

## LARVAE AND ADULTS OF *AMELETUS* MAYFLIES (EPHEMEROPTERA: AMELETIDAE) FROM ALBERTA

JACEK ZLOTY and GORDON PRITCHARD

Division of Ecology, Department of Biological Sciences, The University of Calgary, Calgary, Alberta, Canada  
T2N 1N4

### Abstract

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Mayflies of the genus *Ameletus* (Ephemeroptera: Ameletidae) occur in practically every drainage of western Alberta and in the Cypress Hills, from headwater spring brooks to larger rivers. The genus is speciose and reaches its greatest diversity in the southwestern part of the province where as many as 12 species can occur at a single site. Of the 30 bisexual species currently recognized from North America, 13 have been collected from Alberta (*A. bellulus*, *A. celer*, *A. cooki*, *A. majusculus*, *A. oregonensis*, *A. pritchardi*, *A. similior*, *A. sparsatus*, *A. subnotatus*, *A. suffusus*, *A. validus*, *A. velox*, and *A. vernalis*), and another, *A. inopinatus*, is assumed to occur in the northern part of the province. Male adults of all North American species were described previously by Zloty (1996, *The Canadian Entomologist* 128: 293–346). In the current paper, we describe late-instar larvae and adult females of all 14 Albertan species, and provide species distributions and keys for identification of male and female adults and larvae. All diagnostic taxonomic characters are described and illustrated. The identification keys can also be used in Saskatchewan, eastern British Columbia, Montana, and the northern parts of Idaho and Washington.

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### Résumé

Les éphémères du genre *Ameletus* (Ephemeroptera: Ameletidae) se retrouvent pratiquement dans tous les bassins hydrographiques de l'ouest de l'Alberta et dans les collines Cypress, des petits ruisseaux de tête aux grandes rivières. La richesse en espèces est élevée, particulièrement dans la partie sud-ouest de la province où l'on peut retrouver jusqu'à 12 espèces au même endroit. Des 30 espèces bisexuées reconnues en Amérique du Nord, 13 ont été trouvées en Alberta (*A. bellulus*, *A. celer*, *A. cooki*, *A. majusculus*, *A. oregonensis*, *A. pritchardi*, *A. similior*, *A. sparsatus*, *A. subnotatus*, *A. suffusus*, *A. validus*, *A. velox* et *A. vernalis*) et une autre, *A. inopinatus*, est soupçonnée vivre dans la portion nord de la province. Les mâles adultes de toutes les espèces nord-américaines ont été décrits par Zloty (1996, *The Canadian Entomologist* 128: 293–346). Dans cet article, nous décrivons les larves des stades avancés et les femelles adultes des 14 espèces trouvées en Alberta; la répartition de chacune des espèces est indiquée et des clés permettront l'identification des adultes, mâles et femelles, et des larves. Tous les caractères diagnostiques sont décrits et illustrés. Les clés d'identification peuvent également servir en Saskatchewan, dans l'est de la Colombie-Britannique, dans le Montana et dans le nord de l'Idaho et du Washington.

[Traduit par la Rédaction]

## INTRODUCTION

Mayflies of the genus *Ameletus* are common inhabitants of running waters in North America, generally in the mountainous areas. The genus reaches its greatest diversity in the western part of the continent, where as many as 12 species can occur at a single site (Zloty et al. 1993). Of the 30 bisexual species currently recognized from North America, 24 are western species and 13 of these have been collected in Alberta (Zloty 1996). *Ameletus* occurs in practically every drainage of western Alberta and in the Cypress Hills, from headwater spring brooks to large rivers.

Despite the common occurrence of *Ameletus*, its taxonomy has been neglected, thus presenting a serious barrier to progress in ecological work on these mayflies (Edmunds et al. 1976; Zloty et al. 1993). A revision of Nearctic *Ameletus* based on adult males was recently published (Zloty 1996). However, mayflies are larvae for most of their lives, and consequently much ecological study is still impossible unless larvae are associated with adults and an identification key to this stage is published. The only key to the larval stage (Needham et al. 1935) has numerous imperfections, and includes only five of the 30 currently recognized North American bisexual species, and only three of the species in Alberta. Larvae of nine species of *Ameletus* in Alberta were described by McDunnough (1934, 1935, 1936), but the descriptions are either incomplete or incorrect (Zloty 1996). In fact, none of the 13 species currently known in Alberta has an adequate larval description.

In this paper, we describe the larvae and female adults of all *Ameletus* in Alberta [see Zloty (1996) for descriptions of adult males], and provide identification keys to larvae and to adults of both sexes. Distributions within Alberta and emergence periods are also provided. Most species of *Ameletus* have widespread distributions and species found in Alberta also occur in adjacent areas. Thus, the keys provided here can be used in Saskatchewan, eastern British Columbia, Montana, and the northern parts of Idaho and Washington. Other regional accounts of larval *Ameletus* in western North America will follow in due course.

### MATERIAL AND METHODS

Most of the material used in this study was collected by the first author between 1988 and 1995, but some came from collections of J. McDunnough (Canadian National Collection, Ottawa), G.F. Edmunds, Jr. (University of Utah, Salt Lake City), and D. Lehmkuhl (University of Saskatoon, Saskatchewan).

Larvae were associated with adults by rearing late-instar larvae to imagoes in the laboratory, or by hand-picking exuviae and associated subimagoes from rocks and rearing the subimagoes to imagoes. Earlier-instar larvae of seven species were also identified using cellulose acetate gel electrophoresis (Zloty et al. 1993).

All illustrations were produced with the aid of a camera lucida. We follow Kluge's (1994) nomenclatural interpretation of the pterothorax.

**Larval Characteristics.** Although body length of final-instar larvae of some species of *Ameletus* (e.g. *A. celer*) varies substantially depending on sex, emergence time, and water temperature (Pritchard and Zloty 1994), size is usually uniform within a species, but varies greatly among species (from 7 to 21 mm, exclusive of caudal filaments). Thus body length can be useful for species identification. By contrast, larval coloration can be variable within a species and may depend on a number of factors including substrate characteristics, water temperature, and length of development. Also, larvae darken just before emergence, and the colour pattern may disappear.

The timing of adult emergence (=presence of final-instar larvae) can be of some diagnostic value in species identification, particularly in separating 'spring', 'summer', and 'autumn' species (Fig. 33). However, although the emergence period usually does not exceed 3–4 weeks at a specific site, it can differ among sites, and so be extended in species with widespread distributions.

We used the following morphological characters of larvae to define species:

**Head.** Markings on the labrum have been used to distinguish among three species from Taiwan (Kang and Yang 1994). In species from Alberta, these markings are more variable and should be used with caution. Dark bands on the middle and apical segments of the antennae are present in some species and can be useful if larvae were collected recently. However, the number of antennal segments, used to differentiate species by Kang and Yang (1994), is too variable in Albertan species.

**Legs.** Spines and hair-fringes on the anterior margin of the fore femora are always present and are useful as diagnostic characters in species that are not too variable. Colour pattern of the legs may also be useful (Table 1).

**Wing-pads.** Final-instar larvae have wing-pads all black or black with pale patches. If wing-pads are dissected (or if larvae are allowed to transform to the subimago), speckled-wing forms can be separated from non-speckled forms, a characteristic that sometimes disappears in adults (see Table 1).

**Abdomen.** The colour pattern of the abdominal sternites or tergites, although variable in a few species, can be of taxonomic value in separating many species (e.g. *A. celer*, *A. oregonensis*, *A. pritchardi*, *A. similior*, *A. vernalis*). Pigmentation of the ganglia, which can be seen through the cuticle, is also useful but sometimes difficult to see in preserved specimens.

The relative length and shape of the posterolateral projections on abdominal segments 8–9 differ among species, but are difficult to quantify. However, spines on the posterior borders of sternites 6–8 (Fig. 28) are very useful in distinguishing even small individuals of *A. oregonensis*, *A. subnotatus*, and *A. validus* from all other Albertan species.

The shape of the gills and the position of the mesal band (which, except in *A. inopinatus*, divides the gill into a 'gill blade' and a 'mesal extension') are fairly consistent within species (Figs. 22, 23). However, there is overlap among species, and so these characters are of limited value, except to separate species at the ends of the range of variation. Tracheation of the gill blades is usually related to body size and can be used to separate larger species from smaller ones. However, species with variable body size (e.g. *A. celer*) will also have variable gill tracheation.

**Caudal filaments.** The colour pattern of the caudal filaments is usually uniform within species and can be of considerable taxonomic value in separating some species (e.g. *A. oregonensis*, *A. majusculus*).

**Adult Characteristics.** Characters on the wings and the abdomen are used for species separation of adults. Wings have a transparent or suffused condition and have light or dark venation, which in some species can be margined with brown, giving them a speckled appearance. The appearance of the wings is diagnostic for most species. However, suffusion around cross-veins can be reduced and difficult to assess. In this case, wings of the subimago can help in determining the state of this character (Table 1).

Cuticular markings on the abdominal sternites and pigmentation of the underlying ganglia are useful in species identification. Ganglionic markings are fixed for all Albertan species, but can be polymorphic in American populations of *A. velox*.

The most important diagnostic characters used to differentiate males of Albertan species of *Ameletus* are found on the lateral lobes and ventral plates of the penes. We illustrate these features with three views for each species. The shape of the lateral lobe, best seen in lateral view, varies. It may have a foot-shaped end (*A. bellulus*, *A. vernalis*) or an acute and curved apex (*A. suffusus*); it can have an inwardly or outwardly twisted apex (*A. inopinatus* and *A. validus*, respectively), or it may possess accessory spicules (*A. majusculus*). The presence or absence of ventral plates, their size and shape, and the number of spines, spinules, or teeth, are the most reliable identification features. Even though these armatures may vary in number and size and may differ between left and right ventral plates in a given specimen (e.g. *A. celer*, *A. pritchardi*, *A. similior*), almost all Albertan species can be easily identified by this structure alone. In smaller species, ventral plates should be viewed under high magnification.

The shape of the posterior margin of the subanal plate in females (Fig. 31) is variable in some species, but is used to distinguish species with a deep indentation from those without an indentation. Eggs, although not used much in this study, may provide useful characters for identifying females and in the study of phylogeny (Kluge pers. comm.). In the key we use egg shape (flattened or ovoid) to differentiate among otherwise unseparable species.

Also, eggs of two Albertan species (*A. oregonensis* and *A. subnotatus*) differ from all other species of *Ameletus* in having a few large knobs at one pole (Fig. 32C).

### SYSTEMATIC ACCOUNTS AND KEYS

**Morphological Keys.** The key to adult males is quite reliable because each species in Alberta has unique genitalia. Male subimagos can also be assigned to species by the structure of the penes. However, adult females may be difficult to identify to species on external characters alone; here, examination of eggs and placement of the flight period are necessary. Association with males also helps.

The larval key is intended for recently collected specimens in the last two or three instars, but younger instars of some species may be identifiable. Larval identification should be confirmed by reference to the species accounts below.

#### KEY TO THE IDENTIFICATION OF *AMELETUS* SPECIES OCCURRING IN ALBERTA

##### Adults

1. Individuals with large, holoptic eyes; forceps present ..... males 2
- Individuals with small, dichoptic eyes; forceps absent ..... females 15
2. Penes with short, broad lateral lobes not reaching to the base of the forceps, and with two or three broad, spine-like projections at their apical ends (Fig. 2) ..... 3
- Penes with long, narrow lateral lobes extending beyond the base of the forceps (Fig. 1) ..... 4
3. Lateral lobes of penes with three spine-like projections (Fig. 12A); basal area of fore and hind wings suffused with dark brown; cross-veins of fore wings not bordered with smoky brown ..... *oregonensis*
- Lateral lobes with two spine-like projections (Fig. 13A); only basal area of hind wings suffused with dark brown; some cross-veins of fore wings bordered with smoky brown, giving them a speckled appearance and forming three or four larger dark patches (Fig. 30C) ... *subnotatus*
4. Ventral plates of penes reduced and without accessory spines or spicules (Figs. 6C, 15C) ... 5
- Ventral plates of penes usually developed and formed into long, rod-like titillators with sharp apical ends (Fig. 3C) or armored with stout spines (Fig. 11C) or small spicules (Fig. 4C) .... 6
5. Lateral lobes of penes inwardly twisted at the apices (Fig. 6B); penes separated by well-developed cleft (Fig. 6A); subgenital plate with deep V-shaped median indentation and with relatively small lateral processes; small species (body length 9–10 mm); associated with lakes; in North America known only from the Northwest Territories but may occur in northern Alberta .... *inopinatus*
- Lateral lobes of penes not inwardly twisted at the apical ends (Fig. 15B); penes separated by shallow cleft (Fig. 15A); subgenital plate with shallow U-shaped median indentation and with enlarged lateral processes; larger species (body length 14–15 mm) ..... *velox*
6. Lateral lobes of penes outwardly twisted at apices and with small spines on lateral surface (Fig. 14A, B); each ventral plate of penes formed into a single spine armed with two to three spinules (Fig. 14C); adults emerge from mid-September to late October (Fig. 33) .... *validus*
- Lateral lobes of penes never outwardly twisted and without small spines on lateral surface; ventral plates of penes, if formed into single spines, never armed with small spinules; flight period variable, but never after mid-September (Fig. 33) ..... 7
7. Wings strongly tinted with dark brown (Fig. 30D); genitalia as in Figure 10 ..... *suffusus*
- Wings transparent, with or without speckled appearance caused by cross-veins being bordered with smoky brown; genitalia not as in Figure 10 ..... 8

