Furthermore, it is uncommon for more than one species of the *invaria* subgroup to occur at the same locality, therefore the species involved appear to be allopatric.

Habitat.—Many larvae of *banksi* were collected from small streams and springs (0.3 to 1.2 m wide). However, a few were collected near the confluence of the hatchery spring and Spring Creek at Marienville. Immatures were also taken from Spruce Run, a naturally acidic stream (pH = 3.5 in July). Seasonally, immatures have been collected in the spring and early summer, and adults are on the wing from June to August.

Material examined.—PENNSYLVANIA. Elk County: Ridgway, small spring near Route 949, 3–4 July 1976, 5 $\delta \delta$, 2 $\varphi \varphi$; 16 April 1977, 9 larvae; 30 May 1977, 2 larvae, 2 prepupae; 23 June 1977, 1 prepupa, 4 δ pupae; 1 July 1977, 4 δ pupae, 1 φ pupa; 12 July 1977, 3 δ pupae, 3 φ pupae, 1 φ . Fayette County: Seven Springs, Neals Run Spring, 15 April 1977, 4 larvae, 2 prepupae; 2 June 1977, 3 δ pupae, 1 δ . Forest County: Marienville Sportsmens Club, hatchery spring, 19 July 1976, 1 larva; 28–29 August 1976, 1 δ ; 18 April 1977, 3 larvae, 2 prepupae; Spring Creek, 18 April 1977, 1 larva, 8 prepupae. Warren County: Cherry Grove, Sandstone Spring Picnic Grounds, 6 June 1976, 1 larva, 1 δ pupa; 18 April 1977, 2 larvae. Washington County: Amity, spring near Ten Mile Creek, 10 June 1976, 6 $\delta \delta$; 16 July 1976, 1 δ . Westmoreland County: Laurel Hill Summit, Spruce Run, 7 June 1973, 3 δ pupae, 2 φ pupae; 16 May 1976, 5 larvae, 5 prepupae; 12–13 June 1976, 3 δ pupae, 2 φ pupae, 18 $\delta \delta$, 4 $\varphi \varphi$; 14–15 July 1976, 41 $\delta \delta$, 1 φ ; 20 March 1977, 3 larvae.

Rhyacophila invaria (Walker)

Polycentropus invarius Walker, 1852.

Rhyacophila invaria (Walker) Ross, 1938*b* (male genitalia). Flint, 1962 (larva). Schmid, 1970 (male genitalia).

In Pennsylvania this species was collected only in the eastern regions of the Tuscorora Mountains and the Piedmont (Fig. 5). It is apparently separated in distribution from *banksi* which is common in the western mountains of the Appalachians. It is also known from Maine, Massachusetts, New York, Quebec, and Nova Scotia. Several larvae were collected in springbrooks from February to July, mature pupae in June, and adults were on the wing in June and July. The larvae are very similar to those of other species of the *invaria* subgroup (see *banksi*).

Material examined.—PENNSYLVANIA. Chester County: Atglen, small spring near Glen Run, 11 April 1977, 1 larva; 24 April 1977, 21 larvae, 6 prepupae; 7 May 1977, 5 prepupae, 1 & pupa; 6–7 June 1977, 5 larvae, 1 prepupa, 1 & pupa, 1 \Im pupa; 19 June 1977, 11 & \Im , 5 \Im \Im ; 23 June 1977, 2 \Im \Im ; 25–26 June 1977, 23 & \Im , 1 \Im ; 12 July 1977, 1 larva; 27 February 1978, 2 larvae. Cumberland County: Mount Holly Springs, Whisky Spring, 1 July 1977, 2 & \Im . Fulton County: McConnellsburgh, Aughwick Creek, 30 June 1977, 1 larva, 3 prepupae, 1 & pupa, 2 \Im pupae, 2 \Im \Im , 1 \Im ; 2 July 1977, 1 \Im pupa, 1 \Im ; 17 July 1977, 3 \Im pupae, 2 \Im pupae. Lancaster County: New Holland Watershed Area, 4–5 April 1977, 2 larvae, 2 \Im pupae; 26–27 June 1977, 7 prepupae, 1 \Im pupa, 3 \Im pupae, 1 \Im ; 16–17 July 1977, 8 \Im \Im ; 23 March 1978, 1 larva.

