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THE ADULT TRICHOPTERA (INSECTA) OF ALBERTA AND EASTERN
BRITISH COLUMBIA, AND THEIR POST-GLACIAL ORIGINS.
II. THE FAMILIES GLOSSOSOMATIDAE AND PHILOPOTAMIDAE

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Of the Glossosomatidae nine species, and of the Philopotamidae three species are here recorded from the study area, with a total of twelve species. Adults are described, and keys are provided for identification to species. Also provided for each species are genitalic illustrations to males and females, venational illustrations, and distribution maps. Two species are represented by unidentifiable females only. No new species are described.

The distributions of each species relative to the other species of the next higher supra-specific taxon are briefly examined, as are the pre-glacial affinities of the fauna, and the altitudinal distribution of the species.

With regard to the post-glacial origins of the twelve species treated here, it is concluded that 84% migrated from the Cordillera south and west of the study area; 8% arrived, as trans-continental species, from south of the ice generally; and 8% moved north from the central plains.

Dans la région étudiée nous reconnaissons neuf espèces de Glossosomatidae et trois espèces de Philopotamidae. Nous décrivons les adultes et présentons une clef pour l'identification des espèces. De plus nous pourvoyons pour chaque espèce des illustrations des organes génitaux mâles et femelles. Seulement deux espèces ne peuvent être reconnues à l'état femelle. Il n'y a aucune nouvelle espèce décrite.

Nous examinons brièvement la distribution de chaque espèce en relation avec d'autres espèces appartenant à des taxons supraspécifiques plus hauts, les affinités pré-glaciales de la faune, et la distribution en altitude des espèces.

En rapport aux origines post-glaciales, nous concluons que 84% des espèces ont émigré de la cordillère au sud et à l'ouest de la région étudiée; 8% sont des espèces transcontinentales, venues généralement du sud de la limite des glaces; et 8% se sont déplacées vers le nord à partir des plaines centrales.

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Additional corrigenda to Nimmo, 1971b.

- p. 38 Fig. 4a. Discoidal cell mis-labeled. Should be between veins R2+3 and R4+5, though not delimited by cross-vein in *Rhyacophila*.

- p. 77 Line 26. Omit reference to Fig. 605 (*N. laloukesi* not shown). See Fig. 1b, right side, for Lake Louise locality.
- p. 211 Line 11. For '... Iadho...' read '... Idaho...?'
- p. 234 Line 4. For '... Lymnephilidae...' read '... Limnephilidae...?'.
Line 5. For '... Homosphyllax...' read '... Homophyllax...?'

INTRODUCTORY REMARKS

This paper is a continuation of my study (Nimmo, 1971a) of the adult Trichoptera found in Alberta and eastern British Columbia, and the post-glacial origins of the fauna. The 1971 paper should be considered as Part I of the series, though not so numbered or titled. Dealt with here are the two small families Glossosomatidae and Philopotamidae. Succeeding papers in the series, dealing with the remaining families represented in the study area, will appear at indeterminate intervals.

Names of the taxa studied are presented in Table 1 below. For a complete exposition of these two families Ross (1956) should be consulted.

Table 1. Names of taxa of Glossosomatidae and Philopotamidae in Alberta and eastern British Columbia.

Family	Subfamily	Tribe	Genus	Subgenus	Species
Glossosomatidae	Glossosomatinae	Glossosomatini	<i>Glossosoma</i>	<i>Ripaeglossa</i>	<i>velona</i> Ross
					<i>alascense</i> Banks
					<i>pterna</i> Ross species 1 (♀)
		<i>Eomystra</i>	<i>intermedium</i> (Klapálek)		
			<i>verdonia</i> Ross		
	Anagapetini	<i>Anagapetus</i>	-	<i>debilis</i> (Ross)	
	?	?	?	Glossosomatinae sp. 1 (♀)	
	Protoptilinae	-	<i>Protoptila</i>	-	<i>tenebrosa</i> (Walker)
Philopotamidae	-	-	<i>Dolophilodes</i>	<i>Sortosa</i>	<i>aequalis</i> (Banks) <i>novusamericanus</i> (Ling)
			<i>Wormaldia</i>	<i>Wormaldia</i>	<i>gabriella</i> Banks

I have examined 900 specimens of both sexes: 748 specimens of Glossosomatidae; and 152 specimens of Philopotamidae. The total number of specimens of each species examined, by numbers per sex, is given at the end of its description in the text.

The reader is referred to the 1971 paper for the bulk of the introduction, as the points made there also apply to this paper, with the exception of direct references to the two families treated therein. However, several additions need to be made, and these follow.

A key to the families of adult Trichoptera is in Ross (1944), which has just recently been reprinted. However, caution should be exercised as the accepted limits of the families recognized therein may have altered. A case in point is the family Glossosomatidae considered here,

which is given as the subfamily Glossosomatinae of the Rhyacophilidae in Ross (1944). For more recent outlines of familial limits see Fischer's 'Trichopterorum Catalogus', published between 1960 and 1974 (several volumes of which are listed in the References herein), and Malicky's (1973) 'Trichoptera (Köcherfliegen)' (pp. 7-9).

Some of my distribution records extend, in southern British Columbia, rather further west than the limits given for the study area in 1971. These are derived from a single collecting trip, in 1968, very early in the season. As my collecting in eastern British Columbia was sporadic to say the least, I have no reason to suppose that the species there recorded do not also occur in the study area as originally defined in 1971. They are, therefore, included here. As before, a complete list of localities, dates, numbers of specimens and sexes collected has been deposited in the Department of Entomology at the University of Alberta, Edmonton, Alberta.

The specimens used in this study have been disposed of as previously, with the exception that there was no borrowed material, and no other collections were examined. Due to circumstances of time and space beyond my control I was unable to visit other institutions to view material. However, the fauna as presented here is as completely recorded as was possible in the circumstances, by personal collecting, and by examination of the literature.

The literature survey is essentially complete to 1973 inclusive. In the synonymical lists given for each species, only the North American literature is given in detail. The reader is referred to the appropriate volume of Fischer's 'Trichopterorum Catalogus' for any Eurasian literature where appropriate.

Figure 1c, presents collecting localities not recorded in the 1971 paper, and is additional to Fig. 1, 1a, and 1b of that paper. All other figure numbers in this paper follow on consecutively from the last figure number in the 1971 paper. This practice will continue in succeeding papers of the series.

As with the Rhyacophilidae in the 1971 paper, in the lateral aspect drawings of the male genitalia, the mesal face of the clasper is shown as this is the face which bears important characters. Only in the cases of *Protoptila tenebrosa* (Walker), where it would serve no purpose, and of *Glossosoma pterna* Ross, where I could not draw from actual specimens, is this practice not followed.

Concerning preparation of genitalia for examination, I would suggest that, after treatment in KOH and glacial acetic acid, as mentioned in 1971, the specimen should be well rinsed in water before storing in ethanol. If not so rinsed, a grey sludge may appear in the storage vial.

In the text, when referring to all or part of the fauna above the species level, I use '. . . the Alberta fauna. . .', '. . . the fauna of the study area. . .', or '. . . the fauna of Alberta and eastern British Columbia. . .' interchangeably. The form used depends simply on convenience and the avoidance of structural complexity, as in key or table headings.

The Family Glossosomatidae Wallengren

This family is represented in Alberta and eastern British Columbia by nine species belonging to three genera. The species names are presented in Table 1, according to the scheme used by Ross (1956). This is the order of presentation used in this study, except that the Anagapetini are treated after the Glossosomatini, not before as in Ross.

The record of one species from Alberta, *Glossosoma pterna* Ross, appears to be open to some doubt. While stated definitely to occur in the Kananaskis River - Lusk Creek area by Radford and Hartland-Rowe (1971), Radford (pers. comm.) indicates that the identification was not certain. Neither can it be determined whether adults, pupae, or larvae were used, and the specimens appear to be no longer available. However, despite the uncertainty of the record, and the fact that the species was previously known only from California, I include Ross' orig-

inal (1947) drawing of the male, and have incorporated his description in the text, inserting figure numbers from this paper.

Character synopsis of the Glossosomatidae. – (Derived from Betten, Kjellgren, Orcutt and Davis (1934), Mosely (1939), and Ross (1956)). Ocelli three. Maxillary palpi five-articled. Spur formula 2, 4, 4. Females of Glossosomatinae with tibiae of middle legs flattened, blade-like. Venation generally complete, though rather modified and reduced in Protoptilinae. Fore wings long, rounded or elliptical at apex, with discoidal cell, and apical cells f1-f5; hind wings narrower, often very narrow, apex somewhat blunt, with or without discoidal cell, only apical cells f1, f2, f3, f5, or f2, f3, f5 present.

In the following key (derived from Ross, 1956) females key to genus, but they are best identified to species, at present, by association with the male and/or by comparison with the drawings presented here.

Key to the taxa of Glossosomatidae in Alberta and eastern British Columbia.

- 1a. Front tibia with pair of apical spurs, prominent, sclerotized (Glossosomatinae) . . . 2
- 1b. Front tibia with only hairlike apical spurs, or none (Protoptilinae)
 *Protoptila tenebrosa* (Walker), p. 328
- 2a. (1a) Mesepisternum divided by central constriction of anterior and posterior sutures
 (Glossosomatini; *Glossosoma*) 3
- 2b. Mesepisternum divided by short, transverse suture (Anagapetini)
 *Anagapetus debilis* (Ross), p. 326
- 3a. (2a) Lateral margins of male segment IX produced posterad as large lateral flaps (Fig.
 680, 693, 705), as hoodlike arrangement about greater part of genitalia (Subgenus
Ripaeglossa) 4
- 3b. No such lateral flaps of male segment IX (Fig. 711, 723) (Subgenus *Eomystra*) . . 6
- 4a. (3a) Male sternite VIII unsclerotized; cercus short, conical, acuminate (Fig. 680) . . .
 *G. velona* Ross, p. 319
- 4b. Male sternite VIII sclerotized; cercus long, slender (Fig. 693, 705) 5
- 5a. (4b) Male segment IX massive; clasper hemi-elliptical in lateral aspect, folded lengthwise,
 with dorsal groove (Fig. 693) *G. alascense* Banks, p. 320
- 5b. Male segment IX not massive; clasper pedicillate, with distally expanded portion,
 curved (Fig. 705) *G. pterna* Ross, p. 322
- 6a. (3b) Male segment X meso-dorsal process (cercus?) long, longer than remainder of seg-
 ment, slender, blade-like acuminate in lateral aspect (Fig. 711, 712)
 *G. intermedium* (Klapálek), p. 323
- 6b. Male segment X meso-dorsal process short, only half length of segment, stout, even-
 ly tapered, acuminate in lateral aspect (Fig. 723, 724) . . . *G. verdoni* Ross, p. 325

The Subfamily Glossosomatinae Wallengren

Synopsis of characters. – (From Ross, 1956). Tibiae of forelegs each with prominent pair of apical spurs, sclerotized. Fore and hind wings with veins Rs, R4+5, and R5 successively aligned throughout length as apparently single vein (Fig. 670a).

The Tribe Glossosomatini Wallengren

Synopsis of characters. – (From Ross, 1956). Mesepisternum divided by central constriction of anterior and posterior sutures. Hind wing with discoidal cell present, prominent; vein R2+3 branched basad of crossvein R3-R4 (Fig. 670b).

The Subgenus *Ripaeglossa* Ross

Synopsis of characters. — (From Ross, 1956). Males with large, opaque, thickened area of anal area of fore wing (Fig. 671a). Middle tibiae each with sharp, simple spurs. Male genitalia with segment IX lateral edges produced posterad as lateral plates or flaps which completely ensheath remainder of genitalia (Fig. 680, 693, 705); claspers simple; segment X bipartite, each part with cercuslike lateral process; aedeagus articulated to sternite IX near base of claspers by solid strap (Fig. 696); basal and apical parts of aedeagus firmly joined or fused.

Glossosoma velona Ross, 1938
(Fig. 670a-c, 680-692, 780)

Glossosoma velona Ross, 1938b: 109-110; Fig. 14. (Type locality: Centralia, Washington).

Ross, 1944: 292. Ross and Spencer, 1952: 45. Fischer, 1960: 24.

Glossosoma (Ripaeglossa) velona; Ross, 1956: 153, 191; Fig. 299a-c, 310; chart 30, 44. Fischer, 1971: 28.

Males of this species are distinguished from those of other species of the subgenus by short lateral extensions of segment IX, by which only segment X and cerci are enclosed (Fig. 680); by short, acute, conical cerci; and by short, distally rounded, fingerlike dorso-lateral lobe of clasper. Females may be distinguished, in lateral aspect (Fig. 688), by meso-lateral wings of segment VIII sclerotized base, and by keeled postero-ventral ledge.

Description. — Antennae pale brownish-straw; two-thirds body length; basal flagellar annulus twice length of second annulus. Vertex of head dark, almost chocolate-brown, except very pale warts and borders of sutures from each lateral ocellus posterad, in irregular arch, to postero-lateral wart, finally to posterior edge of cranium; dorso-median suture black. Front leg spurs very short, conical; latero-apical spur hyaline. Middle leg spurs short; dark apical spurs like apical setae, opposite true apical setae. Hind legs similarly with two setae-like spurs, acuminate, hyaline. Fore wing length of male 5.1 mm; very pale brown, faint patterning present; stigma present, indistinct, thick; venation darker in female; hind wings hyaline, fringed by long silken hairs on anal edge and lobe; similar hairs on basal half of 1A and all of 2A. Male venation as in Fig. 670a-b; female identical except as shown in Fig. 670c. Body generally dark brown, legs paler. Male sternites VI and VII with ventral processes as in Fig. 686 and Fig. 687 respectively. Female sternite VI with lobe as in Fig. 692. Female middle tarsus considerably laterally compressed, mesally concave.

Male genitalia. (Specimen from Emily Murphy Park, Edmonton, Alberta). Tergum VIII with irregular row of long setae parallel to posterior edge; sternum apparently unsclerotized (Fig. 680). Segment IX of very irregular form in lateral aspect (Fig. 680); with relatively narrow dorsal and ventral straps, and prominent trapezoidal antero-lateral wings ventrally (Fig. 681, 682); dorsal portion of dorso-lateral edges produced posterad as irregular wings to enclose segment X, joined dorso-mesally by membrane (Fig. 681). Clasper barely projected posterad of segment IX (Fig. 680); high proximally, with ventro-mesal ledge; mesal face concave; postero-dorsal process longer than main body of clasper, rounded, thumb-like in lateral aspect, with dense bed of stout setae on mesal face. Segment X pair of complex sclerites (Fig. 680, 683); each sclerite with prominent hooked lateral horn, and toelike ventro-lateral lobe; mesal face concave; dorsal lobe domed postero-laterally, slightly pitted, with antero-dorsal horn in posterior aspect (Fig. 683). Anus in folded membranous mass between segment X sclerites. Aedeagus complex (Fig. 684, 685); with two pairs of lobes ventrad of main body; ventral pair membranous, originated between heavily sclerotized intermediate pair which have serrated disto-dorsal edges in lateral aspect. Main body of aedeagus with regular dorsal edge in lateral

aspect, with ventro-lateral lobes basally; expanded disto-ventrally, with lip at tip (Fig. 685); with dorsal channel slightly expanded at tip. Whole aedeagus originated from narrow membranous base.