- 8. Apical ends of lateral penes lobes with many small spines (Fig. 7A); abdominal sternites marked with blackish patches at the centre of each segment, but without ganglionic markings (except sternite 8); large species (body length 18–20 mm) ..... *majusculus*  
 — Apical ends of lateral penes lobes without such spines; abdominal sternites without blackish patches at the centre of each segment; ganglionic markings variable; smaller species (body length <17 mm) ..... 9
- 9. Ventral plates of penes formed into relatively long single titillators that do not bear accessory spines or teeth (Figs. 3C, 9C, 16C); cross-veins of fore wings bordered with smoky brown, at least in radial area, giving them a speckled appearance (Fig. 30B, C) ..... 13  
 — Ventral plates of penes without elongated titillators but with prominent spines (Fig. 13C), accessory spinules (Fig. 4C), or small teeth (Fig. 8C) (*A. cooki* has a single spine, as in Fig. 5C); wings without speckled appearance (Fig. 30A) ..... 10
- 10. Ganglionic markings on abdominal sternites 2–8 (Fig. 18A) ..... 11  
 — Ganglionic markings on abdominal sternites 7–8 or only on sternite 8 (Fig. 18B) ..... 12
- 11. Ventral plates of penes with two to five prominent spines (Fig. 11B) ..... *similior*  
 — Ventral plates of penes with three to 13 small accessory spinules (Fig. 4C) ..... *celer*
- 12. Ventral plates of penes formed into a single spines (Fig. 5C) ..... *cooki*  
 — Ventral plates of penes somewhat elongated and with two to six small teeth at apical ends (Fig. 8C) ..... *pritchardi*
- 13. Tips of lateral lobes bent dorsally forming foot-shaped ends (Fig. 3C); larger species (body length 13–17 mm) ..... 14  
 — Tips of lateral lobes straight or slightly curved, not forming foot-shaped ends (Fig. 3C); smaller species (body length 9–11 mm) ..... *sparsatus*
- 14. Fore wings with two to three larger distinct dark patches (Fig. 30C); adults emerge from end of July to beginning of September (Fig. 33) ..... *bellulus*  
 — Cross-veins of fore wings bordered with smoky brown, but without large dark patches (Fig. 30B); adults emerge from mid-April to mid-June (Fig. 33) ..... *vernalis*
- 15. Ganglionic markings on abdominal sternites 2–8 (Fig. 18E) ..... 16  
 — Ganglionic markings absent, or on abdominal sternites 7–8, or only on sternite 8 (Fig. 18B) ..... 17
- 16. Eggs ovoid (Fig. 32B); small species (body length 8–10 mm); adults emerge from early August to mid-September (Fig. 33) ..... *similior*  
 — Eggs flattened (Fig. 32A); larger species (body length 10–15 mm); adults emerge from mid-June to mid-August (Fig. 33) ..... *celer*
- 17. Wings tinted with amber-brown (Fig. 30D) ..... 18  
 — Wings transparent [in some species cross-veins of fore wings bordered with smoky brown, giving them a speckled appearance (Fig. 30B) but wings never uniformly suffused] ..... 19
- 18. Adults emerge from mid-September to late October (Fig. 33) ..... *validus*  
 — Adults emerge from beginning of July to early August (Fig. 33) ..... *suffusus*
- 19. Abdominal sternites marked with blackish patches at the centre of each segment, but without ganglionic markings (except sternite 8); sternite 9 with deep indentation in posterior margin (Fig. 31D); large species (body length 18–21 mm) ..... *majusculus*  
 — Abdominal sternites without blackish patches at the centre of each segment; ganglionic markings variable; sternite 9 not as in Figure 31D; smaller species (body length <17 mm) ..... 20

20. At least some cross-veins of fore wings bordered with smoky brown, giving them a speckled appearance (Fig. 30B, C) . . . . . 21  
 — Cross-veins of fore wings not bordered with smoky brown and wings without speckled appearance (Fig. 30A) . . . . . 25
21. Cross-veins of fore wings faintly bordered with smoky brown but not forming dark patches (Fig. 30B) . . . . . 22  
 — Cross-veins of fore wings prominently bordered with smoky brown and forming two to four dark patches (Fig. 30C) . . . . . 23
22. Smaller species (body length 9–11 mm); eggs ovoid with a few large knobs at one pole (Fig. 32C) . . . . . *oregonensis*  
 — Larger species (body length 13–15 mm); eggs ovoid without large knobs (Fig. 32B) . . . . . *vernalis*
23. Eggs flattened (Fig. 32A); smaller species (body length 10–11 mm) . . . . . *sparsatus*  
 — Eggs ovoid (Fig. 32B); larger species (body length 13–17 mm) . . . . . 24
24. Ganglionic markings absent; sternites 2–7 with a pair of crescentic or ovoid dark markings; eggs ovoid with a few large knobs (Fig. 32C); adults emerge from late April to beginning of June (Fig. 33) . . . . . *subnotatus*  
 — Ganglionic markings present on sternites 7–8; sternites 2–7 without crescentic or ovoid markings; eggs ovoid without large knobs (Fig. 32B); adults emerge from late July to early September (Fig. 33) . . . . . *bellulus*
25. Larger species (body length 14–15 mm); adults emerge in the spring (early May to beginning of June) (Fig. 33); longitudinal veins and cross-veins of fore wings with pronounced dark colour . . . . . *velox*  
 — Smaller species (body length <12 mm); adults emerge during the summer months (July to August); longitudinal veins and cross-veins of fore wings with light colour (cross-veins faintly visible) . . . . . 26
26. Eggs flattened (Fig. 32A); mesonotum yellowish with brown laterally . . . . . *cooki*  
 — Eggs ovoid (Fig. 32B); mesonotum brown . . . . . 27
27. Found in lakes; known only from the Northwest Territories but may occur in northern Alberta; subanal plate without pronounced indentation in posterior margin (Fig. 31H) . . . . . *inopinatus*  
 — Found in running waters in southwestern Alberta; subanal plate with pronounced indentation in posterior margin (Fig. 31F) . . . . . *pritchardi*

### Larvae

1. Ganglionic markings present on abdominal sternites 2–8 (Fig. 18E) . . . . . 2  
 — Ganglionic markings absent (occasionally visible on sternites 7–8 or on sternite 8) . . . . . 3
2. Small species (final-instar larva 8–9 mm); abdominal sternite 9 mostly pale (Fig. 18E); abdominal tergites with contrasting colour markings; anterior tergites pale with a pair of rounded dark markings; posterior tergites with a thin, pale, middorsal stripe (Fig. 18C) that can be less pronounced or absent in some individuals (Fig. 18D); final-instar larvae occur from beginning of August to mid-September (Fig. 33) . . . . . *similior*  
 — Larger species (final-instar larva 12–13 mm); abdominal sternite 9 mostly brown (Fig. 17C), at least anteriorly; abdominal tergites usually without contrasting colour markings, but with a series of pale, middorsal ovoid spots bordered by crescentic dark markings (Fig. 17B); final-instar larvae occur from mid-June to mid-August (Fig. 33) . . . . . *celer*

- 3. Posterior margin of abdominal sternites 6–8 with numerous spines (Fig. 28A, B) . . . . . 4
  - Posterior margin of abdominal sternites 6–8 without such spines . . . . . 6
  
- 4. Basal two-thirds or middle one-third of caudal filaments with alternating dark and light rings every two or three segments; mesal gill extension of middle gills about 50% of gill blade width (Figs. 22G, 23D); colour pattern of abdominal tergites 8 and 9 as in Figures 19C and 20B; final-instar larvae occur early in the season (April to June) . . . . . 5
  - Caudal filaments without alternating dark and light rings, but with a broad dark band at the middle; mesal gill extension of middle gills about 20% of gill blade width (Fig. 23F); colour pattern of abdominal tergites 8 and 9 as in Figure 18F; final-instar larvae occur late in the season (September to October) (Fig. 33) . . . . . *validus*
  
- 5. Posterior margin of abdominal sternites 6–8 with numerous large spines at the middle (Fig. 28A) . . . . . *oregonensis*
  - Posterior margin of abdominal sternites 6–8 without large spines at the middle but with numerous small spines laterally (Fig. 28B) . . . . . *subnotatus*
  
- 6. Mesal band of middle gills along or near mesal margin, mesal gill extension reduced or absent (Figs. 22E, 23A, G) . . . . . 7
  - Mesal band of middle gills at distance from mesal margin, mesal gill extension well developed (Fig. 22F) . . . . . 9
  
- 7. Mesal band of middle gills along mesal margin (Fig. 22E); species found in lakes; known only from the Northwest Territories but may occur in northern Alberta. . . . . *inopinatus*
  - Mesal band of middle gills near mesal margin (Fig. 23A, F, G); in lotic habitats . . . . . 8
  
- 8. Tergite 7 brown with pale fleur-de-lis shape at the centre (Fig. 19B); length of gill 4 no more than 1.5 times its width (Fig. 23A); small species (final-instar larva 9–11 mm); final-instar larvae occur late in the season (August) (Fig. 33) . . . . . *pritchardi*
  - Tergite 7 not with such a pattern (Fig. 20C); length of gill 4 more than 1.8 times its width; larger species (final-instar larva 13–15 mm); final-instar larvae occur earlier in the season (June to July) (Fig. 33) . . . . . *velox*
  
- 9. Basal two-thirds of caudal filaments completely brown, apical one-third pale; abdominal tergites more or less uniformly brown (Fig. 19A); large species (final-instar larvae up to 20 mm) . . . . . *majusculus*
  - Basal one-third or less of caudal filaments pale (in *A. bellulus* only about eight basal segments pale) with a broad dark band at the middle; abdominal tergites with a distinct colour pattern (Fig. 17A, E); smaller species (final-instar larvae <16 mm) . . . . . 10
  
- 10. Larger species (final-instar larvae 13–16 mm) . . . . . 11
  - Smaller species (final-instar larvae <10 mm) . . . . . 12
  
- 11. Anterior surface of the front femora mostly pale; dark band on caudal filaments begins on about segment 20 and covers about one-third of filament's length; colour pattern of abdominal tergites as in Figure 21A; final-instar larvae occur early in the season (April to mid-June) (Fig. 33) . . . . . *vernalis*
  - Anterior surface of front femora mostly brown; dark band on caudal filaments begins on about segment 8 and covers about one-half of filament's length; colour pattern of abdominal tergites as in Figure 17A; final-instar larvae occur later in the season (late July to early September) (Fig. 33) . . . . . *bellulus*
  
- 12. Abdominal sternites with broad brown longitudinal stripe (Fig. 21B); sternite 9 all brown; abdominal tergites with colour markings as in Figure 20A or Figure 21C . . . . . 13

- Abdominal sternites without well-defined longitudinal stripe, at least on anterior sternites (Fig. 17D); sternite 9 pale at least posteriorly; abdominal tergites with colour markings as in Figure 17E . . . . . *cooki*
- 13. Abdominal tergites with colour markings as in Figure 21C; labrum with brown ovoid marking (Fig. 29F); final-instar larvae have black wing-pads with pale patches and if wings are dissected and unfolded they are suffused and cross-veins are bordered with black, forming distinct patches . . . . . *sparsatus*
- Abdominal tergites with colour markings as in Figure 20A; labrum with brown triangular marking (Fig. 29C); final-instar larvae have wing-pads without pale patches and if wings are dissected and unfolded they are uniformly suffused without black patches around cross-veins . . . . . *suffusus*

## SPECIES ACCOUNTS

### *Ameletus bellulus* Zloty 1996

(Figs. 3A–C, 17A, 22B, 24C, 25A, 27C, 30C, 31A, 32B)

**Larva** (in alcohol). Body length 15–17 mm. Antennae pale, with first segment and five to seven middle segments brown, at least dorsally. Labrum mainly brown, but pale distally. Incisor area of left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with a few short spines (Fig. 24C) and with a fringe of relatively long hairs (about one-half the width of the femur); anterior surface of front femora brown with a pale patch dorsodistally (Fig. 24C). Abdominal tergites with distinct colour pattern (Fig. 17A). Gills on abdominal segments 3–5 with prominent mesal extension (about 25–30% of maximum gill blade width) and with heavy tracheation (Fig. 22B). Posterolateral spines on abdominal segments 8–9 relatively small (seen in lateral view, about as long as their basal widths, as in Fig. 27C). Posterior edge of sternites 6–8 without spines. Ganglionic markings present on sternites 7–8. Caudal filaments with a very narrow basal pale band (about eight segments), followed by a broad dark band covering about one-half of each filament's length, and with pale apical segments. Larvae of *A. bellulus* are distinguished from all other Albertan species by the combination of characteristics given in Table 1.

Larval *A. bellulus* are usually found in second or third order streams, where they are the largest *Ameletus* in late July and August. Adults were observed swarming about 10–15 m above the water surface, between 1200 and 1600 hours on 3 August 1992, at Ford Creek, (50°48'N, 114°51'W), 2.7 km upstream from Elbow River. The univoltine life history was described by Zloty et al. (1993).

**Female Imago** (in alcohol). Body length 15–17 mm. Mesotergum yellowish with brown longitudinal streaks; scutellum yellow, changing to deep brown and black on the posterolateral areas. Wings transparent with brown longitudinal veins and cross-veins; fore wings with brown shadings around the cross-veins giving them a speckled appearance and forming four larger patches (Fig. 30C). Abdominal tergites pale, with brown shading on the posterior margin that forms a pattern of triangular lateral patches and a pair of median longitudinal markings; this pattern is more pronounced on the posterior segments. Abdominal sternites with ganglionic markings on sternites 7 and 8. Posterior margin of the subanal plate usually with a pronounced indentation (Fig. 31A). Caudal filaments golden yellow, with a narrow, deep brown to black ring at the base of each segment. Eggs ovoid without large knobs (Fig. 32B).

The appearance of the wings in female *A. bellulus* is similar to *A. sparsatus* and *A. subnotatus*. However, *A. bellulus* is much larger than *A. sparsatus* and has a different flight period than *A. subnotatus* (Fig. 33). Other differences are given in Table 1.

**Distribution in Alberta.** Foothills in SW. South Castle River (49°18'N, 114°25'W), SW of Beaver Mines on Rd #774; Lynx Creek (49°32'N, 114°30'W), S of Blairmore; Lyons Creek (49°35'N, 114°26'W), S of Blairmore; Gold Creek (49°36'N, 114°25'W) at Frank on Hwy #3; Blairmore Creek (49°40'N, 114°26'W), N of Blairmore; Ford Creek (50°48'N,



114°51'W), Powder Face Trail, 2.7 km upstream from Elbow River; Prairie Creek (50°52'N, 114°47'W), W of Bragg Creek on Hwy #66; Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Waiparous Creek (51°23'N, 115°03'W), NW of Cochrane on Forestry Trunk Road.