Rhyacophila vibox Milne

Rhyacophila vibox Milne, 1936 (male and female genitalia). Ross, 1944 (male and female genitalia, larva). Flint, 1962 (larva). Schmid, 1970 (male genitalia).





Fig. 7.—Distribution of the species of *Rhyacophila* of the *nigrita* subgroup in Pennsylvania.

This is the most widely dispersed species of the *invaria* subgroup, being known from Illinois, Maine, Massachusetts, Michigan, New Hampshire, New York, North Carolina, Ontario, Quebec, Tennessee, Vermont, Wisconsin, and recorded herein for the first time from Pennsylvania and New Jersey (Fig. 5). Its distribution in Pennsylvania apparently is not restricted to a specific geographic region of the state as observed for two other species of the *invaria* subgroup, *banksi* and *invaria*. The larvae of *vibox* are very difficult to distinguish from the other known larvae of this subgroup (see *banksi*). The immatures of *vibox* have been collected mostly from small eurythermic streams, 0.6 to 1.5 m wide from April to June. Mature pupae and adults occur in May and June.

Material examined.—PENNSYLVANIA. Beaver County: Raccoon Creek State Park, Mineral Run, 30 May 1976, 2 $\delta \delta$; stream near marina, April 1975, 2 larvae; 28 May 1976, 5 δ pupae, 1 δ ; 19 May 1977, 1 larva, 5 δ pupae. Clearfield County: S. B. Elliott State Park, Lick Run, 18 April 1977, 9 larvae, 2 prepupae; 30 May 1977, 2 larvae, 6 prepupae, 14 δ pupae, 1 δ , 1 \Im ; 23 June 1977, 12 δ pupae, 8 \Im pupae; 1 May 1978, 3 larvae, 2 prepupae; 1 June 1978, 2 larvae, 1 prepupa, 3 δ pupae, 4 \Im pupae, 3 $\delta \delta$. Forest County: Kellettville, small spring near Ross Run, 7 June 1978, 6 δ pupae, 7 \Im pupae. Potter County: Harmontown, small spring near Route 449, 2 July 1978, 4 larvae, 5 prepupae, 1 δ pupa. Westmoreland County: Rector, Powdermill Nature Reserve, White Oak Run, 31 May 1975, 1 δ , 2 \Im . New JERSEY. Sussex County: Stokes State Forest, small stream near Sawmill Road, 4 April 1977, 3 larvae; 11 April 1977, 1 δ , 2 \Im ? \Im ; 30 June 1977, 1 larva, 1 prepupa.



Fig. 8.—*Rhyacophila carpenteri*, larva: A = head and pronotum, dorsal view; B = anal proleg, lateral view; C = mandibles, dorsal view; D = maxillary palpus (MP).

nigrita Subgroup Rhyacophila carpenteri Milne

Rhyacophila carpenteri Milne, 1936 (male and female genitalia). Ross, 1956 (male genitalia).
Schmid, 1970 (male genitalia).
Rhyacophila sp. 3 (banksi?), Flint, 1962.

This interesting species is distributed throughout the Appalachian Mountains, being documented from Kentucky, Massachusetts, New Hampshire, North Carolina, and Quebec. It is a new state record for Pennsylvania, where three localities were discovered to be frequented by adults, and subsequent samplings procured several larvae and meta-morphotypes (Fig. 7). It is identical to R. sp. 3 larval form of Flint

(1962), who remarks, "This species is easily recognized by the shape of the head, for no other species yet found in the East has a head capsule that gradually narrows toward the rear."

Description of larva (Fig. 8).—Overall length, 14 mm. Head: Light chestnut color, nearly parallel sided, but distinctly narrowing posteriorly; right mandible with three apical teeth, middle tooth longest; left mandible with two apical teeth, ventral tooth longer; maxillary palpi with second segment 2.5 times as long as the first. Thorax: Pronotum with a row of setae on the anterior margin, shorter mesad and gradually lengthening anterolaterally. Abdomen: Anal proleg with basoventral and apicolateral processes, neither free of the membrane; anal claw with one small ventral tooth.

Habitat.—Immatures were collected from a small springbrook, 0.9 to 1.5 m wide, approximately 60 m from the source. Larvae were taken in April and May; prepupae, May and June; pupae, June and July; adults, June, July, and August.