Female genitalia. (Specimen from Edmonton, Alberta). Basal portion of segment VIII sclerotized to partly overlap distal portion (Fig. 688); wider proximal portion declivous to thin lateral wings; postero-dorsal edge with small triangular median process (Fig. 689); ventrally keeled, abruptly tapered, in lateral aspect, to thin level plate cleft mesally, in ventral aspect (Fig. 689); retractor rods of segment attached along ventro-lateral edges. Retractor rods of Segment IX expanded distally, with acuminate tip. Spermathecal sclerite bipartite, each process of approximately equal length (Fig. 690). Ventral process irregular, thin except at slightly swollen base, with small, membranous tip partially cleft in ventral aspect; originated from cavity in ventral surface of base of dorsal process. Dorsal process much larger, slightly constricted laterally at base (Fig. 691), concave dorsally, tapered to slightly bulbous rounded tip (Fig. 691). The whole originated from membranous base.

Notes on biology. — Specimens of this species were taken mainly in the vicinity of the larger rivers of Alberta, in the less turbulent parts of their courses; also taken from smaller, slow-flowing streams. The flight period extends from May 26 to August 13, with a possible peak in July.

Geographical distribution. — The known range of this species extends from the MacKenzie River, Northwest Territories, to Utah, and from Montana to the Pacific coast (Fig. 780). In Alberta it is known from central and southern areas of the Province, apparently confined to the plains and eastern edges of the foothills. In altitude it has been found no higher than about 4000'.

I have examined 422 specimens, 108 males and 314 females, from the study area.

Glossosoma alascense Banks, 1900
(Fig. 671a-c, 693-704, 780)

Glossosoma alascensis Banks, 1900: 472; pl. 28, Fig. 17-18. (Type locality: Popov Island, Alaska). Banks, 1907: 41. Essig, 1926: 177.

Glossosoma alascense; Ulmer, 1905: 72. Ulmer, 1907: 212. Ulmer, 1932: 209, 217. Betten, Kjellgren, Orcutt and Davis, 1934: 139. Milne, 1936: 109, 110. Knowlton and Harmston, 1939: 285. Ross, 1944: 292. Ross and Spencer, 1952: Fig. 4a-b. Ross, 1965: Fig. 5. Fischer, 1960: 16.

Glossosoma (Ripaeglossa) alascense; Ross, 1956: 134, 153, 191; Fig. 306b, 311; chart 30, 44. Ross, 1965: Fig. 5. Fischer, 1971: 25-26.

Males of this species are distinguished from those of other species of the subgenus by massive segment IX with postero-lateral edges produced dorso-posterad as lateral wings to enclose remainder of genitalia except cercal tips; by very long, thin, sharp cerci; and by curious longitudinally folded claspers (Fig. 693). Females may be distinguished by relatively simple sclerotized segment VIII base with postero-ventral concavity, and antero-lateral groove on each side (Fig. 700).

Description. — Antennae pale reddish-brown; two-thirds body length; basal flagellar annulus more than twice length of second annulus. Vertex of head and frons deep reddish-brown; median suture of vertex black; warts pale; suture from each lateral ocellus to cranial posterior margin gently curved, pale, linked to pale ocellar area and adjacent warts. Fore leg spurs very short; meso-apical spur hyaline. Tibiae of middle and hind legs each with two short, fine, hyaline pseudospurs opposite apical spurs. Fore wing length of male 6.2 mm; pale reddish-brown, veins little darker; irrorate, especially in cells f1-f5; stigma present, indistinct; entire area bounded

by veins 1A+2A and 3A thickened, padlike, with incipient folding to form pocket; hind wings hyaline, anal edge, anal lobe, and veins 1A-3A fringed with long hairs; venation as in Fig. 671a-b. Female wings similar except for irroration missing in fore wing, no pad between veins 1A-3A; venation as in Fig. 671c. Body generally dark, almost chocolate-brown; legs paler. Male sternites VI and VII with ventral processes as in Fig. 698, 699. Female sternite VI with ventral process as in Fig. 704. Female middle tibia and tarsal segments considerably laterally compressed; mesal faces concave.

Male genitalia. (Specimen from Public Campsite, Kickinghorse River, Field, British Columbia). Segment VIII simple; tergum and sternum each with row of long setae parallel, close to posterior edges (Fig. 693). Segment IX massive, with short dorsal and ventral straps; lateral portion of ventro-lateral edges produced anterad into segment VIII, merged smoothly dorsad with main body of segment (Fig. 693, 694); entire postero-lateral edges of segment produced posterad to form wings to enclose remainder of genitalia; each wing tapered gently postero-dorsad in lateral aspect, with irregular ventral edge; thick, with slightly concave mesal face; ventral strap with postero-median process, setose (Fig. 695). Clasper simple, hemi-elliptical in lateral aspect (Fig. 693); with ventral edge folded dorsad along mesal face to form dorso-mesal groove; each clasper with irregular, thin strap to base of aedeagus (Fig. 696). Segment X of two complex sclerites (Fig. 693-695); antero-ventral process with very long, thin, cylindrical process curved abruptly dorsad distally, with acuminate, black tip; dorsal portion of each sclerite with dorsally directed acuminate blade, and anteriorly directed, rounded blade (Fig. 693); postero-ventral lobe of each sclerite with mesal faces opposed, thin-bladed distally, with lateral ledges at tips (Fig. 693, 694). Aedeagus in lateral aspect more or less uniform width till just anterad of tip, then abruptly narrow; with minute membranous tip; with deep dorsal groove; just posterad of strap to clasper a sinuous, narrow, thin bladed process on ventral surface. In ventral aspect (Fig. 697) aedeagus dumbbell-shaped, with broad, bilobed, membranous tip fused imperceptibly with main body; basal portion of main body hollow ventrally, with almost elliptical ventral aperture.

Female genitalia. (Specimen from Emily Murphy Park, Edmonton, Alberta). Basal portion only of segment VIII sclerotized (Fig. 700); with shallow groove parallel to antero-dorsal edge; abruptly narrowed for remaining two-thirds of length; basal third with shallow ventro-lateral fold from anterior edge; ventral surface concave, domed dorsad into sclerotized body of segment for posterior two-thirds of length; retractor rods attached internally; in ventral aspect (Fig. 701) sclerotized portion of segment mesally cleft to various depths, except on antero-mesal edges. Retractor rods of segment IX with small, bulbous tips. Spermathecal sclerite, in lateral aspect, simple, with pale body terminated by bilobed membranous tip (Fig. 702); with rectangular base for one quarter length, tapered abruptly, to expand slightly to smoothly rounded tip; with dark interior sclerite of uniform width except for globular posterior end (Fig. 703) and lozenge-shaped anterior end; the whole arched gently dorsad, with membranous, tubular base.

Notes on biology. — This species has been taken in the vicinity of flowing waters ranging from the most turbulent mountain streams to large, smoothly flowing plains rivers, and smaller, more gently flowing creeks. The flight period extends from May 7 to August 23, with an apparent peak in July.

Geographical distribution. — The known range of this species extends from Alaska to Utah, and from Montana to Oregon (Fig. 780). In Alberta it is known primarily from the mountains and foothills of the Rockies, with one record from the Plains, at Edmonton. In altitude it has been found from 2000' to about 5500'.

I have examined 166 specimens, 29 males and 137 females, from the study area.

Glossosoma pterna Ross, 1947
(Fig. 705, 780)

Glossosoma pterna Ross, 1947: 130; pl. 2, Fig. 6. (Type locality: Waddell Creek, Santa Cruz, California). Denning, 1956b: 246; Fig. 10:13e. Radford and Hartland-Rowe, 1971: 893, 902.

Glossosoma (Ripaeglossa) pterna; Ross, 1956: 134, 153; Fig. 303a, 311; chart 30, 44. Fischer, 1971: 27.

The male of this species may be distinguished '... in having the sclerotized lateral lobes of the tenth tergite forming only shallow straps, in having the clasper constricted to form a stem-like neck near the base, and in having a large 'heel' near the base of the cercus' (Ross, 1947).

'Male. — Length 8 mm ((?)). Color various shades of light brown, the venter of the body and all the legs straw colored. General structure typical for the subgenus *Glossosoma*, distinctive characters apparently confined to the genitalia. Genitalia as in Fig. 705. Ninth segment with the lateral margins produced into flaps which form a hood-like covering for the rest of the genitalia. Tenth tergite having a pair of large mesal membranous lobes and a pair of lateral sclerotized lobes, each of the latter forming a shallow strap. Cercus elongate, having a large heel-like base, from the ventral part of which there extends a long curved sclerotized rod, tapering evenly to a sharp tip, and bearing on its basal portion a few short scattered setae. Clasper membranous, consisting of a short broad base, a short and very narrow neck, and beyond this a somewhat ovate apical portion bearing a few setae. Aedeagus elongate and somewhat cylindrical, its apex bearing an area of membranous folds; from the ventral portion near the base extend a sclerotized rodlike structure and a pair of short finger-like processes each bearing a cluster of long setae at its tip'.

'Female. — Length 8.5 mm ((?)). Color light brown, similar in this and in general structure to male. Sixth sternite with a sharp sclerotized projection near the apical margin. Eighth segment wide at base and tapering to apex. Apical margin truncate on venter, slightly incised on dorsum'.

Notes on biology. — If the record in Alberta for this species is correct, it appears to inhabit either intermediate sized, fast rivers and/or smaller, gravel-bottomed, shallow creeks. The flight period is unknown.

Geographical distribution. — To date this species appears to be known only from California and Alberta (Fig. 780). In Alberta it is recorded only from the Kananaskis River system, close to the Continental Divide, at an altitude of about 5000'.

I have not been able to examine specimens of this species.

Glossosoma species 1
(Fig. 672c-d, 706-710, 780)

The single female of this species known to me is distinguished from females of other species in the subgenus by deeper concavity of postero-ventral surface of sclerotized part of segment VIII (Fig. 706); by two-compartmented nature of the concavity in ventral aspect (Fig. 707); and by lack of ventro-lateral folds on basal part of segment.

Description. — Antennae half body length; reddish-straw, pedicel darker; first flagellar annulus twice length of second. Vertex of head and frons deep reddish-brown; warts, and suture between lateral ocellus and posterior cranial margin, paler. Fore leg apical spurs much smaller than all others; of unequal length; hyaline. Middle and hind tibiae with small, hyaline, apical pseudospurs opposite each pair of apical spurs. Fore wing length of female 5.8 mm; pale, translucent, reddish-brown; stigma present, indistinct; hind wing hyaline, with fringes of long hairs

along anal area and lobe margins, and along veins 1A+2A and 3A. Venation as in Fig. 672c-d. General body colour reddish-brown, legs paler, to straw. Sternite VI posterior margin lobed as in Fig. 710. Tibial and tarsal segments of middle legs considerably laterally compressed, concave on mesal faces.

Male genitalia. Unknown.

Female genitalia. (Specimen from Sheep River, at Gorge Creek, west of Turner Valley, Alberta). Segment VIII basal portion sclerotized; simple, narrowed posterad, with abrupt declivity of ventral surface for posterior two-thirds of length (Fig. 706); declivous area deeply concave mesally; concavity partially divided to two lateral pockets by median keel (Fig. 707); dorsal and ventral margins of posterior rim deeply cleft in ventral aspect (Fig. 707); retractor rods attached internally. Retractor rods of segment IX with minute bulbous tips. Spermathecal sclerite simple, with dark main body tipped distally by deeply cleft membranous lobe (Fig. 708); in ventral aspect dark body long, thin, with small, rounded, expanded posterior tip, and large, gradually expanded, lozenge-shaped anterior end (Fig. 709).

This specimen was taken adjacent to a fast, turbulent, foothills stream about 15 miles west of Turner Valley, in southwestern Alberta (Fig. 780), on August 10, 1965. Altitude about 5500'.

The Subgenus *Eomystra* Martynov

Synopsis of characters. — (From Ross, 1956). Males with distinctive clavate (in lateral aspect) paired dorsal lobes of aedeagus, with distal head of each lobe dentate, medially opposed (Fig. 711, 723). Latero-apical spur of middle tibia of male at least curved; more extensively modified in most species (Fig. 722, 734).

Glossosoma intermedium (Klapálek), 1892 (Fig. 673a-d, 711-722, 781)

Mystrophora intermedia Klapálek, 1892: 444, 461; Fig. 8 (1-5). (Type locality: Bohemia (Czechoslovakia)). Fischer, 1960: 31-32. (See Fischer, 1960: 31-32, and 1971: 22-23, for palaeartic literature).

Glossosoma intermedium: Ross, 1944: 8, 39, 292; Fig. 93, 100, 108, 110, 136, 138-140.

Etnier, 1965: 144. Ross, 1965: 587. (See Fischer, 1971: 23, for palaeartic literature).

Glossosoma (Eomystra) intermedium; Ross, 1956: 137, 155, 168, 188, 193; Fig. 6, 318a, e, 319a, b; chart 31. Fischer, 1971: 22-23.

Klapalekia intermedia; (See Fischer, 1971: 23, for palaeartic literature).

Mystrophorella intermedia; (See Fischer, 1971: 23, for palaeartic literature).

Males of this species are distinguished from those of other species of the subgenus by long, narrow, acuminate, meso-dorsal process of each half of segment X (Fig. 711, 712); by regular spatulate clasper, in meso-lateral aspect; by main body of dorsal lobes of aedeagus bent at right angles, with irregular distal expansion; and by massive, rectangular, in lateral aspect, halves of segment X terminated dorso-distally by small, acuminate process. Females are distinguished by scalloped postero-ventral margin of sclerotized base of segment VIII (Fig. 719) in lateral aspect; and by pronounced bilateral carination of sternal area of posterior two-thirds of sclerotized area.

Description. — Antennae uniformly golden-brown; about two-thirds body length; with basal flagellar annulus twice length of second annulus. Vertex of head uniform dark brown except for paler warts and almost white, arcuate sutures originated from lateral extremities of postero-lateral warts; median suture almost black. Front leg spurs short; meso-apical spur almost black.

Middle tibial spurs long, curved; shorter, straighter in female. Hind tibial spurs long, irregular, except male meso-apical spur spatulate, with sharp distal spine at right angles to spur body (Fig. 722). Tibia and tarsal segments of middle legs strongly laterally compressed; mesal face concave. Fore wing length of male 4.82 mm; uniformly translucent brownish-straw; veins darker; stigma prominent, brown. Hind wings paler except costal edge; no pattern; basal third of vein 2A, and posterior edges of wing and anal lobe with long fringes of silken hairs. Venation of male as in Fig. 673a-b; female venation as in Fig. 673c-d. Body generally reddish-brown; thoracic tergites darker; legs straw coloured. Male sternites VI and VII with ventral processes as in Fig. 716, 717. Female sternite with ventral process as in Fig. 721.