***Ameletus celer* McDunnough 1934**

(Figs. 4A–C, 17B, C, 22C, 24B, 30A, 31B, 32A)

**Larva** (in alcohol). Body length 9–15 mm. Antennae amber-brown. Labrum brown with variable pale patches distally. Incisor area of left mandible with the second denticle equal to or larger than the first one (Fig. 25B). Dorsal surface of front femora with many short spines (Fig. 24B) and with a fringe of relatively long hairs (about one-half the width of femur); anterior surface of front femora uniformly light brown (Fig. 24B). Abdominal tergites without distinct colour pattern, but with dark, paired, comma-shaped markings on each tergum (Fig. 17B). Gills on abdominal segments 3–5 with reduced mesal extension (2–4% of maximal gill blade width), and with reduced, light tracheation (Fig. 22C). Posterolateral spines on abdominal segments 8–9 relatively small (seen in lateral view, about as long as their basal widths, as in Fig. 27C). Posterior edge of sternites 6–8 without spines. Ganglionic markings present on sternites 2–8. Caudal filaments with a broad basal pale band (about one-third of each filament's length), followed by a dark band (covering about one-third of each filament's length), followed by a narrow pale band, and with brown apical segments.

Larvae of *A. celer* are distinguished from all other Albertan species, except for *A. similior*, by the presence of ganglionic markings on sternites 2–8 (Fig. 18E). Larvae of *A. celer* are separable from *A. similior* by the colour pattern of sternite 9 (mostly brown in *A. celer*, as in Fig. 17C, but mostly pale in *A. similior*, as in Fig. 18E), and by body size (*A. celer* is larger). Other characteristics are given in Table 1.

The larva of *A. celer* was described by McDunnough (1934). He also described larvae of *A. alticolus* and *A. celeroides* (McDunnough 1934), which were recently synonymized with *A. celer* (Zloty 1996). However, because the description of larval *A. alticolus* was not associated with adults, and the drawing of the fourth abdominal gill (McDunnough 1934) has an enlarged mesal extension, we suspect that this description represents another species and not *A. celer*. See also under the larva of *A. velox* below.

Larvae of *A. celer* are usually found in first to third order streams, and often attain large population sizes. In Alberta, larvae take 1 or 2 years to complete their life cycle depending on the number of day-degrees available (Pritchard and Zloty 1994).

**Female Imago** (in alcohol). Body length 10–15 mm. Mesotergum brown with a yellow irregular patch in front of the scutellum; scutellum brown. Wings transparent with brown longitudinal veins and yellowish cross-veins (Fig. 30A). Abdominal tergites amber-brown, with brown shading on the posterior margin and a pair of median longitudinal markings on tergites 6–9. Abdominal sternites with ganglionic markings on sternites 2–8. Posterior margin of the subanal plate with a shallow indentation (Fig. 31B). Caudal filaments golden yellow. Eggs flattened (Fig. 32A).

The presence of ganglionic markings on abdominal sternites 2–8 will separate females of *A. celer* from all other Albertan species except *A. similior*. Females of *A. celer* have flattened eggs, whereas the eggs of *A. similior* are ovoid. Also, *A. celer* has a larger body size and a different flight period (Fig. 33). Other differences are given in Table 1.

**Distribution in Alberta.** Foothills and mountains in W. Cameron Creek (49°02'N, 114°01'W), Waterton Lakes National Park; Blakiston Creek (49°05'N, 113°51'W), Waterton Lakes National Park; South Castle River (49°18'N, 114°25'W), SW of Beaver Mines on Rd #774; Lynx Creek (49°32'N, 114°30'W), S of Blairmore; Elbow Creek (50°38'N, 115°00'W), 1 km downstream from Elbow Lake; Ford Creek (50°48'N, 114°51'W), Powder

Face Trail, 2.7 km upstream from its confluence with the Elbow River; Prairie Creek (50°52'N, 114°47'W), W of Bragg Creek on Hwy #66; Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Lusk Creek (51°03'N, 115°01'W), 2 km N of Barrier Lake on Hwy #40; small stream in Sunshine Village (51°05'N, 115°40'W), W of Banff; Lake Agnes (near the lake) (51°25'N, 116°15'W), NE of Banff; Moraine Lake (51°25'N, 116°16'W), small stream near the lake, Banff National Park; Bow Lake (51°40'N, 116°30'W), small stream near the lake on Hwy #93, Banff National Park; Stream on Hwy #93 (51°48'N, 116°38'W), 10 km NW of Peyto Lake (Overflow campground), Banff National Park; Veronique Creek (53°56'N, 118°50'W), E of Grande Cache on Hwy #40; Carcante Creek (53°56'N, 119°03'W), E of Grande Cache on Hwy #40.

***Ameletus cooki* McDunnough 1929**

(Figs. 5A–C, 17D, E, 22D, 26B, 31C)

**Larva** (in alcohol). Body length 7–9 mm. Antennae brown with middle and apical segments pale (in some individuals the last apical segment is brown). Labrum with a triangular brown marking proximally, but pale distally (as in Fig. 29C). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with a few short spines (as in Fig. 24C) and with a fringe of relatively short hairs (about one-third the width of the femur); anterior surface of front femora pale with a brown band at the middle (Fig. 24A). Abdominal tergites with complex pattern (Fig. 17E). Gills on abdominal segments 3–5 with moderately sized mesal extension (15–20% of maximal gill blade width) and with reduced, light tracheation (Fig. 22D). Posterolateral spines on abdominal segments 8–9 relatively long (seen in lateral view, about 2.5 times their basal widths; as in Fig. 27A). Posterior edge of sternites 6–8 without spines. Ganglionic markings may be present on sternite 8. Caudal filaments pale with brown band at the middle (one-quarter to one-third of each filament's length), and with brown apical segments.

Larvae are similar to those of *A. sparsatus* and *A. suffusus*, and are usually difficult to separate in early stages. However, final-instar larvae of *A. cooki* are smaller and usually have a larger number of pale abdominal segments. The combination of characteristics given in Table 1 will separate final-instar larvae of these three species. The larva was also described by McDunnough (1935).

Larvae of *A. cooki* usually inhabit first or second order streams.

**Female Imago** (in alcohol). Body length 7–9 mm. Mesotergum bright yellowish with light brown laterally; scutellum bright yellow, changing to brown on the posterolateral areas. Wings transparent with yellowish veins and white, faintly visible cross-veins (Fig. 30A). Abdominal segments pale without distinct markings; ganglionic marking may be present on sternite 8. Posterior margin of the subanal plate with a very shallow indentation (Fig. 31C). Caudal filaments golden yellow. Eggs flattened (Fig. 32A).

Females of *A. cooki* are separable from all other Albertan species by the combination of small body size (7–9 mm), lack of ganglionic markings, transparent wings, and flattened eggs. Other differences are given in the key and in Table 1.

**Distribution in Alberta.** Foothills in SW. Blakiston Creek (49°05'N, 113°51'W), Waterton Lakes National Park; small stream on Hwy #6 (49°14'N, 113°52'W), 6 km N of Waterton Lakes National Park; Ford Creek (50°48'N, 114°51'W), Powder Face Trail, 2.7 km upstream from its confluence with the Elbow River; Prairie Creek (50°52'N, 114°47'W), W of Bragg Creek on Hwy #66; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Wildhorse Creek (51°39'N, 115°21'W), E of Ya Ha Tinda Ranch, 1 km upstream from Red Deer River.

***Ameletus inopinatus* Eaton 1887**

(Figs. 1, 6A–C, 18A, B, 22E)

**Larva** (in alcohol). Body length 9–10 mm. Antennae pale with first segment and middle segments light brown, at least dorsally. Labrum pale with brown pigmentation in proximal corners (in some individuals the brown colour covers the proximal half of the labrum except the middle of the proximal edge that has a rounded pale patch). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with a few short spines (Fig. 24C) and with a fringe of short hairs (about one-quarter the width of the femur) mixed with a few long hairs (about one-half the width of the femur); anterior surface of front femora pale with a small brown patch proximally and a broad brown band at the middle (Fig. 24A). Abdominal tergites with distinct pattern (Fig. 18A). Gills on abdominal segments 3–5 without mesal extension, and with reduced light tracheation (Fig. 22E). Posterolateral spines on abdominal segments 8–9 relatively long (seen in lateral view, about twice their basal widths, as in Fig. 27B). Posterior edge of sternites 6–8 without spines. Ganglionic marking on sternite 8. Caudal filaments pale with a dark band at the middle (covering about one-third of each filament's length).

Larvae of *A. inopinatus* can be easily distinguished from all other Albertan species by the lack of a mesal extension on the abdominal gills (Fig. 22E). Also, the lacustrine habitat and the combination of characteristics given in Table 1 are diagnostic. A drawing of the larva was provided by Schoenemund (1930).

The life history of *A. inopinatus* in Europe was described by Gledhill (1959), Larsen (1968), Ulfstrand (1968), and Brittain (1974).

**Female Imago** (in alcohol). Body length 9–10 mm. Mesotergum brown; scutellum light brown, changing to brown on the posterolateral areas. Wings transparent with amber veins and faintly visible cross-veins (Fig. 30A). Abdominal tergites pale, with brown shading on the posterior margin. Distinct ganglionic markings on sternites 7–8. Posterior margin of the subanal plate without a pronounced indentation (Fig. 31H). Caudal filaments yellow. Eggs ovoid without large knobs (Fig. 32B).

*Ameletus inopinatus* shares transparent wings with *A. celer*, *A. cooki*, *A. pritchardi*, *A. similior*, and *A. velox*. However, the geographical distribution and habitat preference will separate *A. inopinatus*. Other differences are given in Table 1.

**Distribution in Alberta.** Not known from Alberta, but found in Great Slave Lake, NWT.

***Ameletus majusculus* Zloty 1996**

(Figs. 7A–C, 19A, 22F, 25B, 29D, 31D)

**Larva** (in alcohol). Body length 17–20 mm. Antennae light brown with increasing pigmentation toward apical segments. Labrum brown with large pale triangular patch proximally (Fig. 29D). Incisor area of left mandible with the second denticle equal to or larger than the first (Fig. 25B). Dorsal surface of front femora with numerous short spines (Fig. 24B) and with a fringe of hairs (about one-third the width of the femur); anterior surface of front femora uniformly brown. Abdominal tergites mostly brown, sometimes with elongated pale patches at the centre of tergites 6–9, and with a pair of black markings at the centre of tergites 1–7 (Fig. 19A). Gills on abdominal segments 3–5 with a moderately sized mesal extension (about 15–18% of maximal gill blade width) and with heavy tracheation (Fig. 22F). Posterolateral spines on abdominal segments 8–9 relatively long (seen in lateral view, about twice their basal widths, as in Fig. 27B). Posterior edge of sternites 6–8 without spines. Ganglionic marking sometimes present on sternite 8. Caudal filaments with basal two-thirds completely brown and apical one-third pale.

Larvae of *A. majusculus* are easily distinguished from all other Albertan species by the colour pattern of the caudal filaments. This is also the largest known species of *Ameletus*. Other characteristics are given in Table 1.

Larvae are usually found in second or third order streams. The univoltine life history was described by Zloty et al. (1993).

**Female Imago** (in alcohol). Body length 18–21 mm. Mesotergum brown changing to dark brown at the scutellum, and with a pair of white markings in front of the scuto-scutellar impression and pale streaks along the lateroparapsidal sutures. Wings transparent with dark brown to black veins and cross-veins, and with amber shading in the stigmatic area of the fore wings; wings of subimagos with brown border around veins and cross-veins (some cells on the apical half of the wings are completely brown). First abdominal tergite dark brown to black; tergites 2–9 pale white, with dark brown shading on the posterior margins extending to form triangular posterolateral patches and U-shaped median markings; this pattern is more pronounced on the anterior segments. Ganglionic marking on sternite 8; sternites 2–8 largely pale white with dark brown patches at the centre. Posterior margin of the subanal plate with a deep indentation (Fig. 31D). Caudal filaments brown, with a deep brown to black narrow ring at the base of each segment. Eggs ovoid without large knobs (Fig. 32B).

The presence of black patches at the centre of sternites 2–8 and the large body size will separate female *A. majusculus* from all other Albertan *Ameletus*. Other differences are given in Table 1.

**Distribution in Alberta.** Foothills in SW. South Castle River (49°18'N, 114°25'W), SW of Beaver Mines on Rd #774; Carbondale River (49°27'N, 114°25'W), S of Blairmore; Lynx Creek (49°32'N, 114°30'W), S of Blairmore; Elbow Creek (50°38'N, 115°00'W), 1 km downstream from Elbow Lake; Ford Creek (50°48'N, 114°51'W), Powder Face Trail, 2.7 km upstream from Elbow River; Elbow River (50°52'N, 114°47'W) at Elbow Falls on Hwy #66, W of Bragg Creek; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country.

#### *Ameletus oregonensis* McDunnough 1933

(Figs. 2, 12A–C, 19C, 22G, 24D, 26A, 27A, 28A, 31E)

**Larva** (in alcohol). Body length 9–11 mm. Antennae with alternating dark and light sections (segment 1 brown, segments 2–4 pale, segments 5–7 brown, segments 8–11 pale, segments 12–16 brown, apical segments pale). Labrum mostly brown, but with a pale patch at the middle and with a pale distal edge. Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with numerous long spines (Fig. 24D) and with a fringe of relatively sparse hairs (one-quarter to one-half the width of the femur, diminishing in size distally); anterior surface of front femora pale with a small brown patch proximally and distally, and with a broad, brown band at the middle (Fig. 24D). Abdominal tergites 8–9 with characteristic colour pattern (Fig. 19C). Gills on abdominal segments 3–5 with enlarged mesal extension (about 50% of maximal gill blade width) and with light tracheation (Fig. 22G). Posterolateral spines on abdominal segments 8–9 very long (seen in lateral view, about three times their basal widths, as in Fig. 27A). Posterior borders of sternites 6–8 with prominent spines, decreasing in size laterally (Fig. 28A). Ganglionic markings absent from abdominal sternites. Basal three-quarters of caudal filaments with alternating dark and light rings, with a pale band near the tip and with dark apical segments.

The larva of *A. oregonensis* was first described by McDunnough (1936). Larvae are unique among Albertan species in having the basal two-thirds of the caudal filaments with alternating dark and light rings and in having a distinct colour pattern on abdominal sternites 8–9 (Fig. 19C). Also, the presence of spines on the posterior borders of sternites

6–8 distinguishes this species from all other species of *Ameletus* except *A. subnotatus* and *A. validus*. These spines are largest at the middle and diminish in size laterally in *A. oregonensis* (Fig. 28A), but they are small or absent at the middle and increase in size laterally in *A. subnotatus* and *A. validus* (Fig. 28B). These differences are easily observed even in early instars. Other characteristics are given in Table 1.

Larvae of *A. oregonensis* are usually found in third to fifth order streams. Adults were observed swarming about 3–5 m above the water surface, between 1100 and 1400 hours on 6 May 1989, at the Clearwater River, 10 km west of Caroline.