Material examined.—PENNSYLVANIA. Elk County: Ridgway, spring near Route 949, 3–4 July 1976, 12 $\delta\delta$; 16 April 1977, 1 larva; 30 May 1977, 2 larvae, 2 prepupae; 23 June 1977, 1 prepupa, 2 δ pupae; 1 July 1977, 4 δ pupae, 1 φ pupa; 12 July 1977, 3 δ pupae, 3 φ pupae, 1 φ ; Ridgway, South Branch Island Run, 3 July 1976, 2 $\delta\delta$. Tioga County: Ansonia, Colton Point, Right Branch Run, 1–2 July 1978, 5 $\delta\delta$, 2 $\varphi\varphi$. Westmoreland County: Rector, Powdermill Nature Reserve, Maul Spring, 19–20 June 1975, 1 δ ; 16–17 July 1975, 19 $\delta\delta$, 3 $\varphi\varphi$; 13–14 August 1975, 4 $\delta\delta$, 1 φ ; 23–24 June 1977, 5 $\delta\delta$.

Rhyacophila nigrita Banks

Rhyacophila nigrita Banks, 1907. Betten, 1934 (male genitalia). Flint, 1962 (larva). Schmid, 1970 (male genitalia).

This species is very common throughout the Appalachians, being previously recorded from Kentucky, Massachusetts, New Hampshire, North Carolina, Pennsylvania, Quebec, and Tennessee; specimens reported herein are a new state record from New Jersey. In Pennsylvania it was collected from many different localities (Fig. 7), its larvae typically inhabiting clear mountain rivulets concurrently with *fuscula* and *carolina*. Many immatures were collected at Maul Spring—first instars, from June to August; fifth (last) instars, from November to June; adults, from May to September.

Material examined.—PENNSYLVANIA. Bedford County: Schellsburg, spring near Route 30, 1 August 1976, 2 larvae. Elk County: Ridgway, South Branch Island Run, 29 May 1977, 1 & pupa. Fayette County: Seven Springs, Neals Run Spring, 2 June 1977, 4 & &; 7 June 1977, 2 & pupae, 2 & pupae. Franklin County: Turnpike between Blue and Kittatinny Mountains, Trout Run, 12 June 1976, 1 &; 18 May 1977, 2 larvae, 1 prepupa. Forest County: Kellettville, Ross Run, 5–6 June 1976, 1 larva, 1 &; Tionesta, small stream at Camp Tionesta, 6 June 1976, 1 &; Truemans Corner, Minister Creek, 5 June 1976, 1 prepupa. Fulton County: Emmaville, Chestnut Bridge Hollow, 28–29 May 1977, 1 larva, 1 &, 1 \Im ; 1 July 1977, 2 & pupae, 2 & d; McConnellsburgh, Aughwick Creek, 30 June 1977, 2 & . Lancaster County: New Holland Watershed Area, 4–5 June 1977, 5 larvae, 3 & pupae, 2 & d; 26–27 June 1977, 1 & pupa, 3 & d, 9 & \Im ; 16–17 July 1977, 3 & d, 4 & \Im . Pike County: Milford, Sawkill Creek, 11 June 1977, 1 prepupa. Tioga

County: Ansonia, Colton Point, Right Branch Run, 1 July 1978, 8 \eth \eth , 11 \Im \Diamond . Warren County: Cobham, Rams Horn Spring, 24-25 July 1976, 2 3 3, 2 9 9; 18 April 1977, 2 larvae. Westmoreland County: Laughintown, Furnace Run, 14-15 July 1976, 1 &; Rector, Powdermill Nature Reserve, Maul Spring, 28 January 1975, 51 larvae; 6 February 1975, 2 larvae; 28 February 1975, 20 larvae; 27 March 1975, 37 larvae; 24 April 1975, 34 larvae; 6 May 1975, 3 larvae, 3 prepupae, 3 pupae; 22 May 1975, 44 larvae, 8 prepupae, 26 pupae; 31 May 1975, 3 ♂ ♂ , 3 ♀ ♀; 19–20 June 1975, 46 larvae, 8 prepupae, 18 pupae, 102 $\delta \delta$, 66 $\varphi \varphi$; 16–17 July 1975, 12 larvae, 2 pupae, 23 $\delta \delta$, 50 $\varphi \varphi$; 13–14 August 1975, 21 larvae, 1 prepupa, 18 $\delta \delta$, 21 $\varphi \varphi$; 10–11 September 1975, 39 larvae, 1 δ , 4 99; 11 October 1975, 54 larvae; 5 November 1975, 52 larvae; 3 December 1975, 93 larvae; 3 January 1976, 38 larvae; 6 May 1977, 3 larvae; 22 January 1977, 4 3 pupae, 6 \bigcirc pupae, 16 $\eth \eth$, 14 $\circlearrowright \circlearrowright$; 1 July 1977, 2 prepupae, 4 \circlearrowright pupae, 2 \circlearrowright pupae. New JERSEY. Sussex County: north of High Point State Park near Route 23, Clove Run, 19 May 1977, 1 prepupa. Stokes State Forest, small stream near Sawmill Road, 4 April 1977, 1 larva; 30 April 1977, 15 larvae, 7 prepupae; 11 June 1977, 2 larvae, 3 prepupae, 3 \eth pupae, 6 \updownarrow pupae, 1 \updownarrow .