Male genitalia. (Specimen from French Creek, Fawcett, Alberta). Segment VIII unmodified, with distinct row of long, heavy setae traversing tergum close to, and parallel with posterior edge. Segment IX of uniform length in lateral aspect except for paler, smoothly rounded projection of lower half of posterior edge on either side separated from main segment body by distinct declivity; a row of long setae parallel to, and anterad of, declivity (Fig. 711). Clasper slightly longer than rest of genitalic appendages; with narrow, laminate, basal half; with expanded, rounded, spatulate distal half (Fig. 711, 713). Segment X massive; cleft to two lateral portions; each portion bifid (Fig. 712); meso-dorsal process longer than lateral, thin, cylindrical, distally acuminate, originated from baso-dorsal area of lateral process; lateral process massive, convex laterally, with concave mesal face; with acuminate, toothlike process disto-dorsally; with small, curved nick at mid-point of ventral edge. Aedeagus connected to clasper bases by complex structure comprised of basal, broad, troughlike strap, and distal portion of two lateral halves beyond strap; in lateral aspect each half with distal third curved ventrad at right angles, with flared, rugose tip (Fig. 711); mesal face of tip with small, dark teeth (Fig. 713); both halves connected by membranous sheet. Aedeagus originated from trough of basal strap, between bases of lateral halves; a simple structure, tapered evenly to slightly smaller tip in lateral aspect (Fig. 714); in dorsal aspect troughed mesally, with wider trough in distal half; at junction of narrow and wide troughs, a rounded cavity in aedeagus body; anchored to basal membrane by two antero-laterally directed horns (Fig. 715); broadened laterally just beyond base, then tapered gradually distad.

Female genitalia. (Specimen from French Creek, Fawcett, Alberta). Basal half of segment VIII sclerotized (Fig. 718), with distal half of ventral area deeply, smoothly, grooved; basal half occupied by posteriorly tapered wedge of membrane (Fig. 719); in lateral aspect, retractor rod of segment VIII fused to segment body in deeply cleft mid-line of lateral wall; posterior edge of segment reverse-sigmoid in outline. Spermathecal sclerite long, narrow in lateral aspect, arched dorsally like slender bridge, expanded posterad (Fig. 718); in ventral aspect (Fig. 720) with wide anterior two-thirds pinched in at either end; posterior third divided to two parts – an anterior, annular portion pierced by large hole; a flared, smoothly rounded posterior lobe.

Notes on biology. – Specimens of this species were taken in the vicinity of smaller, relatively fast, smoothly flowing creeks and streams, in both the plains, foothills, and the larger valley bottoms in the mountain areas. The flight period extends from May 8 to July 30, with a possible peak in July.

Geographical distribution. – This species is recorded from Europe and in North America, from Illinois to British Columbia (Fig. 781). In Alberta it is known from the Plains, and from the lower valleys of the mountains and foothills. In altitude it ranges from about 1800' to about 4500'.

I have examined 20 specimens, 5 males and 15 females, from the study area.

Glossosoma verdona Ross, 1938
(Fig. 674a-c, 723-734, 781)

Glossosoma verdona Ross, 1938b: 110-111; Fig. 15. (Type locality: Green River, north of Pinetree, Wyoming). Knowlton and Harmston, 1939: 285. Ross, 1944: 292. Fischer, 1960: 24.

Glossosoma (Eomystra) verdona; Ross, 1956: 137, 155; Fig. 317a; chart 31. Fischer, 1971: 24.

Males of this species are distinguished from those of other species of the subgenus by irregular spatulate clasper in meso-lateral aspect (Fig. 723); by short, curved, daggerlike meso-dorsal process of each half of segment X (Fig. 723, 724); by stout, short, gently curved dorsal processes of aedeagus with semi-circular distal head minutely toothed; by main body of each half of segment X terminated by large, acuminate, curved tooth. Females may be distinguished by deep v-shaped notch along mid-line of ventral surface, from posterior edge of sclerotized portion of segment VIII anterad (Fig. 731); by large, roughly triangular paler area of anterior portion of ventral surface of same part; and by deep, thumblike gash from antero-lateral edge posterad, within which segment VIII retractor rod is attached (Fig. 730).

Description. — Antennae reddish-brown, joints pale; about two-thirds body length; basal flagellar annulus twice length of second annulus. Vertex of head and frons dark chocolate-brown except creamy-white warts; median and frontal sutures black. Tibiae of middle legs with two very short, hyaline, spurlike setae on opposite side to apical spurs. Meso-apical spur of male hind leg spatulate, with tip turned at 90° to concave face (Fig. 734); basal segment of tarsus with setae disposed as in Fig. 734. Female middle leg with tibia and tarsal segments considerably laterally compressed; mesal faces concave. Female spurs shorter than male; middle tibia with two short, hyaline, spurlike setae opposite apical spurs. Male fore wing length 7.0 mm; translucent pale chocolate-brown; veins darker; stigma distinct. Hind wings hyaline except veins darker; vein 1A with fringe of long, silken hairs along basal third; similar hairs along posterior edges of wings as a whole, and anal lobes. Venation of male and female wings as in Fig. 674a-b, and Fig. 674c respectively. General body colour reddish chocolate-brown. Male sternites VI and VII with ventral processes as in Fig. 728 and 729. Female sternite VI with ventral process as in Fig. 733.

Male genitalia. (Specimen from Gold Creek, Frank, Alberta). Segment VIII unmodified; with distinct row of long setae parallel to posterior edge of tergum (Fig. 723). Segment IX in lateral aspect about one third as long as high (Fig. 723) except for sternal area; sternal area divided to posterior and anterior portions by abrupt declivity posterad, obscured dorso-laterad, clearly bordered anteriorly by row of setae merged dorsad with randomly dispersed setae. Clasper projected posterad of remainder of genitalia; massive, blunt, of uniform width in ventral aspect (Fig. 725); in meso-lateral aspect (Fig. 723), with narrow basal stem fairly abruptly expanded to mesally concave distal head fringed with strong setae; clasper bases, in ventral aspect, separated by area of clear integument (Fig. 725). Segment X large, of two distinct lateral halves (Fig. 724); each half bifid, with massive latero-ventral portion setose, acuminate distally; dorso-mesal portion half length of latero-ventral, evenly tapered, distally acuminate, scythelike. Aedeagus small, with membranous tip; fairly evenly tapered to narrow, rounded tip (Fig. 726); with dark, smoothly curved internal cavities and tubes of ejaculatory duct; dorsal groove and membranous tip visible in dorsal aspect (Fig. 727). Paired dorsal processes of aedeagus each comprised of short, almost square bases joined antero-ventrally (Fig. 725), with rounded, minutely dentate distal lobes at ventral corner; lobes with opposable mesal faces; basad of dorsal processes a concave sclerite which unites aedeagal structures to clasper bases.

Female genitalia. (Specimen from Gold Creek, Frank, Alberta). Basal two-thirds segment VIII sclerotized (Fig. 730, 731); postero-dorsal edge slightly bulged in lateral aspect; posterior,

and antero-ventral edges paler than remainder; retractor rod fused to antero-lateral edge within lateral, rounded, incision; ventral edge of segment sinuate; in ventral aspect posterior edge with v-notch extended anterad to meet paler antero-ventral area (Fig. 731). Spermathecal sclerite long, narrow in any aspect, complex (Fig. 730, 732); with distinct, winged posterior end keeled ventro-mesally, with lateral concave areas sharply demarcated (Fig. 732); wings with acuminate antero-lateral processes; anterad of head a large aperture; ventral surface of sclerite with heavy keel, anterad of which another aperture leads to internal reproductive organs. Anterior end of sclerite tapered to vanish in membranous envelope.

Notes on biology. — Specimens of this species were generally taken from near the smaller, swift streams of the foothills and lower valleys of the mountains, though a few records are derived from the smaller rivers. The flight period extends from May 7 to July 29, with no apparent peak. I have observed pupae of this species emerging on May 21 from Whitehorse Creek, Cadomin, Alberta, and eventually taking wing as adults. The pupae crawled from the water onto rocks, or ice, at the edge of the shallow, swift, boulder-strewn creek. Twenty-seven males, and 41 females were taken on that occasion, in random selection of specimens.

Geographical distribution. — This species is known from Utah, Wyoming, British Columbia, and Alberta (Fig. 781). In Alberta it is known only from the Swan Hills, the foothills, or the lower valleys of the mountains. In altitude it ranges from about 2500' to about 5000'.

I have examined 90 specimens, 35, males, and 55 females, from the study area.

The Tribe Anagapetini Ross

This is a very small group, of one genus and five species. All are restricted to western North America, and only one is presently known from the study area.

Synopsis of characters. — (From Ross, 1956). Mesepisternum divided by short, transverse suture. Male genitalia without cerci; with large, postero-ventrally curved claspers, wider, and deeply cleft distally (Fig. 735); segment X simple (Fig. 735, 736).

The Genus *Anagapetus* Ross

The above synopsis for the tribe will suffice for the genus, the only one of the tribe, and of which only one species is here described.

Anagapetus debilis Ross, 1938
(Fig. 675a-d, 735-743, 782)

Agapetus (Anagapetus) debilis Ross, 1938b: 108-109. (Type locality: Logan Canyon, Utah).
Fischer, 1960: 63.

Agapetus debilis: Knowlton and Harmston, 1939: 285.

Anagapetus debilis; Ross, 1944: 292. Denning, 1948: 113; pl. 4, Fig. 20-20b. Ross, 1951a: Fig. 1. Ross, 1951b: 143-144. Ross, 1956: 129-130, 152; Fig. 295a, 296a, 297; chart 28. Denning, 1965: 270. Fischer, 1971: 55.

Males of this species are distinguished by massive, very long, distally widened, bifurcate claspers (Fig. 735). Females are distinguished by simple sclerotized portion of segment VIII, and by large, dark, angular sclerite of segment IX, the angle of which is adjacent to distal extremity of retractor rod (Fig. 739).

Description. — Antennae about two-thirds body length; reddish-brown; with first flagellar annulus one and a half times length of second. Vertex and frons of head dark brown to chocolate; warts and sutures from lateral ocelli to posterior cranial margin, also between post-ocellar

warts, pale (except in female). Fore leg spurs short, lateral shorter, paler, than mesal; apical spurs of middle and hind legs each with short, hyaline pseudospurs opposite. Male fore wing length 4.0 mm; very pale greyish-brown, almost hyaline; female darker, reddish-brown; stigma very indistinct. Hind wings greyish-brown except hyaline anal area; stigma evident, indistinct. Venation of male and female as in Fig. 675a-b, and Fig. 675c-d, respectively. General body colour dark brown to chocolate, legs paler. Only female with process on sternite VI posterior margin (Fig. 743).

Male genitalia. (Specimen from Lineham Creek, Forestry Trunk Road, north of Highwood Jct, Alberta). Segment VIII unmodified. Segment IX roughly rectangular in lateral aspect (Fig. 735); with postero-dorsally arched ventral surface projected posterad as short ledge; with very short, black demarcation line between tergal and sternal areas. Clasper very large, projected postero-ventrally in short-radius curve (Fig. 735); of greater overall width distally than basally; deeply cleft distally, with acuminate ventral lobe; dorsal lobe fingerlike, rounded, with series of stout setae which increase to great length at distal extremity; each clasper with strap attachment to aedeagal base (Fig. 737); concave on mesal face, complexly folded in dorsal aspect (Fig. 736). Segment X a single, rooflike (Fig. 735), postero-mesally cleft sclerite projected posterad from slightly within segment IX; with dorso-median strip paler (Fig. 736). Aedeagus short, stout, with sinuous, tapered dorsal body with ejaculatory duct connected to internal system of two sclerites of membranous aedeagal body (Fig. 737, 738); with sclerotized plate at antero-ventral portion of membranous body, above which is a laterally triangular plate attached to straps from clasper bases.

Female genitalia. (Specimen from Lineham Creek, Forestry Trunk Road, north of Highwood Jct., Alberta). Segment VIII with very simple sclerotized proximal portion which considerably overlaps remaining membranous portion (Fig. 739); weakly sclerotized; with deep v-cleft at postero-ventral edge (Fig. 740); retractor rod weakly attached at antero-lateral edge. Segment IX with retractor rod terminated proximal to, but not attached to, massive L-shaped sclerite (Fig. 739). Spermathecal sclerite in lateral aspect (Fig. 741) long, sinuate, with narrow neck between larger, complex, anterior and posterior portions; posterior portion with complex keel (Fig. 741, 742); anterior portion divided, in ventral aspect, to two concavities (Fig. 742), with v-cleft on anterior edge and lateral concavities on dorsal surface.

Notes on biology. — Specimens of this species were taken adjacent to smaller, pebble-bottomed, rippling foothills streams. The flight period is recorded as July 15 to August 2. Records are insufficient to suggest a peak.

Geographical distribution. — The known range of this species extends from Utah and Colorado to Alberta, British Columbia, and Oregon (Fig. 782). In Alberta it is known only from the foothills of the far southwest of the Province, at altitudes of around 4500' to 5000'.

I have examined a total of 18 specimens, 10 males and 8 females, from the study area.

Unidentifiable species of Glossosomatinae

One species is dealt with here, to which no certain identification can be applied, except that it belongs to the subfamily Glossosomatinae. The venation is identical to that of *Glossosoma* (*Ripaeglossa*) sp. 1, and this species could belong in that subgenus. The male is unknown or, at best, unassociated.

Glossosomatinae species 1

(Fig. 744-748, 782)

Description. — Antennae pale yellowish-brown; pedicel darker; first flagellar annulus twice

length of second. Vertex and frons of head dark reddish-brown, except warts and suture from each lateral ocellus to cranial posterior margin. Spurs as in *Glossosoma* species 1. Fore wing length of female 4.8 mm; translucent straw colour, veins darker; no evident pattern; stigma present. Hind wing hyaline; fringes of long hair on anal edge, anal lobe, and vein 2A. Venation of female as in Fig. 672c-d. General body colour brown to reddish-brown, legs paler, to straw; tibiae and tarsal segments of middle and hind legs considerably laterally compressed, concave on mesal faces. Sternum IV posterior margin with process as in Fig. 748.

Male genitalia. (Unknown).

Female genitalia. (Specimen from Sheep River, Black Diamond, Alberta). Segment VIII with basal sclerotized portion simple, gently tapered posterad in lateral aspect (Fig. 744), pinched in at mid-point of length in dorsal aspect (Fig. 745); sternal area completely divided meso-longitudinally; postero-dorsal edge symmetrically sinuate; entire posterior edge, except ventrally, projected posterad of junction with membranous portion of segment, as lateral wings; retractor rods attached ventro-laterally to anterior edge of segment. Spermathecal sclerite massive, with simple sclerotized main body with dorsal groove on distal two-thirds (Fig. 746); encased in hyaline membrane; with smaller ventral sclerite concave ventro-mesally (Fig. 747) to produce two lateral wings; tapered to acuminate, bladelike, posterior shelf; free of main body of spermathecal sclerite.

Notes on biology. — Specimens of this species were taken adjacent to larger, boulder-bottomed, relatively smoothly flowing rivers along the eastern margin of the foothills. The only flight dates known are July 15, and July 29.

Geographical distribution. — The known range of this species is confined to the eastern margin of the Rocky Mountain foothills in far southwestern Alberta, where they meet the Great Plains (Fig. 782).

I have examined 5 females of this species from the study area.

The Subfamily Protoptilinae Ross

Of this subfamily a single species of one genus is presently known from the study area.