**Female Imago** (in alcohol). Body length 9–12 mm. Mesotergum light brown. Wings transparent with dark brown longitudinal veins and cross-veins; at least some cross-veins faintly bordered with smoky brown; wings of subimagos with brown border around veins and cross-veins (some cells on the apical half of the wings are completely brown); base of wings without the brown suffusion that is characteristic of males of this species. Abdominal tergites pale, with brown shading on the posterolateral area and with a pair of brown median longitudinal markings; this pattern is more pronounced on the posterior segments. Abdominal sternites without ganglionic markings, but with a pair of small brown median markings. Posterior margin of the subanal plate with a pronounced indentation (Fig. 31E). Caudal filaments uniformly light brown. Eggs ovoid with a few large knobs at one pole (Fig. 32C).

The combination of characteristics provided in the key and in Table 1 will differentiate females of *A. oregonensis* from all other Albertan species.

**Distribution in Alberta.** Belly River (49°03'N, 113°42'W), Waterton Lakes National Park; Battle Creek (49°38'N, 110°05'W), Cypress Hills; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Bow River (51°17'N, 115°55'W), Castle Mountain, W of Banff; Clearwater River (52°01'N, 115°10'W), 30 km W of Caroline on Rd #591; Clearwater River (52°06'N, 114°50'W), 8 km W of Caroline on Hwy #54; James River (51°56'N, 114°45'W), 18 km S of Caroline; Wampus Creek (53°10'N, 117°15'W), Forestry Trunk Road, SE of Hinton; Bigoray River (53°32'N, 115°27'W), 27 km N of Cynthia on Rd #753.

#### *Ameletus pritchardi* Zloty 1996

(Figs. 8A–C, 19B, 23A, 31F)

**Larva** (in alcohol). Body length 9–11 mm. Antennae brown. Labrum brown proximally, but pale distally and laterodistally. Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with numerous long spines (Fig. 24D) and with a fringe of sparse hairs (one-third to one-half the width of the femur); anterior surface of front femora brown with a pale band near proximal and distal ends (Fig. 24D). Abdominal tergites with distinct colour pattern; tergite 7 brown with pale fleur-de-lis shape at the centre (Fig. 19B). Gills on abdominal segments 3–5 with reduced mesal extension (about 6% of maximal gill blade width) and with light tracheation; length of gill 4 no more than 1.5 times its width (Fig. 23A). Posterolateral spines on abdominal segments 8–9 relatively long (seen in lateral view, about twice their basal widths, as in Fig. 27B). Posterior edge of sternites 6–8 without spines. Ganglionic markings present on sternites 7–8 or only on sternite 8. Basal two-thirds of caudal filaments light brown, grading to pale on the distal segments; apical one-third brown.

Larvae of *A. pritchardi* are distinguished from all other Albertan species by the pale fleur-de-lis shape at the centre of abdominal tergite 7 (Fig. 19B), and by the shape of gills 3–5, which have small mesal extensions and are more circular than all other species except *A. inopinatus* (Fig. 23A). Other characteristics are given in Table 1.

Larvae of *A. pritchardi* inhabit first or second order streams or temporary side channels of larger streams. Because water does not flow in these side channels from mid-September to mid-June, this species probably has a univoltine life cycle with a long egg diapause.

**Female Imago** (in alcohol). Body length 9–11 mm. Mesotergum brown with a large opaque-white spot in front of the scuto-scutellar impression and with light streaks anterolaterally of this spot; scutellum brown, grading to dark brown on the posterolateral areas. Wings transparent; fore wings with milky white suffusion between costal and radial veins, more intense in stigmatic area (best seen over a dark surface); longitudinal veins light brown; cross-veins white. Abdominal tergites light brown anteriorly, grading to brown posteriorly. Abdominal sternites with ganglionic markings on sternite 8 and sometimes also on sternite 7. Posterior margin of subanal plate with a pronounced indentation (Fig. 31F). Caudal filaments golden yellow. Eggs ovoid without large knobs (Fig. 32B).

Females of *A. pritchardi* are likely to be confused with females of *A. celer*, *A. cooki*, and *A. similor*. However, the distribution of ganglionic markings (present on sternites 2–8 in *A. celer* and *A. similor*, but only on sternite 8 in *A. pritchardi*), and egg shape (flattened in *A. cooki* and ovoid in *A. pritchardi*), will distinguish these species. Other characteristics are given in Table 1.

**Distribution in Alberta.** Foothills and mountains in SW. Prairie Creek (50°52'N, 114°47'W), W of Bragg Creek on Hwy #66; Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Elbow River (51°02'N, 114°28'W), Hwy #22, 6 km S jct Hwy #1; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; stream on Hwy #93 (51°48'N, 116°38'W), 10 km NW of Peyto Lake (Overflow campground), Banff National Park; Clearwater River (52°06'N, 114°50'W), 8 km W of Caroline on Hwy #54.

*Ameletus similor* McDunnough 1928

(Figs. 11A–D, 18C–E, 23B, 26C, 29A, 31G)

**Larva** (in alcohol). Body length 8–10 mm. Antennae mostly pale with brown longitudinal streaks on their medial and lateral surfaces. Labrum brown with small pale area distally (Fig. 29A). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with at least a few long spines (Fig. 24A) and with a fringe of relatively long hairs (about one-half the width of the femur); anterior surface of front femora brown with a pale patch dorsodistally (Fig. 24C). Abdominal tergites with colour pattern as in Figure 18C, D. Gills on abdominal segments 3–5 with reduced mesal extension (about 8–10% of maximal gill blade width) and with pronounced tracheation (Fig. 23B). Posterolateral spines on abdominal segments 8–9 relatively small (seen in lateral view, about as long as their basal widths, as in Fig. 27C). Posterior edge of sternites 6–8 without spines. Ganglionic markings present on sternites 2–8 (Fig. 18E). Caudal filaments with a narrow basal pale band (about one-quarter of each filament's length), followed by a broad dark band (about one-half of each filament's length), followed by a pale narrow band and dark apical segments.

The larva has been previously described by McDunnough (1935) and by Mayo (1952) (as *A. montana*). Larvae of *A. similor* are distinguished from all other Albertan species except *A. celer* by a full sequence of ganglionic markings on abdominal sternites 2–8 (Fig. 18E). The incisor area of the left mandible has the second denticle about equal in size to the first in *A. celer* (Fig. 25B), but the second denticle is much smaller than the first in *A. similor* (Fig. 25A). Abdominal sternite 9 is mostly brown in *A. celer* (Fig. 17C), but mostly pale in *A. similor* (Fig. 18E). Also, larvae of *A. similor* are smaller than larvae of *A. celer* and their abdominal tergites have a more pronounced colour pattern (Fig. 18C, D). Other characteristics are given in Table 1.

Larvae of *A. similor* are usually found in first or second order streams. The univoltine life history was described by Zloty et al. (1993) and Pritchard and Zloty (1994).

**Female Imago** (in alcohol). Body length 8–10 mm. Mesotergum pale medially and brown laterally; scutellum yellow with brown at the centre. Wings transparent with brown

longitudinal veins and light-coloured cross-veins (Fig. 30A). Abdominal tergites light brown. Ganglionic markings on abdominal sternites 2–8. Posterior margin of the subanal plate with a shallow indentation (Fig. 31G). Caudal filaments golden yellow. Eggs ovoid without large knobs (Fig. 32B).

Only females of *A. similior* and *A. celer* have ganglionic markings on abdominal sternites 2–8. However, egg shape, body size, and flight period (Fig. 33) will distinguish these species. Other differences are given in Table 1.

**Distribution in Alberta.** Foothills and mountains in W. Cameron Creek (49°02'N, 114°01'W), Waterton Lakes National Park; Blakiston Creek (49°05'N, 113°51'W), Waterton Lakes National Park; Elbow Creek (50°38'N, 115°00'W), 1 km downstream from Elbow Lake; Ford Creek (50°48'N, 114°51'W), Powder Face Trail, 2.7 km upstream from its confluence with the Elbow River; Prairie Creek (50°52'N, 114°47'W), W of Bragg Creek on Hwy #66; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Lusk Creek (51°03'N, 115°01'W), 2 km N of Barrier Lake on Hwy #40; small stream in Sunshine Village (51°05'N, 115°40'W), W of Banff; Wildhorse Creek (51°39'N, 115°21'W), E of Ya Ha Tinda Ranch, 1 km upstream from Red Deer River; Bow Lake (51°40'N, 116°30'W), small stream near the lake on Hwy #93, Banff National Park; stream on Hwy #93 (51°48'N, 116°38'W), 10 km NW of Peyto Lake (Overflow campground), Banff National Park; Jacques Lake (outflow of the lake) (52°55'N, 117°45'W), E of Jasper; Veronique Creek (53°56'N, 118°50'W), E of Grande Cache on Hwy #40; Carcante Creek (53°56'N, 119°03'W), E of Grande Cache on Hwy #40.

#### *Ameletus sparsatus* McDunnough 1931

(Figs. 9A–C, 21B, C, 23C, 31H)

**Larva** (in alcohol). Body length 10–11 mm. Antennae mostly brown with segments 2–4 pale. Labrum pale with brown ovoid patch proximally (Fig. 29F). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with numerous long spines (Fig. 24B) and with a fringe of sparse and relatively short hairs (about one-quarter the width of the femur); anterior surface of front femora yellow with a broad brown patch at the middle that does not extend onto the ventral surface. Abdominal tergites with colour pattern as in Figure 21C. Gills on abdominal segments 3–5 with moderately sized mesal extension (about 20% of maximal gill blade width) and with light tracheation (Fig. 23C). Posterolateral spines on abdominal segments 8–9 very long, (seen in lateral view, about three times their basal widths, as in Figure 27A). Posterior edge of sternites 6–8 without spines. Ganglionic markings sometimes visible on sternite 8. Caudal filaments pale with a broad brown band at the middle (covering about one-third of each filament's length) and with a few brown apical segments.

Larvae of *A. sparsatus* could be confused only with larvae of *A. cooki* and *A. suffusus*. However, larvae of *A. cooki* are smaller and have a larger number of pale abdominal segments than do *A. sparsatus* and *A. suffusus*. Characteristics presented in the key and Table 1 will distinguish larvae of *A. sparsatus* from *A. suffusus*. The larva of *A. sparsatus* was first described by McDunnough (1935).

Larvae of *A. sparsatus* are found in third or fourth order streams, where they are usually abundant in littoral vegetation.

**Female Imago** (in alcohol). Body length 10–12 mm. Mesotergum yellowish with brown longitudinal streaks; scutellum yellow, changing to deep brown and black on the posterolateral areas. Wings transparent with brown longitudinal veins and cross-veins; fore wings with brown shadings around the cross-veins, giving them a speckled appearance and forming four larger patches (Fig. 30C). Abdominal tergites pale, with brown shading on the posterior margin that forms a pattern of triangular posterolateral patches and a pair of median longitudinal markings; this pattern is more pronounced on the posterior segments. Abdominal

sternites with ganglionic markings on sternites 7 and 8. Posterior margin of the subanal plate with a shallow indentation (Fig. 31H). Caudal filaments golden yellow, with a narrow, dark-brown to black ring at the base of each segment. Eggs flattened (Fig. 32A).

Females of *A. sparsatus* have wing pigmentation similar to *A. bellulus* and *A. subnotatus* (Fig. 30C). However, *A. sparsatus* is much smaller than *A. bellulus* and usually smaller than *A. subnotatus*. Also, *A. sparsatus* has a different flight period from *A. subnotatus* (Fig. 33). Other differences are given in Table 1.

**Distribution in Alberta.** Foothills in SW. Blakiston Creek (49°05'N, 113°51'W), Waterton Lakes National Park; Castle River (49°24'N, 114°25'W), SW of Beaver Mines on Rd #774; Oldman River (49°48'N, 114°10'W), N of Lundbreck on Hwy #22; Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Bow River (51°08'N, 114°20'W), Bowness Park, Calgary; Clearwater River (52°06'N, 114°50'W), 8 km W of Caroline on Hwy #54.

***Ameletus subnotatus* Eaton 1885**  
(Figs. 13A–C, 20B, 23D, 28B, 31I, 32C)

**Larva** (in alcohol). Body length 11–15 mm. Antennae pale with segment 1 and the middle segments brown. Labrum brown proximally and pale distally. Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with numerous long spines (Fig. 24D) and with a fringe of relatively long hairs (about one-half the width of the femur); anterior surface of front femora pale with a small brown patch at the middle (Fig. 24A). Abdominal tergites with colour pattern as in Figure 20B. Gills on abdominal segments 3–5 with enlarged mesal extension (about 50% of maximal gill blade width) and with pronounced tracheation (Fig. 23D). Posterolateral spines on abdominal segments 8–9 about 1.5–2 times as long as their basal widths, seen in lateral view (Fig. 27B). Posterior edge of sternites 6–8 with numerous spines decreasing in size medially (Fig. 28B). Ganglionic markings absent from abdominal sternites. Caudal filaments with a few brown basal segments followed by a light brown band (about one-third of each filament's length), followed by a band consisting of alternating brown and pale rings (covering about one-third of each filament's length), followed by a pale band, and a few brown apical segments. In smaller larvae the light brown band near the base of the caudal filaments is paler.

The presence of spines on the posterior edge of abdominal sternites 6–8 is shared only with larvae of *A. oregonensis* and *A. validus*. These spines are largest medially and diminish in size laterally in *A. oregonensis* (Fig. 28A), but they are largest laterally and diminish in size medially in *A. subnotatus* and *A. validus* (Fig. 28B). The enlarged mesal extension on abdominal gills 3–5 (Fig. 23D) will readily distinguish *A. subnotatus* from *A. validus*. Other characteristics are given in Table 1.

Larvae of *A. subnotatus* are unique among *Ameletus* in that they are usually found in larger rivers (fifth to seventh order).

**Female Imago** (in alcohol). Body length 12–15 mm. Mesotergum yellowish with brown longitudinal streaks; scutellum yellow, changing to deep brown and black on the posterolateral areas. Wings transparent with brown longitudinal veins and cross-veins; fore wings with brown shadings around the cross-veins giving them a speckled appearance and forming four larger patches (Fig. 30C). Abdominal tergites pale, with brown shading on the posterior margin that forms a pattern of triangular posterolateral patches and a pair of median longitudinal markings; this pattern is more pronounced on the posterior segments. Abdominal sternites with ganglionic markings on sternites 7 and 8. Posterior margin of the subanal plate usually with a moderate indentation (Fig. 31I). Caudal filaments golden yellow, with



a narrow, dark-brown to black ring at the base of each segment. Eggs ovoid with a few large knobs at the pole (Fig. 32C).