lobifera Group Rhyacophila lobifera Betten

Rhyacophila lobifera Betten, 1936 (male and female genitalia, larva). Ross, 1944 (male and female genitalia, larva). Flint, 1962 (larva). Ross, 1956 (male genitalia). Schmid, 1970 (male genitalia).

This lone member of the *lobifera* group occurs throughout the Ohio River Valley and the central United States. It is recorded for the first time from Pennsylvania (Fig. 2) while other state records include Illinois, Kentucky, Ohio, Oklahoma, and Tennessee. In Pennsylvania, only one specimen was collected from the riffle area of a stream approximately 6 m wide. However, Ross (1944) mentioned that they were common in small springs and temporary streams. It is probable that this is their definitive habitat as Stern and Stern (1969) found many larvae amid the moss and algae in a springbrook. In Kentucky, Resh et al. (1975) found its flight period to be limited to two weeks in late April and early May.

Material examined.-PENNSYLVANIA. Armstrong County: Vandergrift, Carnahan Run, 16 March 1975, 1 larva.

sibirica Group Rhyacophila atrata Banks

Rhyacophila atrata Banks, 1911. Ross, 1956 (male genitalia). Flint, 1962 (larva).

This montane species is indigenous to the Appalachian Mountains of Massachusetts, North Carolina, New Hampshire, and New York. It is also a new state record for Pennsylvania where adults have been collected from three counties in May and June (Fig. 9). Flint (1962) discovered that the larvae live in riffles of streams 1.8 to 4.8 m wide.

Material examined.—PENNSYLVANIA. Forest County: Kellettville, Ross Run, 5-6 June 1976, 1 3, 1 9. Franklin County: Turnpike between Blue and Kittatinny Moun-



Fig. 9.—Distribution of the species of Rhyacophila of the sibirica group.

tains, Trout Run, 12 June 1976, 1 &, 1 P. Westmoreland County: Rector, Powdermill Nature Reserve, White Oak Run, 31 May 1975, 1 &.

Rhyacophila manistee Ross

Rhyacophila manistee Ross, 1938a (male genitalia). Flint, 1962 (larva).

This species has been recorded previously from Michigan, New Hampshire, and New York. This caddisfly is recorded here for the first time from Pennsylvania where we believe it to be relatively rare (Fig. 9). The larvae live in meandering trout streams approximately 4.8 to 5.5 m wide (Flint, 1962). Adults have been collected in late May.

Material examined.—PENNSYLVANIA. Westmoreland County: Rector, Powdermill Nature Reserve, White Oak Run, 31 May 1975, 2 ♂♂, 1 ♀.

Rhyacophila melita Ross

Rhyacophila melita Ross, 1938*a* (male genitalia). Ross, 1956 (male genitalia). Flint, 1962 (larva). Roback, 1975 (larva).

This species has been recorded from Michigan, New Hampshire, New York, and Vermont. *R. melita* probably occurs in Pennsylvania, because it has been collected in New Jersey (new state record) only a few miles from the Pennsylvania state line (Fig. 9). These immatures were discovered in a large, clear mountain stream approximately 9 m wide, only a few km east of the Appalachian Trail.

Material examined.—New JERSEY. Sussex County: north of High Point State Park, Clove Run, 16 April 1977, 3 larvae.

Rhyacophila minor Banks

Rhyacophila minora Banks, 1924 (lapsus). Ross, 1956 (male genitalia). Flint, 1962 (larva). Roback, 1975 (larva).