Synopsis of characters. — (From Ross, 1956). Apical spurs of fore tibia hairlike or absent. Male cerci absent. Veins M3+4 and Cu1b missing from fore wing (Fig. 676a). Trailing edges of wings with very long hair fringes; hind wings very acuminate, with distal half of leading edge retracted posterad (Fig. 676b). Chord of fore wing a single line, or with slight zigzag (Fig. 676a); fore wing with pale hair area coincident with chord.

The Genus *Protoptila* Banks

Synopsis of characters. — (From Betten, Kjellgren, Orcutt, and Davis, 1934). Spur formula 2, 4, 4, or 0, 4, 4. Last article of maxillary palp simple, unarticulated. Three ocelli. Antennae shorter than body, slender. Middle and hind tibiae heavily fringed posteriorly.

Protoptila tenebrosa (Walker), 1852
(Fig. 676a-b, 749-758, 782)

Hydroptila tenebrosa Walker, 1852: 134. (Type locality: St. Martin's Falls, Albany River, Hudson's Bay). Hagen, 1861: 274. McLachlan, 1863: 158, 162, Hagen, 1864: 825. Ulmer, 1905: 73. Ulmer, 1907: 223.

Hydroptila tenebrosa partim = *Agapetus* sp.; McLachlan, 1863: 158, 163.
Agapetus tenebrosa; Hagen, 1864: 802.

Agapetus tenebrosus; Banks, 1892: 365. Ulmer, 1905: 72. Banks, 1907: 41. Ulmer, 1907: 214. Betten, Kjellgren, Orcutt, and Davis, 1934: 142.

Protoptila tenebrosa; Mosely, 1934: 149-151. Milne, 1936: 74, 77. Betten and Mosely, 1940: 8-10; Fig. 4a-f. Ross, 1941: 49. Ross, 1944: 42, 43, 292; Fig. 147c, 154a. Leonard and Leonard, 1949: 4-5; Fig. 1. Fischer, 1960: 65-66. Etnier, 1965: 144. Fischer, 1971: 59.

Males of this species are distinguished by genital capsule deeply recessed into segment VIII (Fig. 749); by sternum VIII posterior edge produced posterad as shelf projected beyond any part of genital capsule; by posterior edge of segment IX sternal area projected posterad as tapered shelf regardless of aspect (Fig. 749, 751); and by slender, hooked, dorsal lobes of aedeagus (Fig. 752). Females are distinguished by lack of sclerotized sternite VIII (Fig. 755, 756); by massive tergal area of segment VIII; and by large, blunt, noselike segment IX in lateral aspect.

Description. — Antennae two-thirds body length, dark brown; basal 4-5 flagellar annuli densely hairy. Vertex and frons of head chocolate-brown, except median suture of vertex black, warts white. Maxillary palpus as in Fig. 758; basal segment produced bulbously disto-laterad. Male fore wing length 2.52 mm; membrane hyaline, with long, dense, pale greyish-brown hairs; band of white hairs coincident with chord, from leading to trailing edges of wing. Male venation as in Fig. 676a-b. Female identical. Male general body colour grey-brown to black in parts, legs paler; female generally paler. Male sternite VI posterior edge with process as in Fig. 754; female as in Fig. 757.

Male genitalia. (Specimen from Little Smokey River, four miles north of Valleyview, Alberta). Segment VIII tergite simple; posterior edge of sternite produced posterad of remainder of genitalia, as broad, distally slightly bilobed, shelf (Fig. 749, 751). Segment IX deeply recessed into segment VIII; antero-lateral edges curved anterad (Fig. 749, 751); dorsal strap relatively wide in lateral aspect; postero-ventral edge of segment produced posterad as lanceolate, ventrally keeled, shelf (Fig. 751). Claspers not evident. Segment X with rooflike, slightly tapered (in dorsal aspect) dorsal body (Fig. 750); a pair of lamellate sclerites, roughly rectangular (in lateral aspect) originated from ventro-lateral edges of segment, with disto-ventral spine directed anterad, and disto-dorsal tooth directed ventrad. Aedeagus sclerotized throughout, beyond membranous base (Fig. 752, 753); with complex base of high, lamellate, dorsal fin divided ventrally to encompass aedeagal base, with each lateral leg tapered ventrad almost to vanishing; entire unit gently bowed. Aedeagus also with concave, distally directed, scooplike structure on ventral surface. Main aedeagal body slender, tapered distad to expanded, postero-ventrally directed, tip divided to two pairs of lobes; concave dorsal surface. Lateral arms originated close to aedeagal base, directed dorsad, then bent at right angles posterad; base membranous, terminated distally by sinuate, distally hooked spine.

Female genitalia. (Specimen from Steen River, McKenzie Highway, Alberta). Telescoped, fused to single unit (Fig. 755). Segment VIII massive (Fig. 755), tapered, curved ventrad, with single row of short, hooked, irregular setae along postero-dorsal edge. Segment IX (?) large, slightly cleft mesally (Fig. 756), rather nose- or beaklike in lateral aspect; directed postero-ventrad; held rooflike over genital aperture. Subgenital plate large, mostly embedded in membrane ventrad of segment VIII; with massive, slightly tapered, meso-ventral lobe, and semi-triangular sclerite directed anterad with thornlike wings on either side (Fig. 756).

Notes on biology. — Specimens of this species were taken adjacent to medium sized rivers of the fairly slow, smooth flowing, mud or sand bottomed type. The flight period, as presently known, extends from June 18 to July 1, too short a period to detect any peak, especially from only 4 capture dates.

Geographical distribution. — The known range of this species extends from Michigan and Ontario to Arkansas, Idaho, and Alberta (Fig. 782). In Alberta it is known from those parts

of the Great Plains portion of the Province which are, or were in the past, occupied by coniferous forest. In altitude it has been found between 1700' and 3200'.

I have examined a total of 26 specimens, 24 males and 2 females, from the study area.

The Family Philopotamidae Stephens

This family is represented in the study area by three species belonging to two genera. The species are presented in Table 1, according to the order used by Ross (1956), which is the order used in this study.

Character synopsis of the Philopotamidae. — (Derived from Betten, Kjellgren, Orcutt, and Davis (1934), Mosely (1939), and Ross (1944)). Ocelli three. Antennae stout, annuli short, no modification. Maxillary palpi each of five articles in both sexes; pedicel short; terminal article long, two or three times longer than subterminal article, flexible, multi-annulated almost as in, for example, Hydropsychidae; intermediate articles variable between genera; cylindrical. Spur formula 2, 4, 4 (1, 4, 4 in *Chimarra*) in both sexes. Wings elongate, roughly parabolic; hind wings shorter than fore wings. Venation generally complete (Fig. 677-679); similar, though not necessarily precisely identical in both sexes; both wings with discoidal cell; only fore wing with median cell; subradial cell present throughout; thyridial cell present or absent. Fore wings with apical cells f1-f5 present; f1 and f4 missing in some species; f4 of hind wing generally missing.

Key to the Genera and species of Philopotamidae in Alberta and eastern British Columbia.

- 1a. Hind wing vein 2A atrophied beyond crossvein a2 (Fig. 679b) *Wormaldia gabriella* Banks, p. 333
- 1b. Hind wing vein 2A extended beyond crossvein a2 (Fig. 677b, 678b) (*Dolophilodes*) 2
- 2a. (1b) Male segment IX narrowed ventrad by large recesses in postero-ventral edges which house clasper bases (Fig. 759); no stout spines on mesal face of clasper basal segment *D. aequalis* (Banks), p. 331
- 2b. Male segment IX curved anterad, of uniform width throughout (Fig. 767); row of stout spines along ventral edge of mesal face of clasper basal segment *D. novusamericanus* (Ling), p. 332

The Genus *Dolophilodes* Navás

This genus is represented in this study by two species of the subgenus *Sortosa*, neither of which is here recorded from Alberta itself, and some records are from slightly further west than the western boundary of the study area as delimited in Nimmo (1971a).

Synopsis of characters. — (From Ross, 1956). Front and hind wings with vein M three- or four-branched. Front wing vein M4 present, or hind wing with vein 2A free part produced to wing margin. Basal fork of M basad of forks of Rs and Cu1. Male genitalia clasper segments not fused; distal segment of claspers undivided; segment X recessed in postero-dorsal edge of segment IX, which is very narrow dorsally in consequence. Female segment VIII otherwise than a nearly cylindrical ring.

The Subgenus *Sortosa* Ulmer

Synopsis of characters. — (From Ross, 1956). Venation complete except R2+3 of hind wing unbranched in some species. Male genitalia with simple two-segmented claspers; tergite X

variously cleft, shallowly in most species; aedeagus large, mostly a membranous sac, with long, thin, internal, sclerotized rod; cerci large.

Dolophilodes aequalis (Banks), 1924
(Fig. 677a-d, 759-766, 783)

Philopotamus aequalis Banks, 1924: 450; pl. 4, Fig. 48. (Type locality: Tolland, Colorado).

Dodds and Hisaw, 1925: 386. Betten, Kjellgren, Orcutt, and Davis, 1934: 168. Milne, 1936: 82, 83. Ross, 1938a: 8. Knowlton and Harmston, 1939: 286. Fischer, 1961: 6.

Trentonius aequalis; Ross, 1944: 292.

Dolophilodes aequalis; Ross, 1949: 159. Denning, 1949: 115; Fig. 5. Ross and Spencer, 1952: 46. Denning, 1956b: 248; Fig. 10: 15f.

Sortosa (Dolophilodes) aequalis; Ross, 1956: 34, 59, 178; Fig. 58a; chart 7. Fischer, 1971: 171-172.

Males of this species are distinguished by segment IX in lateral aspect tapered ventrad, sinuate, with posterior ventro-lateral edges recessed for reception of clasper bases (Fig. 759, 761); by claspers of almost uniform width except distal segment tapered slightly to rounded tip; by lack of setae other than fine hairs on mesal faces of claspers; and by segment X and cerci projected posterad of segment IX at same level. Females are distinguished by large, unmodified tergum of segment VIII in lateral aspect (Fig. 764); and by lightly sclerotized rugose area postero-ventrad of segment VIII.

Description. — Antennae dark reddish-brown. Vertex and frons of head deep chocolate-brown, warts slightly paler; gena and dorsal edge developed as carinate ridge laterad of vertex, roughly parallel to median epi-cranial suture. Spur formula 2, 4, 4. Tibiae of middle legs with pair of small, hyaline pseudospurs opposite apical spurs. Fore wing length of male 8.2 mm; reddish-brown, veins much darker. Hind wings translucent pale brown. Fore and hind wings each with distinct stigma. Venation of male and female as in Fig. 677a-b, and 677c-d, respectively. General body colour deep reddish-brown to chocolate. Tibiae of hind legs cream-coloured. Tibiae of middle legs and femora of hind legs piebald cream and brown.

Male genitalia. (Specimen from creek on Highway 5, at Little Fort, British Columbia). Segment VIII unmodified. Segment IX tapered ventrad, curved (Fig. 759), with posterior ventro-lateral edges recessed to receive clasper bases; dorsal strap apparently absent, sides of segment IX, separated dorsally by body of segment X, projected slightly dorsad of lateral edges of segment X (Fig. 759, 760). Claspers massive (Fig. 759, 761), long, directed postero-dorsad, two segmented, with each segment of uniform width in lateral aspect; distal segment with smoothly rounded tip, slightly bulbous. Segment X simple, horizontal plate, with postero-median lobe deeply cleft to form two distally opposed, upright plates projected posterad (Fig. 759, 760); two solid, clavate lobes located laterad of longer median lobe. Aedeagus simple, membranous (Fig. 762), with ventral protrusion partially encircled by sclerotized strap; ventro-basal surface minutely denticulate (Fig. 762).

Female genitalia. (Specimen from creek on Highway 5, at Little Fort, British Columbia). Segment VIII with simple, four-sided tergum, each side slightly bowed centrad (Fig. 764, 766); sternum of two lateral sclerites, roughly triangular in lateral aspect, tapered meso-ventrad, not quite in contact ventrally (Fig. 765); postero-ventral edge of each sclerite with row of long setae; retractor rods attached at antero-dorsal angle of each sternal sclerite; ventro-posterad of sternal sclerites, a large, membranous lobe with minutely denticulate ventro-lateral surfaces (Fig. 764, 765). Segment IX small relative to VIII (Fig. 764), distally shallowly cleft (Fig. 765), held rooflike over anus; with minute pair of papillate cerci between two lateral lobes; segment largely membranous, except for two small, triangular sclerites antero-dorsally, each with long,

sinuous process at antero-lateral angle, directed ventrad to form attachment for retractor rod.

Notes on biology. — Specimens of this species were taken adjacent to smaller mountain streams, usually of the more turbulent sort. The known flight period extends from May 18 to May 21, too short a period to detect a peak.

Geographical distribution. — The known range of this species extends from California and Colorado to southern British Columbia (Fig. 783). In the study area it is known only from southeastern British Columbia, usually from hill streams, though I have one record from a small, gentle stream in the bottom of the Kootenay Valley. In altitude it ranges from about 1600' to about 3000'.

I have examined a total of 43 specimens, 31 males and 12 females, from the study area.

Dolophilodes novusamericanus (Ling), 1938
(Fig. 678a-b, 767-769, 783)

Philopotamus novusamericanus Ling, 1938: 63. Fischer, 1961: 25.

Trentonius novusamericanus; Ross, 1944: 292.

Dolophilodes novusamericanus; Denning, 1949: 113, 115, Fig. 3. Ross, 1949: 159, Fig. 1.

Denning, 1956b: 248, Fig. 10, 15d. Smith, 1969: 46-47.

Sortosa (Dolophilodes) novusamericanus; Ross, 1956: 59, 178, Fig. 61B, chart 7. Fischer, 1971: 175.

Males of this species are distinguished by segment IX in lateral aspect curved, of more or less uniform width from top to bottom, with no latero-ventral recesses of posterior edges specifically for reception of clasper bases (Fig. 767); by claspers of variable width, with distal segment smaller, fingerlike, distally rounded; by row of heavy setae of various lengths along ventral edge of concave area of mesal face of basal segment of clasper; and by segment X directed postero-ventrad at about 40° to horizontal cerci.

Description. — Antennae two-thirds body length; chocolate-brown. Cranium generally dark chocolate-brown; warts very slightly paler. Male fore wing length 6.6 mm; orange-brown, faintly irrorate; hind wing pale brown; stigma in both wings distinct. Venation of male as in Fig. 678a-b. General body colour dark brown to chocolate; legs paler; tibiae of hind legs straw coloured.

Male genitalia. (Specimen from creek joining Summit Creek, 10 miles west of Creston on Highway 3, British Columbia). Segment VIII unmodified. Segment IX in lateral aspect parallel-sided (Fig. 767), bowed anterad at point one-third height from ventral surface; ventral surface of same width as segment body; dorsal strap apparently narrow, difficult to distinguish from segment X with which it is apparently fused (Fig. 768). Claspers very long, tapered distad, two-segmented (Fig. 767); distal segment half length of basal, slightly curved, concave on mesal face (Fig. 769); basal segment with distal two-thirds of mesal face concave, with prominent ventral ledge fringed with stout setae of various lengths. Segment X with rooflike median lobe sharply cleft disto-medially for about quarter of length (Fig. 768); curved postero-ventrad, with paler sclerotized median area; segment with two thumblike lateral lobes of the appearance of cerci, equal in length to median lobe. Aedeagus missing in the single specimen available to me; possibly lost during treatment.