Extensive shading that forms large brown patches around some cross-veins of the fore wings is distinctive for females of *A. subnotatus*, *A. bellulus*, and *A. sparsatus*. However, *A. subnotatus* has a different flight period from the other two species (Fig. 33). Other differences are given in Table 1.

**Distribution in Alberta.** In large rivers throughout the province. Oldman River (49°43'N, 113°23'W), Fort Macleod; Oldman River (49°40'N, 112°50'W), Lethbridge; South Saskatchewan River (50°04'N, 110°45'W), Medicine Hat; Clearwater River (52°01'N, 115°10'W), 30 km W of Caroline on Rd #591; Clearwater River (52°06'N, 114°50'W), 8 km W of Caroline on Hwy #54; James River (51°56'N, 114°45'W), 18 km S of Caroline; Athabasca River (54°11'N, 115°50'W), 5–10 km W of Whitecourt; Athabasca River (54°58'N, 112°50'W), about 40 km NE of Athabasca; Athabasca River (55°17'N, 112°43'W), 20 km NW of Wandering River; Athabasca River (55°47'N, 112°37'W), Pelican Portage, NE of Athabasca; Peace River (56°30'N, 117°07'W), N of Peace River.

***Ameletus suffusus* McDunnough 1936**

(Figs. 10A–C, 20A, 23E, 29C, 30D, 31J)

**Larva** (in alcohol). Body length 9–10 mm. Antennae pale with segment 1 and a few middle segments brown. Labrum pale with brown triangular patch proximally (Fig. 29C). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with a few long spines (Fig. 24A) and with a fringe of hairs of variable length (one-quarter to one-half the width of the femur); anterior surface of front femora pale with a narrow brown patch at the middle (Fig. 24A). Abdominal tergites with colour pattern as in Figure 20A. Gills on abdominal segments 3–5 with moderately sized mesal extension (about 15% of maximal gill blade width) and with indistinct tracheation (Fig. 23E). Posterolateral spines on abdominal segments 8–9 relatively small (seen in lateral view, about as long as their basal widths, as in Fig. 27C). Posterior edge of sternites 6–8 without spines. Ganglionic markings sometimes visible on sternite 8. Caudal filaments pale with a brown band at the middle (covering about one-third of each filament's length), and with pale apical segments.

Larvae of *A. suffusus* are similar to those of *A. cooki* and *A. sparsatus*, but the combination of characteristics given in the key and in Table 1 will distinguish these species. The larva of *A. suffusus* was also described by McDunnough (1936).

Larvae of *A. suffusus* are usually found in third or fourth order streams.

**Female Imago** (in alcohol). Body length 9–10 mm. Mesotergum light brown with a lighter patch before the scuto-scutellar impression and with two similarly coloured longitudinal streaks; scutellum light brown, changing to brown on the posterolateral areas. Wings usually suffused with brown (Fig. 30D); veins and cross-veins light brown (wing suffusion may be reduced or even absent in some individuals, making identification difficult). Abdominal tergites pale to light brown, sometimes with a pair of median longitudinal markings pronounced on the posterior segments. Abdominal sternites with ganglionic markings on sternites 7 and 8. Posterior margin of the subanal plate usually with a moderate indentation (Fig. 31J). Caudal filaments pale, with a brown narrow ring at the base of each segment. Eggs flattened (Fig. 32A).

Wing suffusion in females of *A. suffusus* is similar only to *A. validus*. However, *A. suffusus* has ganglionic markings on sternites 7 and 8 (no ganglionic markings in *A. validus*), and has a different flight period (Fig. 33) from *A. validus*. Other differences are given in Table 1. Individuals with reduced wing suffusion may be confused with

clear-winged species, although egg shape, ganglionic markings, and flight period should separate them.

**Distribution in Alberta.** Western foothills. Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Muskeg River (53°55'N, 114°20'W), E of Grande Cache on Hwy #40.

*Ameletus validus* McDunnough 1923

(Figs. 14A–C, 18F, 23F, 24A, 27B, 29E, 31K)

**Larva** (in alcohol). Body length 9–11 mm. Antennae brown with a few pale apical segments. Labrum pale with two brown patches in the proximal corners (Fig. 29E). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with a few long spines (Fig. 24A) and with a fringe of hairs (one-third to one-half the width of the femur); anterior surface of front femora pale with a small brown patch proximally and dorsodistally and with a brown band at the middle (covering about one-quarter of the femur length) (Fig. 24A). Abdominal tergites with colour pattern as in Figure 18F. Gills on abdominal segments 3–5 with moderately sized mesal extension (about 20% of maximal gill blade width) and with light tracheation (Fig. 23F). Posterolateral spines on abdominal segments 8–9 very long (seen in lateral view, about 2.5–3 times their basal widths, as in Fig. 27A). Posterior edge of sternites 6–8 with small spines (Fig. 28B). No abdominal ganglionic markings. Caudal filaments pale with a dark band at the middle (about one-quarter of each filament's length) and with brown apical segments.

The larva was first described by McDunnough (1935). Small spines on the posterior edge of sternites 6–8 in larval *A. validus* are shared with only *A. oregonensis* and *A. subnotatus*, and these species can be distinguished from *A. validus* by the characteristics listed under their species accounts. Also, the colour pattern on the labrum (Fig. 29E) will distinguish species with similar abdominal markings (e.g. *A. cooki*, *A. suffusus*). Other characteristics are given in Table 1.

Larvae of *A. validus* occur in second or third order streams, and this is the only Albertan species in which final-instar larvae occur after mid-September (Fig. 33).

**Female Imago** (in alcohol). Body length 9–11 mm. Mesotergum brown with a large yellow patch and yellow longitudinal streaks in front of the scutellum; scutellum light brown. Wings uniformly suffused with brown (Fig. 30D); longitudinal veins and cross-veins brown. Abdominal tergites light brown; a pair of median, brown, longitudinal markings on the posterior segments. No abdominal ganglionic markings. Posterior margin of the subanal plate without indentation (Fig. 31K). Caudal filaments light brown to brown. Eggs ovoid without large knobs (Fig. 32B).

The suffused wings will distinguish *A. validus* from all other Albertan species except *A. suffusus*. However, *A. validus* lacks abdominal ganglionic markings and has a different flight period from *A. suffusus* (Fig. 33). Other differences are given in Table 1.

**Distribution in Alberta.** Western foothills. Cameron Creek (49°02'N, 114°01'W), Waterton Lakes National Park; Blakiston Creek (49°05'N, 113°51'W), Waterton Lakes National Park; Kananaskis River (50°45'N, 114°10'W), Kananaskis Lodge, Kananaskis Country; Ford Creek (50°48'N, 114°51'W), Powder Face Trail, 2.7 km upstream from its confluence with the Elbow River; Prairie Creek (50°52'N, 114°47'W), W of Bragg Creek on Hwy #66; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Bow River (51°10'N, 115°34'W), Banff; Maligne Lake (near the lake) (52°40'N, 117°31'W), E of Jasper; Carcante Creek (53°56'N, 119°03'W), E of Grande Cache on Hwy #40.

***Ameletus velox* Dodds 1923**  
(Figs. 15A–C, 20C, 23G, 31L)

**Larva** (in alcohol). Body length 13–15 mm. Antennae pale with first segment and a few middle segments brown, at least dorsally. Labrum mainly pale, with some brown pigmentation proximally that can form median and lateral triangular patches. Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with at least a few long spines (Fig. 24A) and with a fringe of hairs (one-third to one-quarter the width of the femur); anterior surface of front femora pale with a brown band (of variable size) at the middle (Fig. 24A). Abdominal tergites 6–7 with characteristic colour pattern (Fig. 20C). Gills on abdominal segments 3–5 with reduced mesal extension (about 5% of maximal gill blade width) and usually with pronounced tracheation (Fig. 23G). Posterolateral spines on abdominal segments 8–9, seen in lateral view, 1.5–2 times as long as their basal widths (Fig. 27B). Posterior edge of sternites 6–8 without spines (minute spines are sometimes present near the posterior corners, but they are visible only under high magnification). No abdominal ganglionic markings. Caudal filaments pale with brown band at the middle (covering about one-quarter of each filament's length) and with brown apical segments.

Larvae of *A. velox* are distinguished from all other Albertan species by the colour pattern on abdominal tergites 6–7 (Fig. 20C), and the combination of characteristics given in Table 1. The larva was described by Dodds (1923), Dodds and Hisaw (1924), McDunnough (1936) (as *A. connectus*), Edmunds (1952), and Allen and Chao (1981). McDunnough (1934) included information on this species from Alberta and provided an illustration of the fourth gill. All of these descriptions are quite general and could apply to a number of different species. They also show abdominal gills with pronounced mesal extensions (about 25% of maximal gill blade width). However, all reared larvae of *A. velox* that we have seen, including individuals from the type locality (South Boulder Creek, Tolland, Colorado), have gills with reduced mesal extensions (about 5% of maximal gill blade width). We have examined type material of *A. velox* and strongly suspect that the larva on which the Dodds' descriptions were based belongs to the recently described *A. doddsianus* (Zloty 1996) and not to *A. velox*. The description of larval *A. velox* provided by Allen and Chao (1981) also represents *A. doddsianus*, but the illustration of the fourth gill in McDunnough (1934) belongs to *A. majusculus*. Finally, the description and illustrations that Edmunds (1952) ascribed to *A. velox* in his unpublished thesis represent larvae of *A. edmundsi*.

Larvae of *A. velox* are usually found in third or fourth order streams.

**Female Imago** (in alcohol). Body length 14–15 mm. Mesotergum light brown with yellow spots in front of the scutellum (in some individuals these spots are fused and form a large yellow patch) and with lateral yellow stripes; scutellum brown, changing to deep brown on the posterolateral areas. Wings transparent (Fig. 30A) with dark brown longitudinal veins and brown cross-veins. Abdominal tergites pale, with brown shading on the posterior margin and with a pair of median, longitudinal markings (these markings are C-shaped on anterior segments). Abdomen usually without ganglionic markings (sometimes visible on sternite 8). Posterior margin of the subanal plate with a pronounced indentation (Fig. 31L). Caudal filaments golden yellow. Eggs ovoid without large knobs (Fig. 32B).

Adults of *A. velox* and four other species (*A. majusculus*, *A. oregonensis*, *A. subnotatus*, and *A. vernalis*) emerge early in the season and this separates them from all other Albertan species (Fig. 33). *Ameletus majusculus* is distinguished from *A. velox* by blackish patches at the centre of each abdominal sternite. *Ameletus oregonensis*, *A. subnotatus*, and *A. vernalis* have fore wing cross-veins bordered with smoky brown, giving them a speckled appearance. Other differences are given in Table 1.

**Distribution in Alberta.** Western foothills. Waterton Lakes National Park (49°05'N, 113°52'W); Castle River (49°24'N, 114°25'W), SW of Beaver Mines on Rd #774; Ford Creek (50°47'N, 114°50'W), mouth of Ford Creek, confluence with Elbow River; Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Bow River (51°08'N, 114°20'W), Bowness Park, Calgary; Bow River (51°10'N, 115°34'W), Banff; Wampus Creek (51°10'N, 117°15'W), Forestry Trunk Road, SE of Hinton; Waiparous Creek (51°23'N, 115°03'W), NW of Cochrane on Forestry Trunk Road; Clearwater River (52°06'N, 114°50'W), 8 km W of Caroline on Hwy #54.

***Ameletus vernalis* McDunnough 1924**

(Figs. 16A–C, 21A, 23H, 29B, 30B, 31M)

**Larva** (in alcohol). Body length 12–13 mm. Antennae pale with middle segments (segments 9–12) dark brown. Labrum mainly brown with pale oval patches in proximal corners (Fig. 29B). Incisor area of the left mandible with the second denticle much smaller than the first (Fig. 25A). Dorsal surface of front femora with numerous long spines (Fig. 24D) and with a fringe of relatively long hairs (about one-half the width of the femur); anterior surface of front femora pale with a small brown patch at the middle (Fig. 24A). Abdominal tergites with colour pattern as in Figure 21A; tergite 6 with unique colour pattern. Gills on abdominal segments 3–5 with reduced mesal extension (about 10% of maximal gill blade width) and with light but profuse tracheation (Fig. 23H). Posterolateral spines on abdominal segments 8–9, seen in lateral view, 1.5–2 times as long as their basal widths (Fig. 27B). Posterior edge of sternites 6–8 without spines. Ganglionic markings sometimes present on sternite 8. Caudal filaments pale with brown band at the middle (covering about one-quarter of each filament's length) and with brown apical segments.

The larva of *A. vernalis* was first described by McDunnough (1936). Larvae are distinguished from all other Albertan species by the colour pattern of abdominal tergite 6 (Fig. 21A). Other characteristics are given in Table 1.

Larvae of *A. vernalis* are usually found in third or fourth order streams.

**Female Imago** (in alcohol). Body length 12–14 mm. Mesotergum brown with yellowish markings at the posterior end. Wings transparent with dark brown longitudinal veins and cross-veins; cross-veins of fore wings shaded with brown, more prominent along radial veins (Fig. 30B). Abdominal tergites pale, with brown shading on the posterior margin that forms a pattern of triangular posterolateral patches (on at least the posterior segments) and a pair of median C-shaped markings; in some individuals the C-shaped markings are replaced with a single median patch. Ganglionic markings clearly visible on abdominal sternite 8 and faintly so on sternite 7. Posterior margin of the subanal plate with a moderate indentation (Fig. 31M). Caudal filaments golden yellow, with a deep brown narrow ring at the base of each segment. Eggs ovoid.

Characteristics provided in the key and in Table 1 will distinguish females of *A. vernalis* from all other Albertan species.

**Distribution in Alberta.** SW foothills. Castle River (49°24'N, 114°25'W), SW of Beaver Mines on Rd #774; Elbow River (50°56'N, 114°35'W), Bragg Creek Provincial Park; Jumpingpound Creek (51°02'N, 114°44'W) on Rd #968 at Pine Top campground, Kananaskis Country; Bow River (51°08'N, 114°20'W), Bowness Park, Calgary; Clearwater River (52°01'N, 115°10'W), 30 km W of Caroline on Rd #591; Clearwater River (52°06'N, 114°50'W), 8 km W of Caroline on Hwy #54; North Saskatchewan River (52°28'N, 116°06'W), S of Nordegg on Forestry Trunk Road.