This is the most familiar species of the *siberica* Group in eastern North America. It has been recorded previously from Maine, Massachusetts, North Carolina, New Hampshire, Nova Scotia, New York, South Carolina, West Virginia, and Tennessee. It is herein recorded for the first time from Pennsylvania where it is relatively common (Fig. 9). Many immatures were collected from Maul Spring, but other records indicate that it inhabits larger streams as well.

Material examined .- PENNSYLVANIA. Beaver County: Raccoon Creek State Park, Mineral Run, 30 May 1976, 2 3 3, 1 9. Fayette County: Seven Springs, Back Run, 2 June 1977, 2 3 3, 3 9 9. Franklin County: Turnpike between Blue and Kittatinny Mountains, Trout Run, 12 June 1976, 1 &. Forest County: Kellettville, Ross Run, 5-6 June 1976, 1 3, 2 99; Tionesta Station, Hunters Creek, 5 June 1976, 4 33, 9 99; Truemans Corner, Minister Creek, 5 June 1976, 1 larva, 1 9. Fulton County: Emmaville, Chestnut Bridge Hollow, 1 July 1977, 2 & d, 1 9; McConnellsburg, Aughwick Creek, 30 June 1977, 25 さき, 7 ♀♀. Pike County: Sawkill Creek, 1 May 1977, 5 prepupae, 2 pupae. Somerset County: Kooser State Park, 7-8 June 1976, 1 &. Westmoreland County: Laughintown, Furnace Run, 7-8 June 1976, 1 &, 1 9; Laurel Hill Summit, Spruce Run, 18 July 1976, 1 &; Rector, Powdermill Nature Reserve, Maul Spring, 28 January 1975, 21 larvae; 6 February 1975, 1 larva; 28 February 1975, 16 larvae; 27 March 1975, 18 larvae; 24 April 1975, 14 larvae; 6 May 1975, 9 larvae, 1 prepupa; 19–20 June 1975, 2 larvae, 6 pupae, 4 $\delta \delta$; 16–17 July 1975, 3 $\delta \delta$, 3 $\Im \Im$; 13–14 August 1975, 3 larvae, 3 33, 3 99; 10 September 1975, 75 larvae; 11 October 1975, 93 larvae; 5 November 1975, 112 larvae; 3 December 1975, 69 larvae; 3 January 1976, 9 larvae; 23 June 1977, 10 33, 8 99; White Oak Run, 15-16 May 1977, 1 3, 2 99; 23-24 June 1977, 8 33.

torva Group Rhyacophila torva Hagen

Rhyacophila torva Hagen, 1861. Ross, 1956 (male genitalia). Flint, 1962 (larva). Schmid, 1970 (male genitalia).

This is the only species of the *torva* group (Schmid, 1970) and is restricted to eastern Nearctica, where its occurrence is common throughout the Appalachian Mountains. It is known from Maine, Massachusetts, North Carolina, New Hampshire, New Jersey, New York, Quebec, Tennessee, Virginia, Vermont, Washington, D.C., and West Virginia. This is the first report of this species from Pennsylvania, where its larvae were found under large stones in a fast-flowing, limpid stream approximately 6 m wide. Flint (1962) stated that they appear to dwell in streams about 1.8 to 2.7 m in width. Mature larvae may be collected in the spring and adults throughout the summer (Fig. 9).

Material examined.—PENNSYLVANIA. Franklin County: Turnpike between Blue and Kittatinny Mountains, Trout Run, 12 June 1976, 1 \Im , 1 \Im ; 18 May 1977, 2 larvae, 1 prepupa. Forest County: Kellettville, Ross Run, 18–19 June 1976, 3 \Im \Im . Fulton County: McConnellsburg, Aughwick Creek, 30 June 1977, 2 \Im \Im , 3 \Im \Im . Somerset County: Laurel Hill State Park, 23 June 1976, 1 \Im . Tioga County: Ansonia, Colton Point, Right Branch Run, 1 July 1978, 1 \Im , 2 \Im \Im . Westmoreland County: Laurel Hill Summit, Spruce Run, 22 August 1976, 1 larva; Laughintown, Furnace Run, 7–8 June 1976, 2 \Im \Im , 1 \Im ; 14–15 July 1976, 8 \Im \Im , 10 \Im \Im ; 20–21 August 1976, 4 \Im \Im , 4 \Im \Im .

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