Female genitalia. Not known.

Notes on biology. — The single specimen known to me was taken beside a swift, turbulent, quite steeply graded mountain stream. Date of capture was May 18.

Geographical distribution. — This species is known from California and Utah to British Columbia (Fig. 783). In the study area it is known from a single locality in southeastern British Columbia, at about 4500' altitude.

I have examined a single male of this species from the study area. O. S. Flint, Jr. reports a male in the collections of the United States National Museum, from Kaslo, British Columbia (pers. comm.).

The Genus *Wormaldia* McLachlan

This genus is represented in the study area by a single species.

Synopsis of characters. – (From Ross, 1956). Venation complete except hind wing vein 2A atrophied beyond basal crossvein; veins 1A and 3A of hind wing divergent, with basal anal crossvein as linear bar. Spur formula 2, 4, 4. Male cerci elongate, or large, rhombic; in some species fused to pleural region of segment IX.

The genus is divided by Ross (1956) to two subgenera – *Wormaldia* and *Doloclanes*, of which only *Wormaldia* is known from the study area. It is characterized by hind wing veins R1 and R3 separate to wing margin.

Wormaldia gabriella (Banks), 1930 (Fig. 679a-c, 770-779, 783)

Dolophiliella gabriella Banks, 1930: 230-231; pl. 12, Fig. 14. (Type locality: San Gabriel Mountains, California). Betten, Kjellgren, Orcutt, and Davis, 1934: 170. Fischer, 1961: 45. *Dolophilus gabriella*; Milne, 1936: 82, 83. Ross, 1938a: 7-8. Knowlton and Harmston, 1939: 285. Simmons, Barnes, Fisher, and Kaloostian, 1942: 78. Ross, 1944: 292. *Wormaldia gabriella*; Ross, 1949: 156, 157. Schmid and Guppy, 1952: 41. Ross and Spencer, 1952: 46. Denning, 1956a: 79. Denning, 1956b: 248; Fig. 10: 16c. Anderson and Wold, 1972: 192, 195, 196, 200. *Wormaldia (Wormaldia) gabriella*; Ross, 1956: 42, 61, 65, 182; Fig. 84; chart 11, 38. Fischer, 1971: 190.

Males of this species are distinguished by distal segment of clasper curved slightly dorsad (Fig. 770), with mesal face of tip heavily armed with short, stout setae; by median lobe of segment X with tip hooked distinctly dorsad; and by completely membranous mesal face of basal clasper segment. Females are distinguished by segment VII tergite and sternite distinct, each with anterior edges heavily sclerotized, black (Fig. 777); by distal attachment of segment VIII retractor rods large, triangular; and by segment IX deeply recessed into segment VIII, deeply cleft in meso-horizontal plane.

Description. – Antennae two-thirds body length; basal two-thirds of each annulus dark brown, remainder straw coloured. Cranium generally deep orange-brown, densely clothed with silken hairs on warts. Male fore wing length 5.5 mm; light golden-brown (female more chocolate-brown), hairy; hind wings translucent brown; veins darker. Venation of male and female as in Fig. 679a-b, and 679c, respectively. Spurs hairy; fore leg spurs shorter than others. General body colour pale brown, legs little paler; male sternites VII and VIII with processes as in Fig. 775, 776. Generally a hairy insect.

Male genitalia. (Specimen from Blindman River at Highway 2, Alberta). Segment VIII unmodified except for ventral lobe as mentioned above (Fig. 775, 776). Segment IX simple, with irregular anterior and posterior edges (Fig. 770); sides wider at bottom than top; dorsal strap not evident (Fig. 771); ventral surface constricted along median (Fig. 772). Claspers long, massive, two-segmented; basal segment in lateral aspect swollen at mid-point; mesal face quite membranous; distal segment constricted at mid-point; with spinate disto-mesal face. Segment X irregular pentagonal plaque in dorsal aspect (Fig. 771), with rooflike, disto-dorsally hooked median lobe; with swordlike lateral lobes, or cerci, concave on mesal faces, of length equal to

median lobe. Aedeagus small, tapered distad (Fig. 773, 774), with thick-bladed ventro-basal lobe (Fig. 773); with lightly sclerotized dorso-basal trough surmounted by basal membranous lobe (Fig. 773); random sclerotized fragments in aedeagal body are apparently artifacts, not constant.

Female genitalia. (Specimen from Blindman River at Highway 2, Alberta). Segment VII with sclerotized tergum and sternum separate, each with black anterior edges (Fig. 777); sternum with slight ventro-lateral keel on each side. Segment VIII with flat-topped tergite laterally declivous to membrane between tergum and sternum (Fig. 777); retractor rods slightly widened anterad, attached internally to sternite at large, triangular distal end; sternite with single row of stout setae on postero-lateral edges; tergite with several strong setae. Segments IX and X apparently fused, with horizontal cleft from distal end to produce bilobed dorsal body, and ventral body; lobes of dorsal body each with two-segmented, papillate cercus; retractor rods attached along anterior edge. Spermathecal sclerite a minute sclerotized ring incomplete ventrally (Fig. 779); gradually, then abruptly tapered ventrad in lateral aspect (Fig. 778).

Notes on biology. — Specimens of this species were generally taken adjacent to a variety of stream types, from quite small streams, to larger rivers, ranging from slow to swiftly flowing, but not turbulent or rocky, except possibly at times of high water. I have one record of a specimen taken beside a road which ran across an area of beaver impoundments with extensive areas of sedge, and standing water. The flight period extends from July 20 to October 4, with no apparent peak.

Geographical distribution. — The known range of this species extends from Alberta to California, Utah, and Nevada (Fig. 783). In Alberta it is known from the lower mountain valleys, and the Great Plains, ranging in altitude from about 3000' to 4000'.

I have examined a total of 108 specimens, 64 males and 44 females, from the study area.

POST-GLACIAL ORIGINS, AND AFFINITIES OF THE FAUNA

Results derived from the preceding faunal survey.

Under this heading I present subsidiary results and comments derived from the study, which do not necessarily relate directly to the post-glacial origins of the fauna, but which are of interest in themselves. Such discussion as there is, is presented under each heading.

Pre-Wisconsin affinities of the Glossosomatidae and Philopotamidae of the study area. — While all but one (*Glossosoma intermedium*) of the twelve species recorded here are nearctic in distribution, and presumably in origin, the ancestry of the species groups, subgenera, or genera to which they belong, is not necessarily nearctic. Only the lowest recognized supra-specific groupings are used here. Table 2 presents the data, and the conclusions as to ancestral origin for each group considered; the table and following text are compiled from Ross (1956), the two unidentifiable species of Glossosomatidae being omitted.

The Glossosomatidae. — Only two of the Alberta species are transcontinental, one of which is also holarctic, in distribution. The remainder is confined to the western Cordillera.

The genus *Glossosoma*, subgenus *Ripaeglossa*. Of the five species of the *parvulum* group one, *velona* (Fig. 780), is known from the study area. Of the remainder, *parvulum* is known from New Mexico to Idaho, *idaho* is known from Montana and Idaho, *montana* is known from Utah and Washington, and *ventrale* is known from Arizona to Wyoming.

Of the eight species of the *alascense* group two, *alascense* and *pterna* (?), (Fig. 780) are known from the study area. Of the remainder, *califica* is known from California and Oregon, *wenatchee* from British Columbia, Washington, and Oregon, and *pyroxum* from Arizona and Washington.

The subgenus *Eomystra*. Of the eight species of this subgenus two, *intermedium* and *verdonia* (Fig. 781), are known from the area. Of the remainder five (*altaicum*, *dulkeji*, *hospitum*,

ussuricum, and *inops*) are known from various parts of eastern Asia. The eighth, *lividum*, is known from eastern North America.

Table 2. Geographical distribution of the higher taxa of the Alberta fauna of Glossosomatidae and Philopotamidae and their probable source areas.

Name of Taxon	Number of species					Total	Probable Source area
	Holarctic	Palaeartic	Nearctic				
			West	Transcon- tinenta	East		
Family Glossosomatidae							
Genus <i>Glossosoma</i>							
Subgenus <i>Ripaeglossa</i>							
Group <i>parvulum</i>			5			5	Eastern Cordillera
<i>alascense</i>			5			5	Coastal Cordillera
Subgenus <i>Eomystra</i>	1	5	1		1	8	Asia
Genus <i>Anagapetus</i>			5			5	Coastal Cordillera
Genus <i>Protoptila</i>			(?)	1	(?)	(?)	Central/South America
Family Philopotamidae							
Genus <i>Dolophilodes</i>							
Subgenus <i>Sortosa</i>							
Group <i>aequalis</i>		* 1+	2			3+	Asia
<i>novusamericanus</i>			1			1	Cordillera
Genus <i>Wormaldia</i>							
Subgenus <i>Wormaldia</i>							
Group <i>moesta</i>		2	1		1	4	?

* The (+) refers to some undescribed Burmese species (Ross, 1956), and other species described since 1956, from Asia, as in Schmid (1960).

(?) Ross (1956) barely mentions this genus, but says that it is entirely American in origin. There is a rich fauna in the Americas generally, especially Central America, and in South America also.

The genus *Anagapetus*. Of the five species in this genus one, *debilis* (Fig. 782), is known from the area. Of the remainder *bernea* is known from Oregon and Washington, *chandleri* and *aisha* from California, and *hoodi* from Washington.

The genus *Protoptila*. Only one species, *tenebrosa* (which is transcontinental), occurs in the study area. The many other species are mostly found south of Canada, in the United States and especially Central and South America.

The Philopotamidae. – The Alberta species are confined to the Cordillera.

The genus *Dolophilodes*, subgenus *Sortosa*. Of the three or more species of the *aequalis* group only one, *aequalis* (Fig. 783), is known from the area. Apart from a number of Burmese and Himalayan species one, *ornata*, is known from east Asia, and the other, *pallidipes*, is known from western North America.

The single species of the *novusamericanus* group is confined to the Cordillera.

The genus *Wormaldia*, subgenus *Wormaldia*. Of the four species of the *moesta* group, only one, *gabriella*, is recorded from the area. One, *moesta*, is found in eastern North America, and the remaining two are Asian.

The origins of the immediately supraspecific groupings of the Alberta species of Glossosomatidae would appear to be very largely North American, primarily Cordilleran, with one group being Asian in ancestry.

The Philopotamidae known from the study area have one genus of doubtful geographic origin but, on the whole, the groups represented appear to be Asian in ancestry.

Altitudinal distribution of the Alberta Glossosomatidae and Philopotamidae. – Table 3 summarizes the presently known altitudinal ranges of the species in the study area. However, as most species are represented in my collections by relatively few specimens, or by very few localities, I hesitate to draw conclusions at this time.

Table 3. Altitudinal distribution of the Alberta species of Glossosomatidae and Philopotamidae based on adult records.

Species	Altitude	Range Pattern
	1,000'	
	2,000'	
	3,000'	
	4,000'	
	5,000'	
	6,000'	
<i>Dolophilodes aequalis</i>	—	3
<i>Glossosoma velona</i>	—	1
<i>Protoptila tenebrosa</i>	—	7
<i>Glossosoma intermedium</i>	—	7
<i>Glossosoma alascense</i>	—	2
<i>Glossosoma verdonia</i>	—	5
<i>Wormaldia gabriella</i>	—	3
<i>Anagapetus debilis</i>	—	5
Glossosomatinae sp. 1	—	6
<i>Dolophilodes novusamericanus</i>	—	3
<i>Glossosoma pterna</i>	—	4
<i>Glossosoma</i> sp. 1	—	6

Post-Glacial origins of the Alberta fauna of Glossosomatidae and Philopotamidae.

Introductory remarks. — An exposition and discussion of procedures and support information, and generalizations derived from my survey of the Alberta Rhyacophilidae and Limnephilidae, are given in Nimmo (1971a). The parts generally applicable to this paper are: - a synopsis of North American glacial history from mid-Wisconsin to the present (p. 197), including possible refugia and post-glacial water bodies and routes; associated climatic events (p. 199); range patterns exhibited by the species of the fauna (p. 200; Fig. 668, 669); and possible routes of post-glacial dispersal of species into the area from refugia. This list of dispersal routes is repeated here for convenience as this relates directly to a principal objective of the study. For the remainder, the reader is referred to the 1971 paper as the results presented here require no alterations.

The possible routes of post-glacial dispersal of species into the area appear to be as follows:

- a). From the entire Cordillera, south of the ice.
- b). From the coastal ranges of the Cordillera only.
- c). From the eastern ranges of the Cordillera only.
- d). From the area immediately south of, and adjacent to, the Cordilleran ice sheet.
- e). From all of North America south of the ice sheets.
- f). From the central plains of North America.
- g). From eastern North America, to the northwest.
- h). From Alaska, to the south and east.
- i). From Alaska and the southern, unglaciated, portion of North America simultaneously.

The problem now is to decide by which of these routes each species may have entered the study area.

Post-Wisconsin affinities of the Alberta Glossosomatidae and Philopotamidae. — Table 4 presents the species in order of ascending range pattern number (See Nimmo, 1971a: 200; Fig. 668, 669), with the transcontinental species, in patterns 7 demarcated.

Table 4. Species of Glossosomatidae and Philopotamidae from the study area, listed under the range pattern to which each is assigned and giving postulated dispersal routes.

Pattern number	Species	Map Fig.	Post-glacial dispersal route
1	<i>Glossosoma velona</i>	780	a
2	<i>Glossosoma alascense</i>	780	c
3	<i>Dolophilodes aequalis</i>	783	a
	<i>Dolophilodes novusamericanus</i>	783	a
	<i>Wormaldia gabriella</i>	783	a
4	<i>Glossosoma pterna</i> (?)	780	b
5	<i>Glossosoma verdona</i>	781	c
	<i>Anagapetus debilis</i>	782	c
6	<i>Glossosoma</i> sp. 1	780	d
	Glossosomatinae sp. 1	782	d
7	<i>Protophila tenebrosa</i>	782	f+g
	<i>Glossosoma intermedium</i>	781	e

The species with ranges from 1-6 present little problem as their dispersal routes to the study

area are mostly directly related to the range pattern. *Glossosoma verdona* and *G. alascense*, with range patterns 1 and 2 respectively, could perhaps belong to route *h* but, as records are so scanty from the far northwest of North America, and as these are low altitude forms in Alberta, I choose to assign them the routes given in Table 4.

Of the species of pattern 7, *Protophila tenebrosa*, which belongs to an essentially southern warm-water group anyway, poses no problem, but requires a combination of routes as it would appear to have been, during the Wisconsin, transcontinental at least as far west as the foothills of the Rockies, and to have moved northward post-glacially. The 'portion' of the species present in Alberta presumably moved north by route *f* only, but in this case I think the species should be considered as a whole.

Glossosoma intermedium I assign to route *e*, and Ross (1965: 587) would appear to support this. However, I am uneasy about this. As a member of a cold-water group, this species, which is holarctic, right through to the British Isles, should surely have at least some more northerly distribution; at least up the Cordillera to Alaska. I suspect a lack of records rather than that the species is missing entirely from the far northwest of North America.

Considering the low number of species involved, and the uncertainty attaching to one of the transcontinental species, I have doubts about the usefulness of reducing the dispersal route information of Table 4 to a percent basis. However, I present the following: from the Cordillera south and west of the study area – 84%; from Alaska – nil; from eastern North America – none certain; from transcontinental species south of the ice – 8%; and from the central plains – 8%.