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## REFERENCES

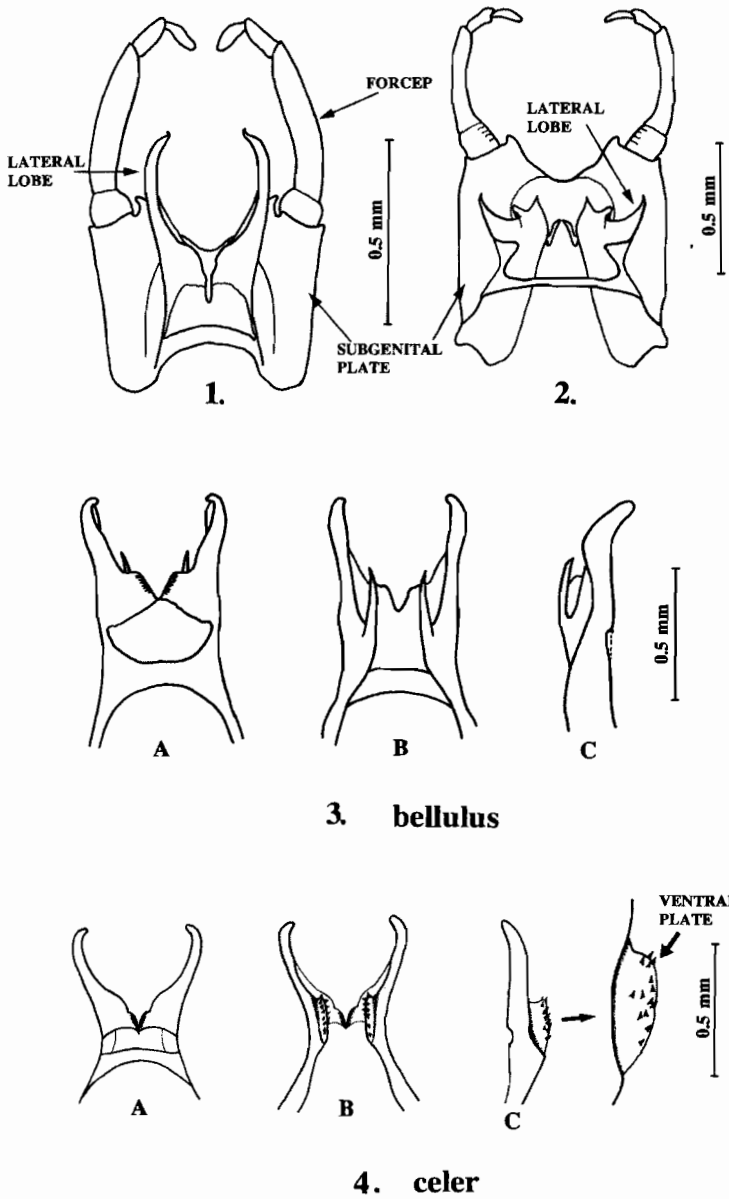
- Allen, R.K., and E.S.M. Chao. 1981. Mayflies of the Southwest: New records and notes of Siphonuridae (Ephemeroptera). *Pan-Pacific Entomologist* **57**: 449–456.
- Brittain, J.E. 1974. Studies on the lentic Ephemeroptera and Plecoptera of Southern Norway. *Norsk Entomologisk Tidsskrift* **21**: 135–154.
- Dodds, G.S. 1923. Mayflies from Colorado. Descriptions of certain species and notes on others. *Transactions of the American Entomological Society* **59**: 93–114.
- Dodds, G.S., and F.L. Hisaw. 1924. Ecological studies of aquatic insects. *Ecology* **5**: 137–148.
- Eaton, A.E. 1883–1888. A revisional monograph of recent Ephemeridae or mayflies. *Transactions of the Linnean Society of London, Zoology* **2**(3): 1–352.
- Edmunds, G.F., Jr. 1952. Studies of the Ephemeroptera. Part II. The Taxonomy and Biology of the Mayflies of Utah. Ph.D. dissertation, University of Massachusetts, Amherst, MA. 339 pp.
- Edmunds, G.F., Jr., S.L. Jensen, and L. Berner. 1976. The Mayflies of North and Central America. University of Minnesota Press, Minneapolis, MN. 330 pp.
- Gledhill, T. 1959. The life-history of *Ameletus inopinatus* (Siphonuridae, Ephemeroptera). *Hydrobiologia* **14**: 85–90.
- Kang, S.C., and C.T. Yang. 1994. Three new species of the genus *Ameletus* from Taiwan (Ephemeroptera: Siphonuridae). *Chinese Journal of Entomology* **14**: 261–269.
- Kluge, N.Ju. 1994. Pterothorax structure of mayflies (Ephemeroptera) and its use in systematics. *Bulletin de la Société entomologique de France* **99**: 41–61.
- Larsen, R. 1968. The life cycle of Ephemeroptera in the lower part of Aurland River in Sogn and Fjordane, western Norway. *Norsk Entomologisk Tidsskrift* **15**: 49–59.
- Mayo, V.K. 1952. New western Ephemeroptera III. *Pan-Pacific Entomologist* **23**: 93–103.
- McDunnough, J. 1923. New Canadian Ephemeridae with notes. *The Canadian Entomologist* **55**: 39–50.
- 1924. New Canadian Ephemeridae with notes, II. *The Canadian Entomologist* **56**: 90–98, 113–122, 128–133.
- 1928. The Ephemeroptera of Jasper Park, Alta. *The Canadian Entomologist* **60**: 8–10.
- 1929. Notes on North American Ephemeroptera with descriptions of new species, II. *The Canadian Entomologist* **61**: 169–180.
- 1931. New species of North American Ephemeroptera. *The Canadian Entomologist* **63**: 82–93.
- 1933. New species of North American Ephemeroptera III. *The Canadian Entomologist* **65**: 155–158.
- 1934. New species of North American Ephemeroptera IV. *The Canadian Entomologist* **66**: 154–164, 181–188.
- 1935. Notes on western species of Ephemeroptera. *The Canadian Entomologist* **67**: 95–104.
- 1936. Further notes on the genus *Ameletus* with descriptions of new species (Ephemeroptera). *The Canadian Entomologist* **68**: 207–211.
- Needham, J.G., J.R. Traver, and Y.C. Hsu. 1935. The Biology of Mayflies with a Systematic Account of North American Species. Comstock Publishing, New York, NY. 759 pp.
- Pritchard, G., and J. Zloty. 1994. Life histories of two *Ameletus* mayflies (Ephemeroptera) in two mountain streams: The influence of temperature, body size, and parasitism. *Journal of the North American Benthological Society* **13**: 557–568.
- Schoenemund, E. 1930. Eintagsfliegen oder Ephemeropteren, Volume 19. pp. 1–104 in Dahl, F., M. Dahl, and H. Bischoff (Eds.), Die Tierwelt Deutschlands. Gustav Fischer, Jena.
- Ulfstrand, S. 1968. Life cycles of benthic insects in Lapland streams (Ephemeroptera, Plecoptera, Trichoptera, Diptera Simuliidae). *Oikos* **19**: 167–190.
- Zloty, J. 1996. A revision of the Nearctic *Ameletus* mayflies based on adult males, with descriptions of seven new species (Ephemeroptera: Ameletidae). *The Canadian Entomologist* **128**: 293–346.
- Zloty, J., G. Pritchard, and R. Krishnaraj. 1993. Larval insect identification by cellulose acetate gel electrophoresis and its application to life history evaluation and cohort analysis. *Journal of the North American Benthological Society* **12**: 270–278.

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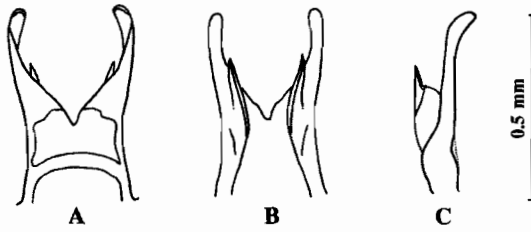
TABLE 1. Morphological characteristics of final-instar larvae (A-L) and adult females (M-S) of Alabertan *Ameletus*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
<i>A. bellulus</i>	1	1	1	1	1	2	4	1	1	1	2	4	2	1	2	2	1	2	2
<i>A. celer</i>	2	1	2	2	1	2	2	1	1	1	1	6	2	2	1	1	3	1/2	2
<i>A. cooki</i>	3	1	1	1	2	1	3	3	1	3	2	6	2	2	1	1	3	1	2
<i>A. inopinatus</i>	1	1	1	1	2	1	1	2	1	2	2	6	2	2	1	1	1	1	2
<i>A. majusculus</i>	2	2	2	2	2	2	3	2	1	2	2	3	1	1	1	2	1	3	1
<i>A. oregonensis</i>	3	1	1	4	3	1	5	3	3	3	2	1	1	1	3	2	2	1	2
<i>A. pritchardi</i>	2	1	1	4	3	1	2	2	1	2	2	5	2	1	1	1	1	1	2
<i>A. similior</i>	1	1	1	3	1	2	2	1	1	1	1	6	2	2	1	1	1	1	2
<i>A. sparsatus</i>	2	1	1	4	2	1	3	3	1	3	2	6	2	2	2	2	3	1	2
<i>A. subnotatus</i>	1	1	1	4	1	1	5	2	2	2	2	2	1	2	2	2	2	2	2
<i>A. velox</i>	1	1	1	3	2	1	2	2	1	2	2	6	2	2	1	1	2	2	2
<i>A. vernalis</i>	1	1	1	3	1	1	2	2	1	2	2	6	1	2	3	2	1	2	2

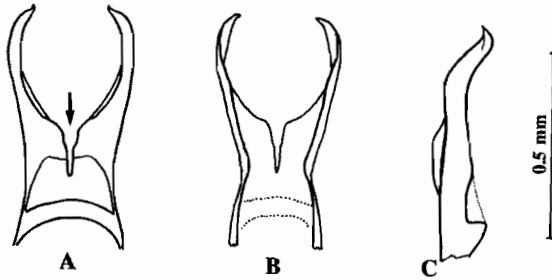
- A: 1, antennae pale with a few brown middle segments; 2, antennae uniformly amber-brown or brown; 3, antennae with alternating pale and brown segments.
- B: 1, labrum long (75–85% its width) (Fig. 29B); 2, labrum short (<65% its width) (Fig. 29D).
- C: 1, incisor area of the left mandible with the second denticle much smaller than the first denticle (Fig. 25A); 2, second denticle equal to or larger than the first denticle (Fig. 25B).
- D: 1, dorsal surface of front femora with a few short spines (Fig. 24C); 2, dorsal surface of front femora with numerous short spines (Fig. 24B); 3, dorsal surface of front femora with a few long spines (Fig. 24A); 4, dorsal surface of front femora with numerous long spines (Fig. 24D).
- E: 1, dorsal surface of front femora with a fringe of long hairs (about one-half the width of the femur); 2, dorsal surface of front femora with a fringe of short hairs (about one-quarter to one-third the width of the femur); 3, dorsal surface of front femora with a fringe of long and short hairs.
- F: 1, anterior surface of front femora with a distinct brown band at the middle (Fig. 24A, D); 2, anterior surface of front femora without a brown band at the middle (Fig. 24B, C).
- G: 1, gills on abdominal segments 3–5 without mesal extension (Fig. 22E); 2, gills on abdominal segments 3–5 with reduced mesal extension (2–10% of maximum gill blade width) (Fig. 22C); 3, gills on abdominal segments 3–5 with moderately sized mesal extension (15–20% of maximum gill blade width) (Fig. 22D); 4, gills on abdominal segments 3–5 with prominent mesal extension (22–30% of maximum gill blade width) (Fig. 22B); 5, gills on abdominal segments 3–5 with enlarged mesal extension (>40% of maximum gill blade width) (Fig. 22G).
- H: 1, posterolateral spines on abdominal segments 8–9 about as long as their basal widths (Fig. 27C); 2, posterolateral spines on abdominal segments 8–9 about 1.5–2 times their basal widths (Fig. 27B); 3, posterolateral spines on abdominal segments 8–9 about 2.5–3 times their basal widths (Fig. 27A).
- I: 1, posterior edge of abdominal sternites 6–8 without spines; 2, posterior edge of abdominal sternites 6–8 with small spines (Fig. 28B); 3, posterior edge of abdominal sternites 6–8 with large spines (Fig. 28A).
- J: 1, posterior edge of abdominal tergites 6–9 with short spines (spines about as long as their basal width) (Fig. 26C); 2, posterior edge of abdominal tergites 6–9 with spines about 1.5–2 times their basal widths (Fig. 26B); 3, posterior edge of abdominal tergites 6–9 with spines more than three times their basal widths (Fig. 26A).
- K: 1, ganglionic markings present on abdominal sternites 2–8 (Fig. 18E); 2, ganglionic markings present only on sternite 7 or sternites 7–8, or absent.
- L: 1, caudal filaments with alternating dark and light rings on basal three-quarters; 2, caudal filaments with alternating dark and light rings on the middle one-third; 3, basal two-thirds of caudal filaments dark brown, apical one-third pale; 4, basal one-half of caudal filaments (with exception of about first eight segments) dark brown, apical one-half pale; 5, basal two-thirds of caudal filaments light brown, apical one-third brown; 6, caudal filaments with conspicuous brown band (one-third to one-half of each filament's length) at the middle.
- M: 1, spring emerging species (Fig. 33); 2, summer emerging species (Fig. 33); 3, autumn emerging species (Fig. 33).
- N: 1, posterior margin of the subanal plate in adult females with a pronounced or deep indentation (Fig. 21D); 2, posterior margin of the subanal plate in adult females with a shallow or moderate indentation (Fig. 31B).
- O: 1, fore wings of adult females transparent, without brown shading around the cross-veins (Fig. 30A); 2, fore wings of adult females transparent, with brown shading around most cross-veins and with four brown patches (Fig. 30C); 3, fore wings of adult females transparent, with brown shadings around some cross-veins but without brown patches (Fig. 30B); 4, fore wings of adult females uniformly suffused with brown (Fig. 30D).
- P: 1, fore wings of subimagos uniformly suffused; 2, fore wings of subimagos with pronounced dark patches.
- Q: 1, eggs of females ovoid without large knobs (Fig. 32B); 2, eggs ovoid with a few large knobs at one pole (Fig. 32C); 3, eggs flattened (Fig. 32A).
- R: 1, adult female body length 7–11 mm; 2, body length 12–17 mm; 3, body length 18–21 mm.
- S: 1, abdominal sternites of adult females with conspicuous dark brown patches at the centre; 2, abdominal sternites of adult females without conspicuous dark brown patches at the centre.