In the case of the two families considered here, all the post-glacial species in the study area were apparently derived from south of the ice, mostly from the western Cordillera.

If the numbers of species using each route are added to the equivalent numbers of the species of Rhyacophilidae and Limnephilidae from my 1971 paper, and the percent values recalculated, the results for the four families combined are as follows (1971 percentages for each route in brackets):

From Cordillera south and west of study area	–	63.6% (61%)
From Alaska	–	4.8% (5%)
From eastern North America	–	8.0% (8%)
From transcontinental species south of ice	–	16.8% (18%)
From central Plains	–	6.4% (7%)

CONCLUSIONS

1. The preglacial affinities of the Glossosomatidae recorded from the study area are primarily with the western Cordillera of North America, with one species, belonging to an entire subfamily which is totally nearctic-neotropical. *Glossosoma (Eomystra)* is Asian in origin.
2. The preglacial affinities of the Philopotamidae from the study area are with Asia.
3. The post-glacial sources of the Alberta fauna of the two families are entirely from south of the Wisconsin ice and, indeed, predominantly from the western Cordillera.
4. All species considered here are flowing water types and, with the exception of *Protophila tenebrosa*, all are restricted by and large to the cooler streams of the mountains and foothills, though occasionally specimens may be taken well out in the plains in what may generally be thought of as warmer streams.

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REFERENCES

- Anderson, N. H., and J. L. Wold. 1972. Emergence trap collections from an Oregon stream. *Can. Ent.* 104: 189-201.
- Banks, N. 1892. A synopsis, catalogue, and bibliography of the neuropteroid insects of temperate North America. *Trans. Am. ent. Soc.* 19: 327-373.
- Banks, N. 1900. Papers from the Harriman Alaska expedition. Entomological results 4: Neuropteroid insects. *Proc. Wash. Acad. Sci.* 2: 465-476.
- Banks, N. 1907. Catalogue of the neuropteroid insects (except Odonata) of the United States. *Trans. Am. ent. Soc.* 33: 1-53.
- Banks, N. 1924. Descriptions of new neuropteroid insects. *Bull. Mus. comp. Zool. Harv.* 65: 419-455.
- Banks, N. 1930. New neuropteroid insects from the United States. *Psyche, Camb.* 37: 223-233.
- Betten, C., B. L. Kjellgren, A. W. Orcutt, and M. B. Davis. 1934. The caddis-flies, or Trichoptera of New York State. *Bull. N. Y. St. Mus.* 292: 1-576.
- Betten, C. and M. E. Mosely. 1940. The Francis Walker types of Trichoptera in the British Museum. *British Museum (Natural History)*, 248 pp.
- Denning, D. G. 1948. A review of the Rhyacophilidae (Trichoptera). *Can. Ent.* 80: 97-117.

- Denning, D. G. 1949. New and little known species of caddis flies. *Am. Midl. Nat.* 42: 112-122.
- Denning, D. G. 1956a. Several new species of western Trichoptera. *Pan-Pacif. Ent.* 32: 73-80.
- Denning, D. G. 1956b. Trichoptera. *In Usinger et.al.*, 'Aquatic insects of California', Univ. California Press, pp. 237-270.
- Denning, D. G. 1965. New Trichoptera from United States and Mexico. *Pan-Pacif. Ent.* 41: 262-272.
- Dodds, G. S., and F. L. Hisaw. 1925. Ecological studies on aquatic insects. IV. Altitudinal range and zonation of Mayflies, Stoneflies, and Caddisflies in the Colorado Rockies. *Ecology* 6: 380-390.
- Essig, E. O. 1926. *Insects of Western North America*. Macmillan, New York. 1035 pp.
- Etnier, D. A. 1965. An annotated list of the Trichoptera of Minnesota, with description of a new species. *Ent. News* 76: 141-152.
- Fischer, F. C. J. 1960. *Trichopterorum Catalogus: 1. Necrotauliidae, Prosepididontidae, Rhyacophilidae*. 169 pp. *Nederlandsch Entomologische Vereeniging*, Amsterdam.
- Fischer, F. C. J. 1961. *Trichopterorum Catalogus: 2. Philopotamidae, Hydroptilidae, Stenopsychidae*. 189 pp. *Nederlandsch Entomologische Vereeniging*, Amsterdam.
- Fischer, F. C. J. 1971. *Trichopterorum Catalogus: 12. Supplement to vols. 1 & 2*. 311 pp. *Nederlandsch Entomologische Vereeniging*, Amsterdam.
- Hagen, H. A. 1861. Synopsis of the Neuroptera of North America, with a list of the South American species. *Smithson. misc. Collns.* 347 pp.
- Hagen, H. A. 1864. Phryganidarum synopsis synonymica. *Verh. zool-bot. Ges. Wien.* 14: 799-890.
- Klapálek, F. 1892. *Trichopterologický Výzkum Cech. v. r. 1891*. *Ropz. České Akad. Cís. Frant. Jos., Prague* 5: 1-22.
- Knowlton, G. F., and F. C. Hamston. 1939. Notes on Utah Plecoptera and Trichoptera. *Ent. News* 49: 284-286.
- Leonard, J. W., and F. A. Leonard. 1949. An annotated list of Michigan Trichoptera. *Occ. Pap. Mus. Zool. Univ. Mich.* 522: 1-35.
- Ling, Shao-Win, 1938. A few new caddis flies in the collection of the California Academy of Sciences. *Pan-Pacif. Ent.* 14: 59-69.
- Malicky, H. 1973. *Trichoptera (Köcherfliegen)*. *Handb. Zool.* 4 (2) 2/29: 1-114. de Gruyter, Berlin.
- McLachlan, R. 1863. Notes on North American Phryganeidae, with special reference to those contained in the collection of the British Museum. *Ent. Ann.* 1863: 155-163.
- Milne, L. J. 1936. *Studies in North American Trichoptera*. 3: 56-128. Cambridge, Mass.
- Mosely, M. E. 1934. New exotic Hydroptilidae. *Trans. R. ent. Soc. Lond.* 82: 137-163.
- Nimmo, A. P. 1971a. The adult Rhyacophilidae and Limnephilidae (Trichoptera) of Alberta and eastern British Columbia and their post-glacial origin. *Quaest. ent.* 7: 3-234.
- Nimmo, A. P. 1971b. *Corrigenda*(A. Nimmo 1971, *Quaest. ent.* 7: 3-234.) *Quaest. ent.* 7: 406.
- Radford, D. S., and R. Hartland-Rowe. 1971. A preliminary investigation of bottom fauna and invertebrate drift in an unregulated and a regulated stream in Alberta. *Jnl. appl. Ecol.* 8: 883-903.
- Ross, H. H. 1938a. Lectotypes of North American caddis flies in the Museum of Comparative Zoology. *Psyche, Camb.* 45: 1-61.
- Ross, H. H. 1938b. Descriptions of nearctic caddis flies (Trichoptera) with special reference to the Illinois species. *Bull. Ill. St. nat. Hist. Surv.* 21: 101-183.
- Ross, H. H. 1941. Descriptions and records of North American Trichoptera. *Trans. Am. ent. Soc.* 67: 35-126.
- Ross, H. H. 1944. The caddis flies, or Trichoptera, of Illinois. *Bull. Ill. St. nat. Hist. Surv.*

- 23: 1-326.
- Ross, H. H. 1947. Descriptions and records of North American Trichoptera, with synoptic notes. *Trans. Am. ent. Soc.* 73: 125-168.
- Ross, H. H. 1949. A classification for the nearctic species of *Wormaldia* and *Dolophilodes*. *Proc. ent. Soc. Wash.* 51: 154-160.
- Ross, H. H. 1951a. Phylogeny and biogeography of the caddisflies of the genera *Agapetus* and *Electragapetus* (Trichoptera: Rhyacophilidae). *J. Wash. Acad. Sci.* 41: 347-356.
- Ross, H. H. 1951b. The caddisfly genus *Anagapetus*. *Pan-Pacif. Ent.* 27: 140-144.
- Ross, H. H. 1956. Evolution and classification of the mountain caddisflies. 213 pp. University of Illinois Press, Urbana.
- Ross, H. H. 1965. Pleistocene events and insects. *In* *The Quaternary of the United States*. H. E. Wright Jr. and G. Frey, eds. 563-595. Princeton Univ. Press.
- Ross, H. H., and G. J. Spencer. 1952. A preliminary list of the Trichoptera of British Columbia. *Proc. ent. Soc. Br. Columb.* 48: 43-51.
- Schmid, F. 1960. Trichoptères du Pakistan. 3me partie. *Tijdschr. Ent.* 103: 83-109.
- Schmid, F., and R. Guppy. 1952. An annotated list of Trichoptera collected on southern Vancouver Island. *Proc. ent. Soc. Br. Columb.* 48: 41-42.
- Simmons, P., D. F. Barnes, D. K. Fisher, and G. H. Kaloostian. 1942. Caddisfly larvae fouling a water tunnel. *J. econ. Ent.* 35: 77-79.
- Smith, S. D. 1969. Two new species of Idaho Trichoptera with distributional and taxonomic notes on other species. *J. Kans. ent. Soc.* 42: 46-53.
- Ulmer, G. 1905. Ueber die geographische Verbreitung der Trichopteren. *Zeitschr. Wiss. Biol.* 1: 68-80.
- Ulmer, G. 1907. Trichoptera. *Genera Insec.* 60: 1-259.
- Ulmer, 1932. Die Trichopteren, Ephemeropteren und Plecopteren der arktischen gebeits. *Fauna arct.* 6: 207-226.
- Walker, F. 1852. Catalogue of the specimens of neuropterous insects in the collections of the British Museum. 1: 1-192. London.

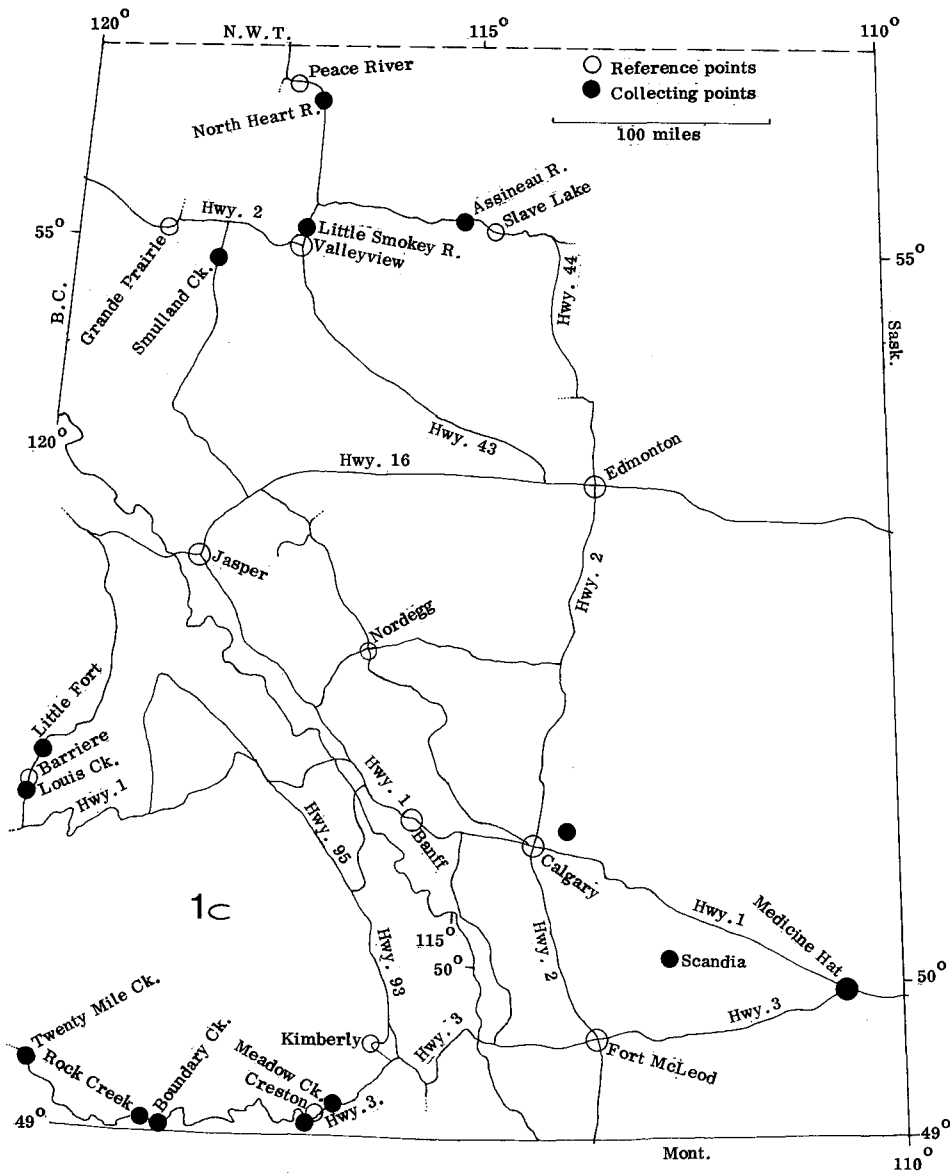


Fig. 1c. Southern and central Alberta, and eastern British Columbia, to show collecting localities not recorded in Fig. 1, 1a, or 1 b of Nimmo (1971a).

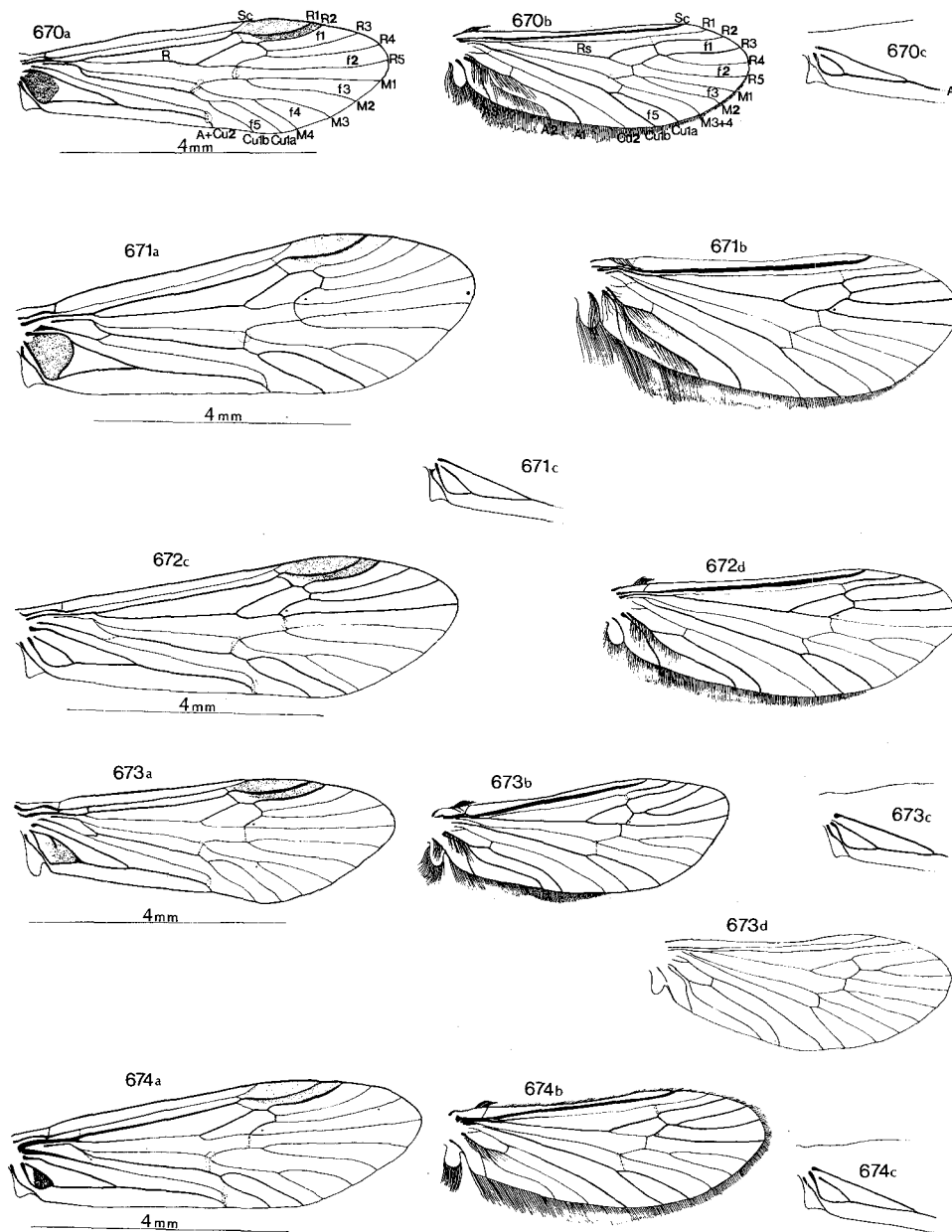


Fig. 670-674. Fore (a) and hind (b) wings of males, and fore (c) and hind (d) wings of females of species of Glossosomatidae. 670. *Glossosoma velona* Ross. 671. *G. alascense* Banks. 672. *G. sp. 1*. 673. *G. intermedium* (Klapálek). 674. *G. verdoni* Ross.

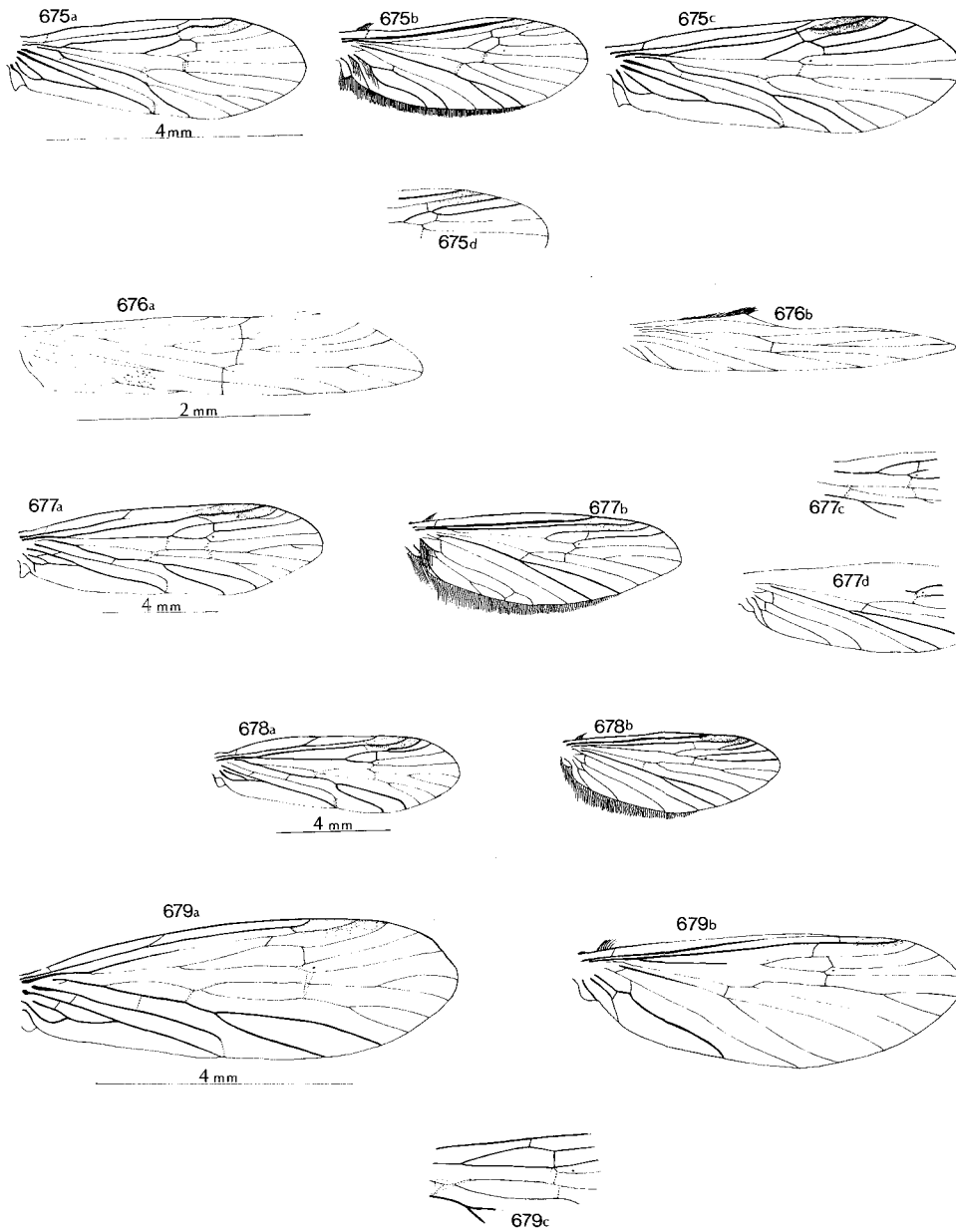


Fig. 675-679. Fore (a) and hind (b) wings of males, and fore (c) and hind (d) wings of females of species of Glossosomatidae (fig. 675-676) and Philopotamidae (fig. 677-679). 675. *Anagapetus debilis* (Ross). 676. *Protophila tenebrosa* (Walker). 677. *Dolophilodes aequalis* (Banks). 678. *D. distincta* (Walker). 679. *Wormaldia gabriella* (Banks).

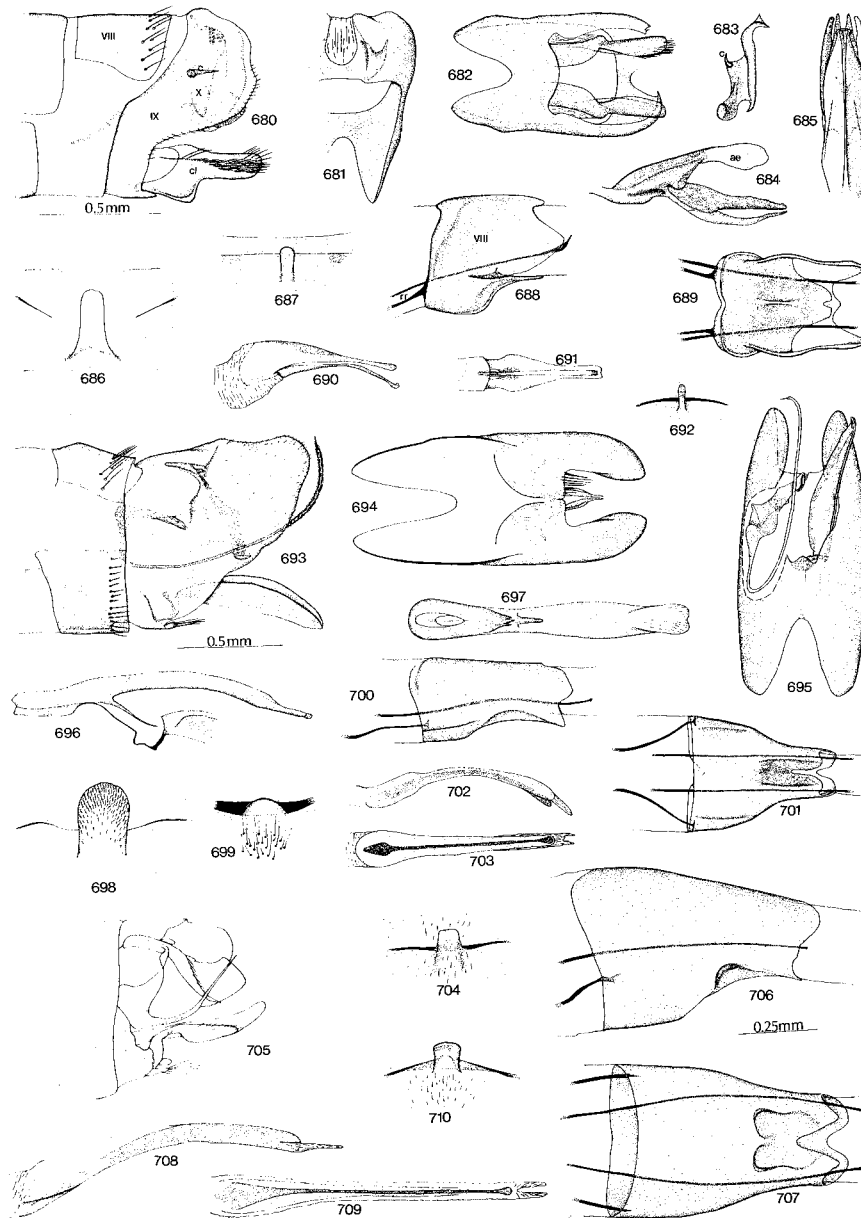


Fig. 680-710. *Glossosoma velona* Ross. 680. Male genitalia, lateral aspect. 681. Male genitalia, dorsal aspect (partial). 682. Male genitalia, ventral aspect (partial, and segment X omitted). 683. Male segment X, posterior aspect, left half only. 684. Aedeagus, lateral aspect. 685. Aedeagus, dorsal aspect. 686. Male sternite VI, process, ventral aspect. 687. Male sternite VII, process, ventral aspect. 688. Female segment VIII base, lateral aspect. 689. Female segment VIII base, ventral aspect. 690. Spermathecal sclerite, lateral aspect. 691. Spermathecal sclerite, ventral aspect. 692. Female sternite VI, process, ventral aspect. *G. alascense* Banks. 693. Male genitalia, lateral aspect. 694. Male genitalia, dorsal aspect (partial). 695. Male genitalia, ventral aspect (partial). 696. Aedeagus, lateral aspect (with clasper base). 697. Aedeagus, ventral aspect. 698. Male sternite VI, process, ventral aspect. 699. Male sternite VII, process, ventral aspect. 700. Female segment VIII base, lateral aspect. 701. Female segment VIII base, ventral aspect. 702. Spermathecal sclerite, lateral aspect. 703. Spermathecal sclerite, dorsal aspect. 704. Female sternite VI, process, ventral aspect. *G. pterna* Ross. 705. Male genitalia, lateral aspect (no scale) (redrawn from Ross (1956: fig. 303a)). *Glossosoma* sp. 1. 706. Female segment VIII base, lateral aspect. 707. Female segment VIII base, ventral aspect. 708. Spermathecal sclerite, lateral aspect. 709. Spermathecal sclerite, dorsal aspect. 710. Female sternite VI, process, ventral aspect. ac. - aedeagus. c. - cercus. cl. - clasper. rr. - retractor rod.

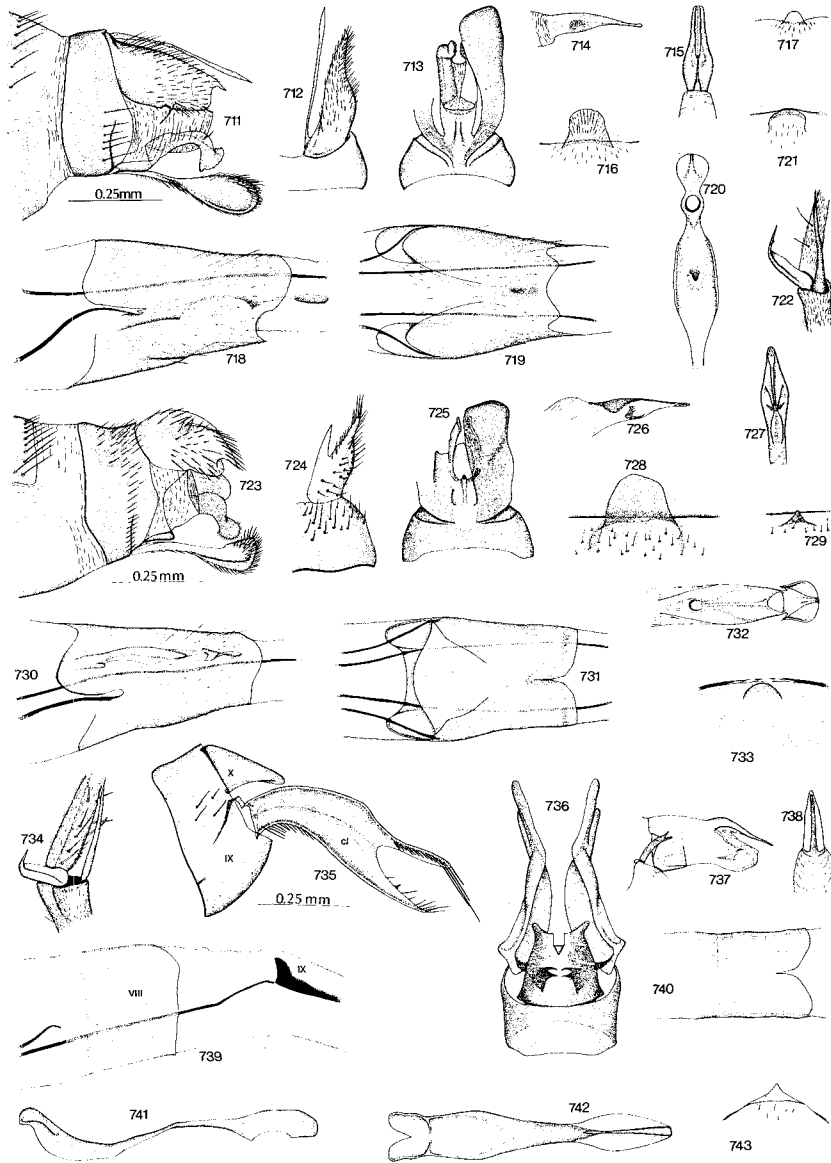


Fig. 711-743. *Glossosoma intermedius* (Klapálek). 711. Male genitalia, lateral aspect, with dorsal lobes of aedeagus *in situ*. 712. Male genitalia, dorsal aspect (partial; cercus and segment X). 713. Male genitalia, ventral aspect (partial). 714. Aedeagus, lateral aspect. 715. Aedeagus, dorsal aspect. 716. Male sternite VI, process, ventral aspect (scale doubled to 0.125 mm). 717. Male sternite VII, process, ventral aspect (scale doubled to 0.125 mm). 718. Female segment VIII base, lateral aspect, spermathecal sclerite *in situ*. 719. Female segment VIII base, ventral aspect. 720. Spermathecal sclerite, ventral aspect. 721. Female sternite VI, process, ventral aspect (scale doubled to 0.125 mm). 722. Male hind leg apical spurs. *G. verdona* Ross. 723. Male genitalia, lateral aspect, with dorsal lobes of aedeagus *in situ*. 724. Male genitalia, dorsal aspect (partial). 725. Male genitalia, ventral aspect (partial). 726. Aedeagus, lateral aspect. 727. Aedeagus, dorsal aspect. 728. Male sternite VI, process, ventral aspect (scale doubled to 0.125 mm). 729. Male sternite VII, process, ventral aspect (scale doubled to 0.125 mm). 730. Female segment VIII base, lateral aspect, spermathecal sclerite *in situ*. 731. Female segment VIII base, ventral aspect. 732. Spermathecal sclerite, ventral aspect. 733. Female sternite VI, process, ventral aspect (scale doubled to 0.125 mm). 734. Male hind leg apical spurs. *Anagapetus debilis* (Ross). 735. Male genitalia, lateral aspect. 736. Male genitalia, dorsal aspect. 737. Aedeagus, lateral aspect, with strap to clasper base. 738. Aedeagus, dorsal aspect. 739. Female segment VIII, and base of IX, lateral aspect. 740. Female segment VIII base, dorsal aspect. 741. Spermathecal sclerite, lateral aspect. 742. Spermathecal sclerite, ventral aspect. 743. Female sternite VI, process, ventral aspect. cl. - clasper.