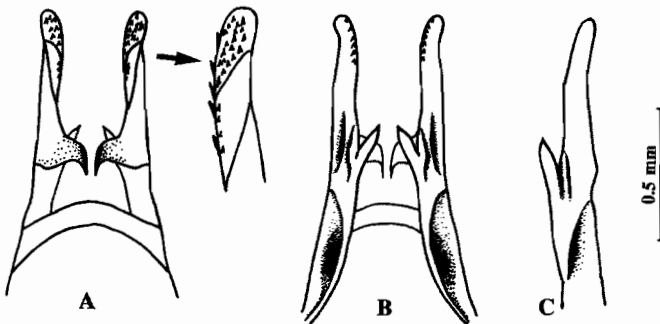
FIGS. 1-4. 1, dorsal view of male genitalia of *Ameletus inopinatus* Eaton, Great Slave Lake, NWT; 2, dorsal view of male genitalia of *A. oregonensis* McDunnough, Jumpingpound Creek, Alberta; 3, penes of *A. bellulus* Zloty, Ford Creek, Alberta [A, dorsal view; B, ventral view; C, lateral view]; 4, penes of *A. celer* McDunnough, Elbow River, Alberta [A, dorsal view; B, ventral view; C, lateral view].



**5. cooki**



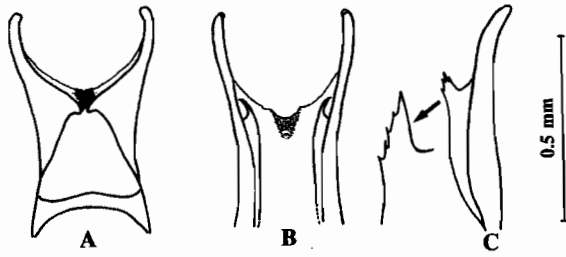
**6. inopinatus**



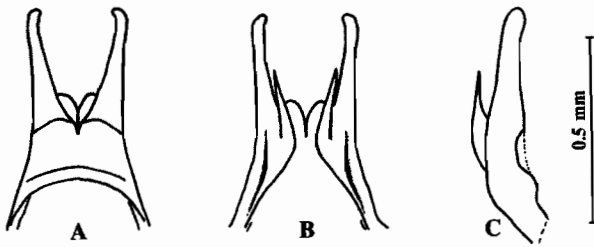
**7. majusculus**

FIGS. 5-7. 5, penes of *Ameletus cooki* McDunnough, Prairie Creek, Alberta [A, dorsal view; B, ventral view; C, lateral view]; 6, penes of *A. inopinatus* Eaton, Great Slave Lake, NWT [A, dorsal view; B, ventral view; C, lateral view]; 7, penes of *A. majusculus* Zloty, Ford Creek, southwestern Alberta [A, dorsal view; B, ventral view; C, lateral view].

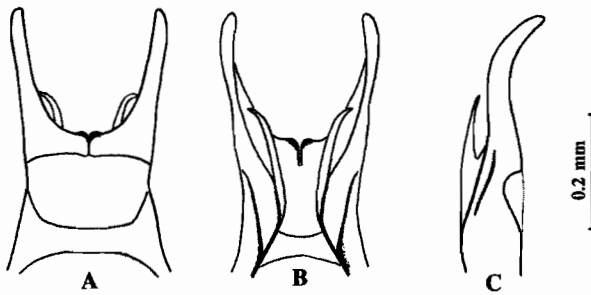




**8. pritchardi**

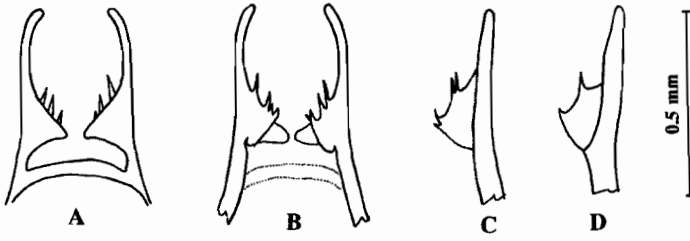


**9. sparsatus**

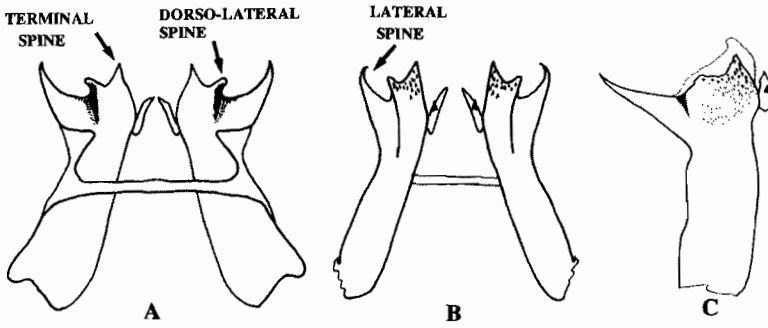


**10. suffusus**

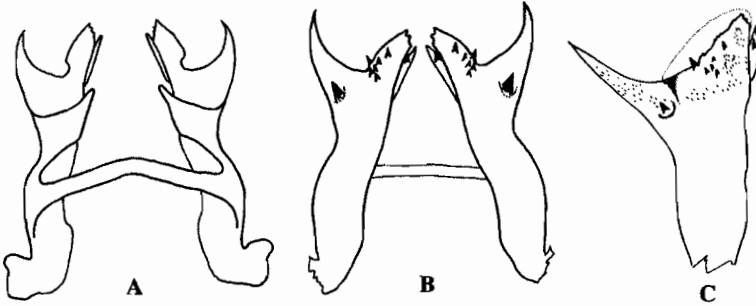
FIGS 8-10. 8, penes of *Ameletus pritchardi* Zloty, Elbow River, Alberta [A, dorsal view; B, ventral view; C, lateral view]; 9, penes of *A. sparsatus* McDunnough, Elk River, southeastern British Columbia [A, dorsal view; B, ventral view; C, lateral view]; 10, penes of *A. suffusus* McDunnough, Boundry Creek, southern British Columbia [A, dorsal view; B, ventral view; C, lateral view].



**11. similior**

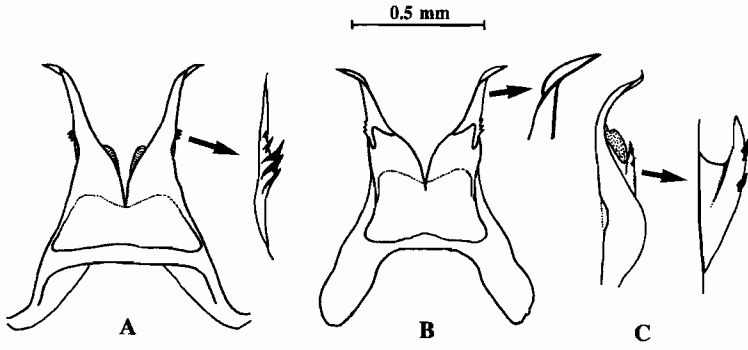


**12. oregonensis**

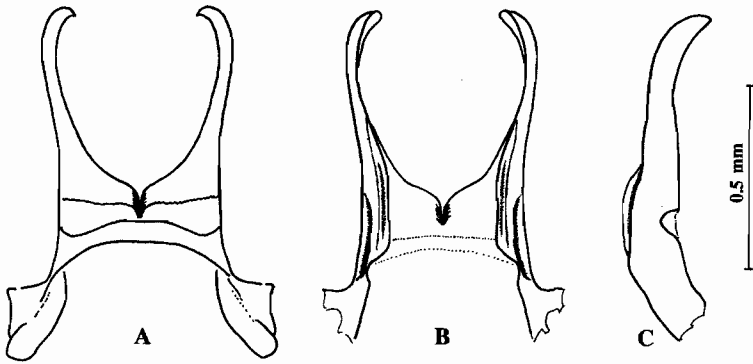


**13. subnotatus**

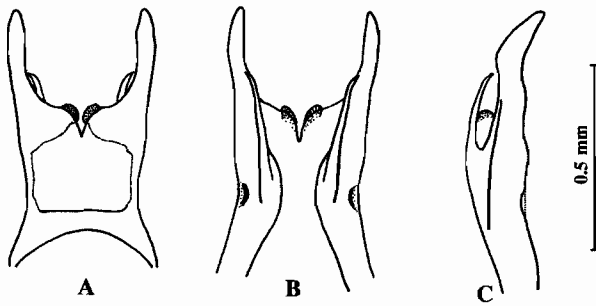
FIGS. 11-13. 11, penes of *Ameletus similior* McDunnough, Ford Creek, Alberta [A, dorsal view; B, ventral view; C, left lateral view; D, right lateral view]; 12, penes of *A. oregonensis* McDunnough, Jumpingpound Creek, southwestern Alberta [A, dorsal view; B, ventral view; C, lateral view]; 13, penes of *A. subnotatus* Eaton, James River, southwestern Alberta [A, dorsal view; B, ventral view; C, lateral view].



14. *validus*



15. *velox*



16. *vernalis*

FIGS. 14-16. 14, penes of *Ameletus validus* McDunnough, Jumpingpound Creek, southwestern Alberta [A, dorsal view; B, ventral view; C, lateral view]; 15, penes of *A. velox* Dodds, South Boulder Creek, Gilpin Co., Colorado [A, dorsal view; B, ventral view; C, lateral view]; 16, penes of *A. vernalis* McDunnough, Bow River, Calgary, Alberta [A, dorsal view; B, ventral view; C, lateral view].

17.

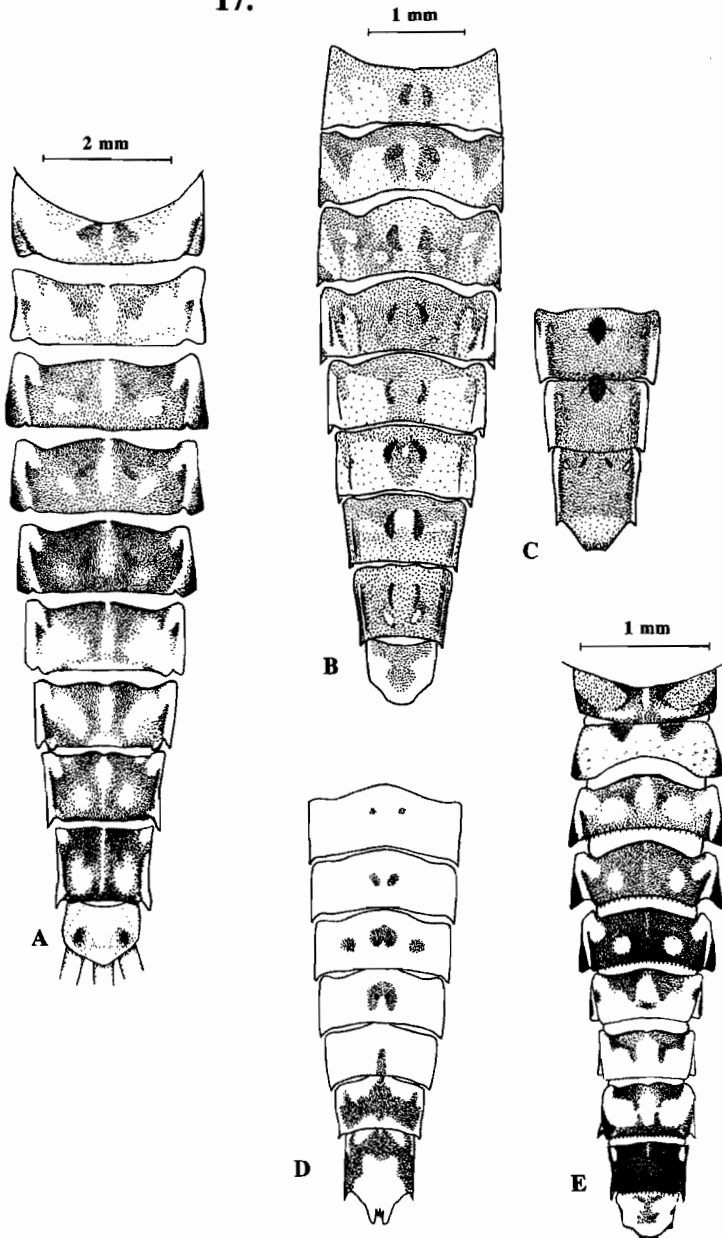


FIG. 17. Larval abdomens: A, abdominal tergites 1-10 of *Ameletus bellulus* Zloty, Ford Creek, Alberta; B, abdominal tergites 2-10 of *A. celer* McDunnough, Ford Creek, Alberta; C, abdominal sternites 7-9 of *A. celer* McDunnough, Ford Creek, Alberta; D, abdominal sternites 3-9 of *A. cooki* McDunnough, Prairie Creek, Alberta; E, abdominal tergites 1-10 of *A. cooki* McDunnough, Prairie Creek, Alberta.