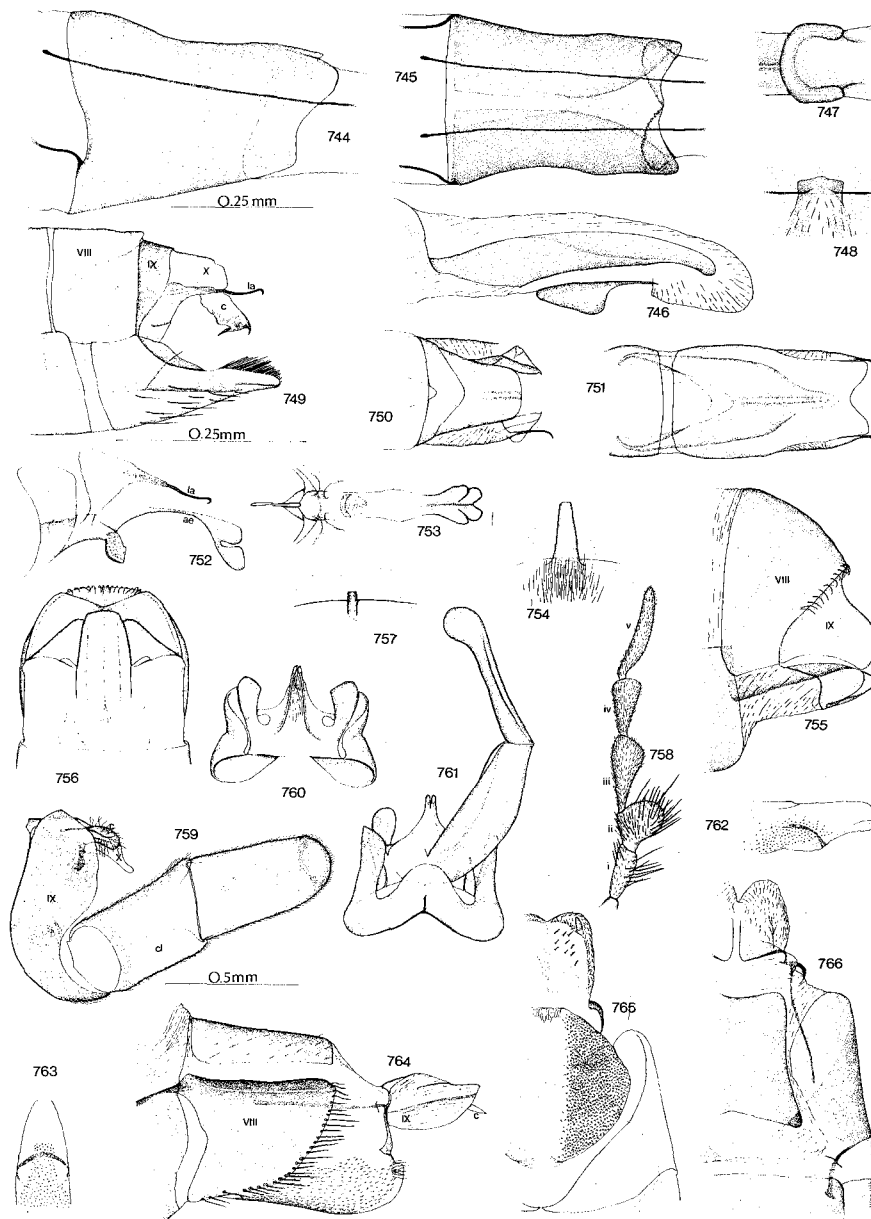


Fig. 744-766. Glossosomatinae sp. 1. 744. Female segment VIII base, lateral aspect. 745. Female segment VIII base, dorsal aspect. 746. Spermathecal sclerite, lateral aspect. 747. Spermathecal sclerite, ventral sclerite, ventral aspect. 748. Female sternite VI, process, ventral aspect. *Protophila tenebrosa* (Walker). 749. Male genitalia, lateral aspect, with lateral arms of aedeagus *in situ*. 750. Male genitalia, dorsal aspect (partial), with 1 lateral arm of aedeagus *in situ*. 751. Male genitalia, ventral aspect, with both lateral arms of aedeagus *in situ*. 752. Aedeagus, lateral aspect. 753. Aedeagus, dorsal aspect, with bases only of lateral arms. 754. Male sternite VI, process, ventral aspect. 755. Female genitalia, lateral aspect. 756. Female genitalia, ventral aspect. 757. Female sternite VI, process, ventral aspect. 758. Left side of maxillary palpus, outer face (male and female). *Dolophilodes aequalis* (Banks). 759. Male genitalia, lateral aspect. 760. Male genitalia, dorsal aspect (partial). 761. Male genitalia, ventral aspect (partial). 762. Aedeagus, lateral aspect. 763. Aedeagus, ventral aspect. 764. Female genitalia, lateral aspect. 765. Female genitalia, ventral aspect (partial). 766. Female genitalia, dorsal aspect (partial). ac. - aedeagus. c. - cercus. cl. - clasper. la. - lateral arm.

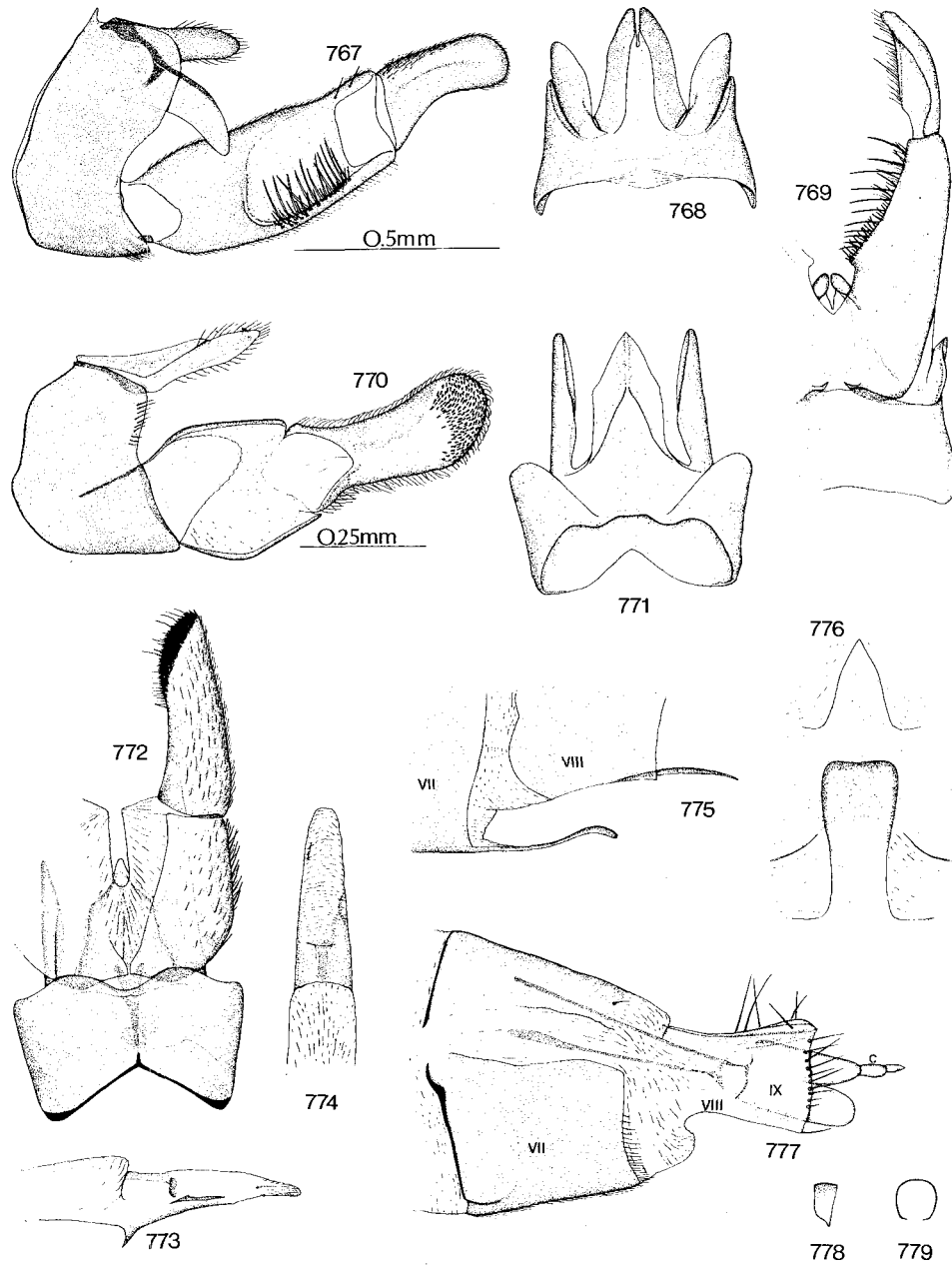


Fig. 767-779. *Dolophilodes novusamericanus* (Ling). 767. Male genitalia, lateral aspect. 768. Male genitalia, dorsal aspect (partial). 769. Male genitalia, ventral aspect (partial). *Wormaldia gabriella* (Banks). 770. Male genitalia, lateral aspect. 771. Male genitalia, dorsal aspect (partial). 772. Male genitalia, ventral aspect (partial). 773. Aedeagus, lateral aspect. 774. Aedeagus, dorsal aspect. 775. Male sternites VII and VIII, processes, lateral aspect. 776. Male sternites VII and VIII, processes, ventral aspect. 777. Female genitalia, lateral aspect (scale increased to 0.75 mm). 778. Spermathecal sclerite, lateral aspect (scale increased to 0.75 mm). 779. Spermathecal sclerite, posterior aspect (scale increased to 0.75 mm). c. - cercus.

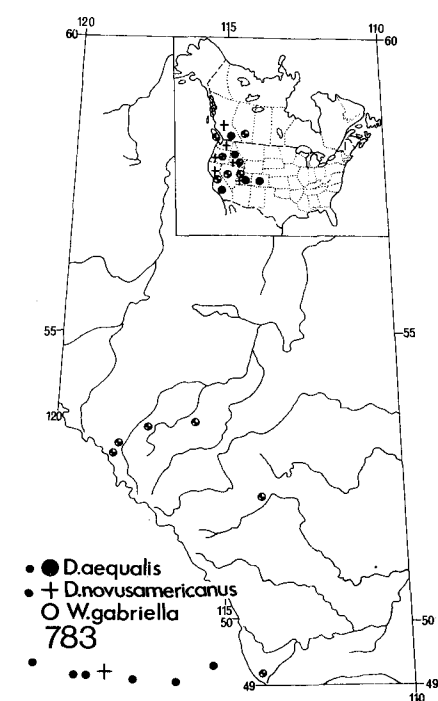
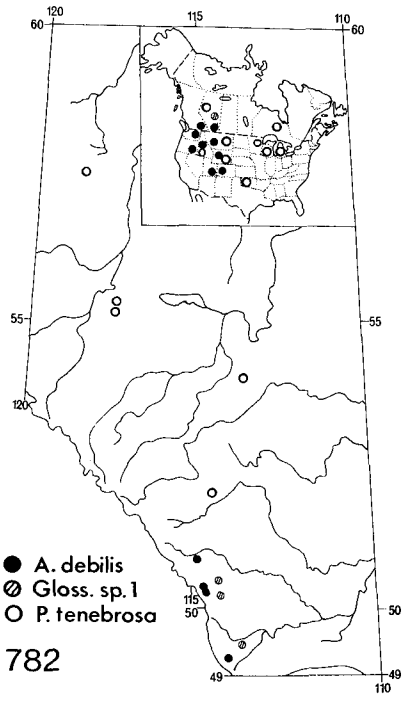
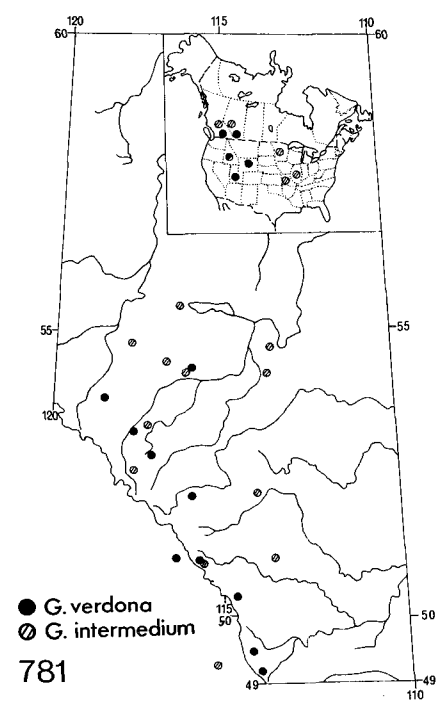
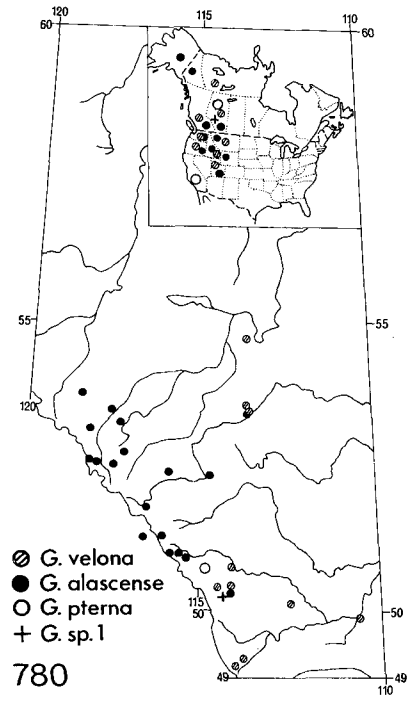


Fig. 780-783. Maps of geographical distribution of species of Glossosomatidae (Fig. 780-782) and Philopotamidae (Fig. 783) species in Alberta, and North America.