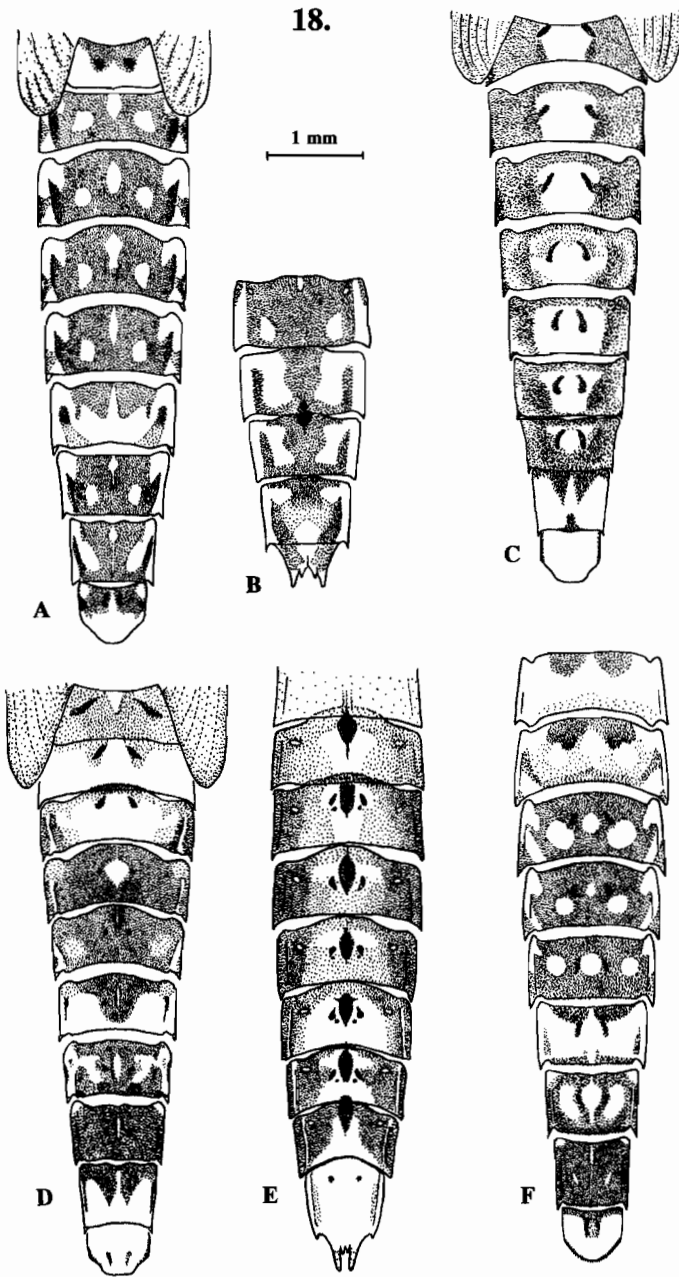


FIG. 18. Larval abdomens: A, abdominal tergites 2-10 of *Ameletus inopinatus* Eaton, Great Slave Lake, NWT; B, abdominal sternites 5-9 of *A. inopinatus* Eaton, Great Slave Lake, NWT; C, abdominal tergites 2-10 of *A. similior* McDunnough, Ford Creek, Alberta; D, abdominal tergites 1-10 of *A. similior* McDunnough, Ford Creek, Alberta; E, abdominal sternites 1-9 of *A. similior* McDunnough, Ford Creek, Alberta; F, abdominal tergites 2-10 of *A. validus* McDunnough, Prairie Creek, Alberta.

## 19.

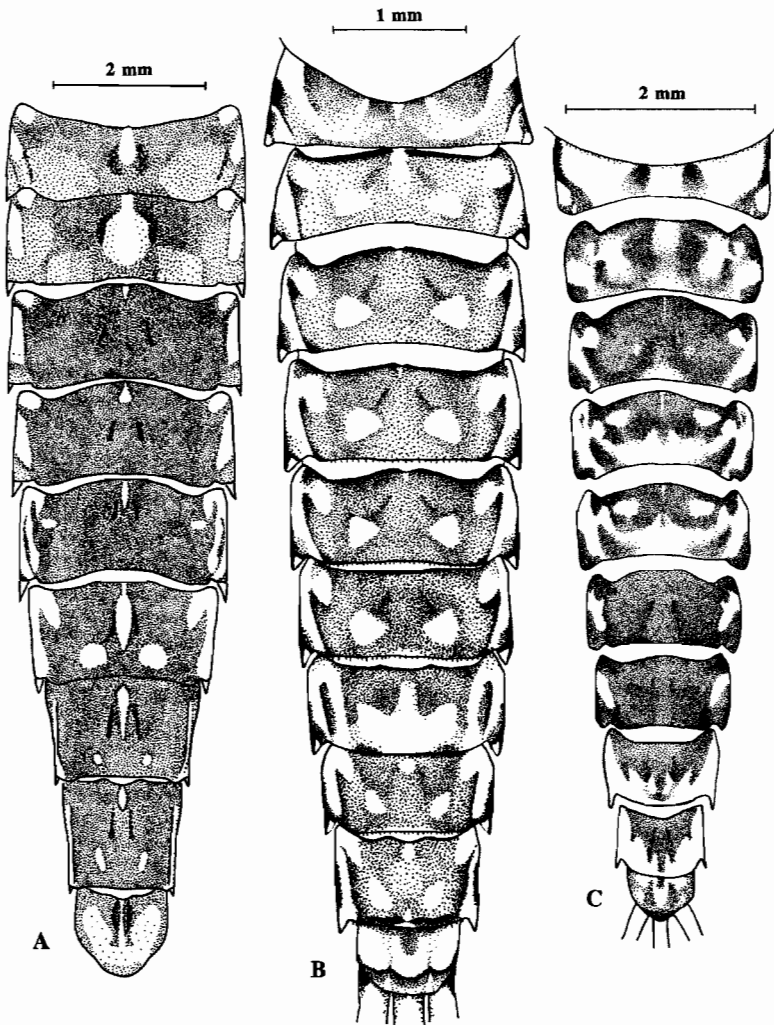


FIG. 19. Larval abdomens: A, abdominal tergites 2-10 of *Ameletus majusculus* Zloty, Ford Creek, Alberta; B, abdominal tergites 1-10 of *A. pritchardi* Zloty, Elbow River, Bragg Creek Prov. Pk., Alberta; C, abdominal tergites 1-10 of *A. oregonensis* McDunnough, Jumpingpound Creek, Alberta.

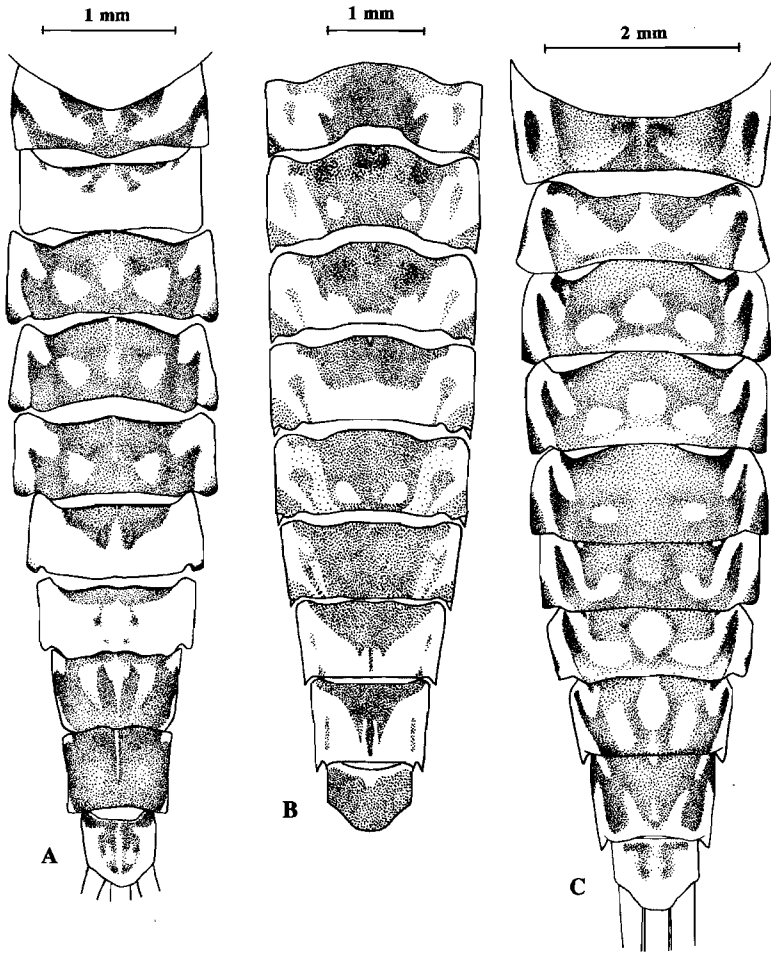


FIG. 20. Larval abdomens: A, abdominal tergites 1–10 of *Ameletus suffusus* McDunnough, Elbow River, Bragg Creek Prov. Pk., Alberta; B, abdominal tergites 2–10 of *A. subnotatus* Eaton, Clearwater River, Alberta; C, abdominal tergites 1–10 of *A. velox* Dodds, Carbondale River, Alberta.

## 21.

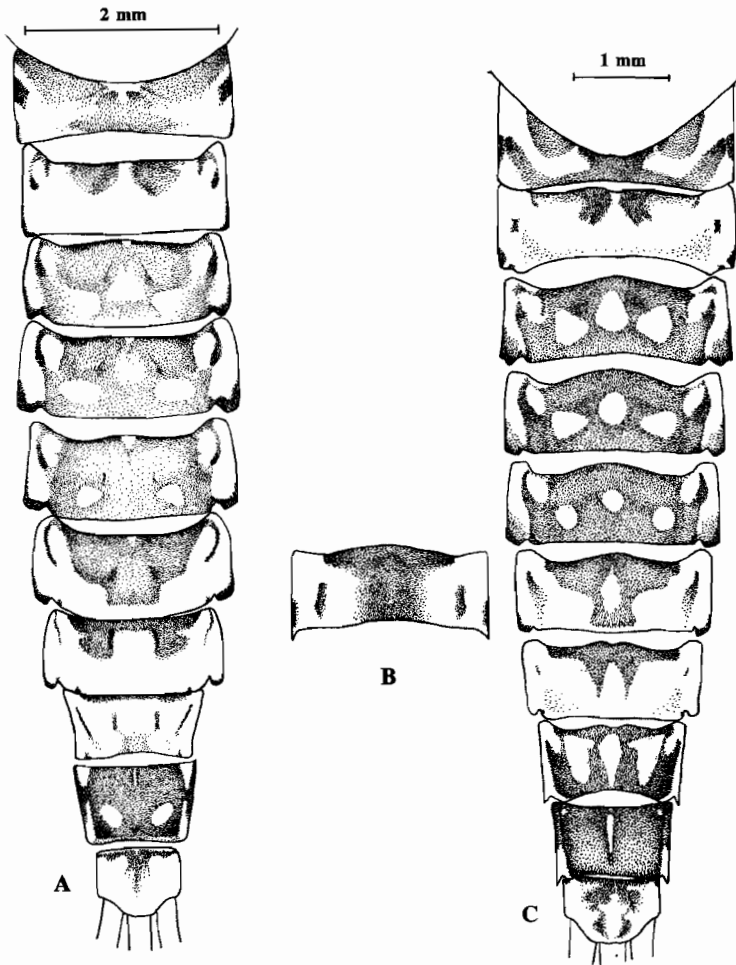


FIG. 21. Larval abdomens: A, abdominal tergites 1–10 of *Ameletus vernalis* McDunnough, Bow River, Calgary, Alberta; B, abdominal sternite 6 of *A. sparsatus* McDunnough, Oldman River, Alberta; C, abdominal tergites 1–10 of *A. sparsatus* McDunnough, Oldman River, Alberta.



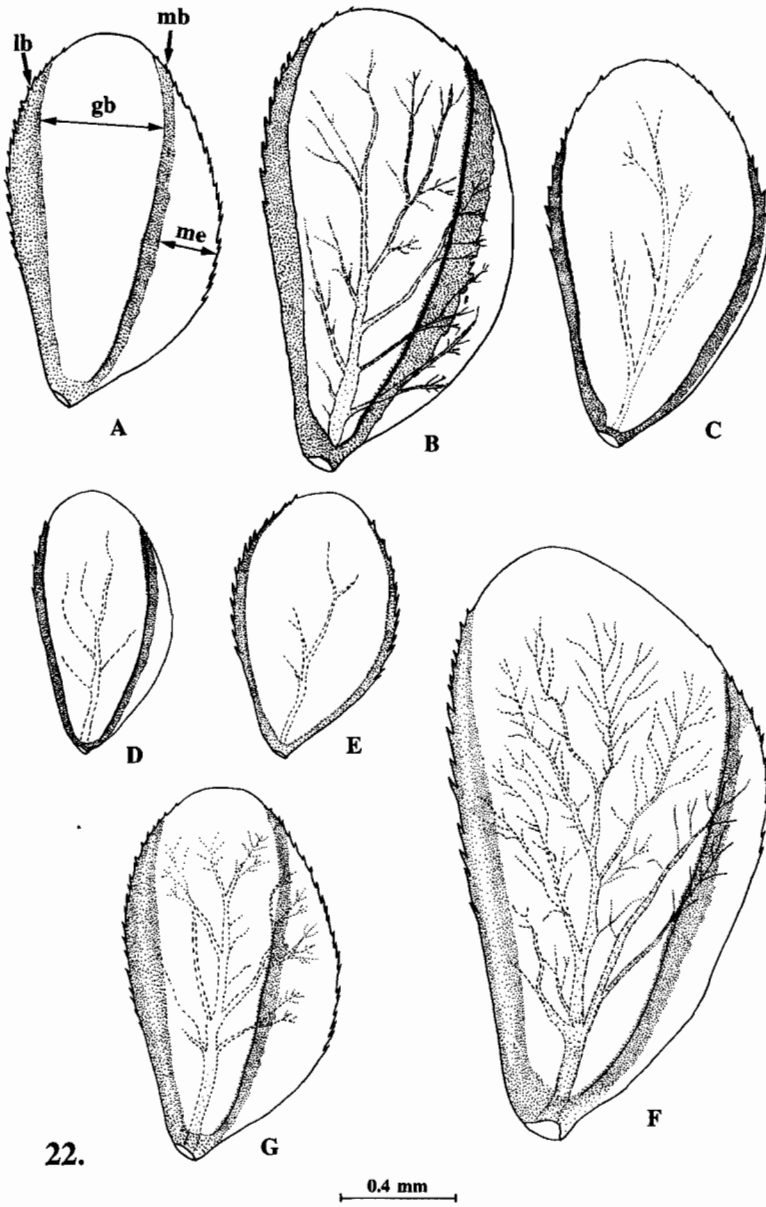


FIG. 22. Abdominal gill 4: A, *Ameletus oregonensis* McDunnough [gill blade (gb), mesal extension (me), lateral band (lb), mesal band (mb)]; B, *A. bellulus* Zloty, Ford Creek, Alberta; C, *A. celer* McDunnough, Elbow Creek, Alberta; D, *A. cooki* McDunnough, Prairie Creek, Alberta; E, *A. inopinatus* Eaton, Great Slave Lake, NWT; F, *A. majusculus* Zloty, Carbondale River, Alberta; G, *A. oregonensis* McDunnough, Jumpingpound Creek, Alberta.

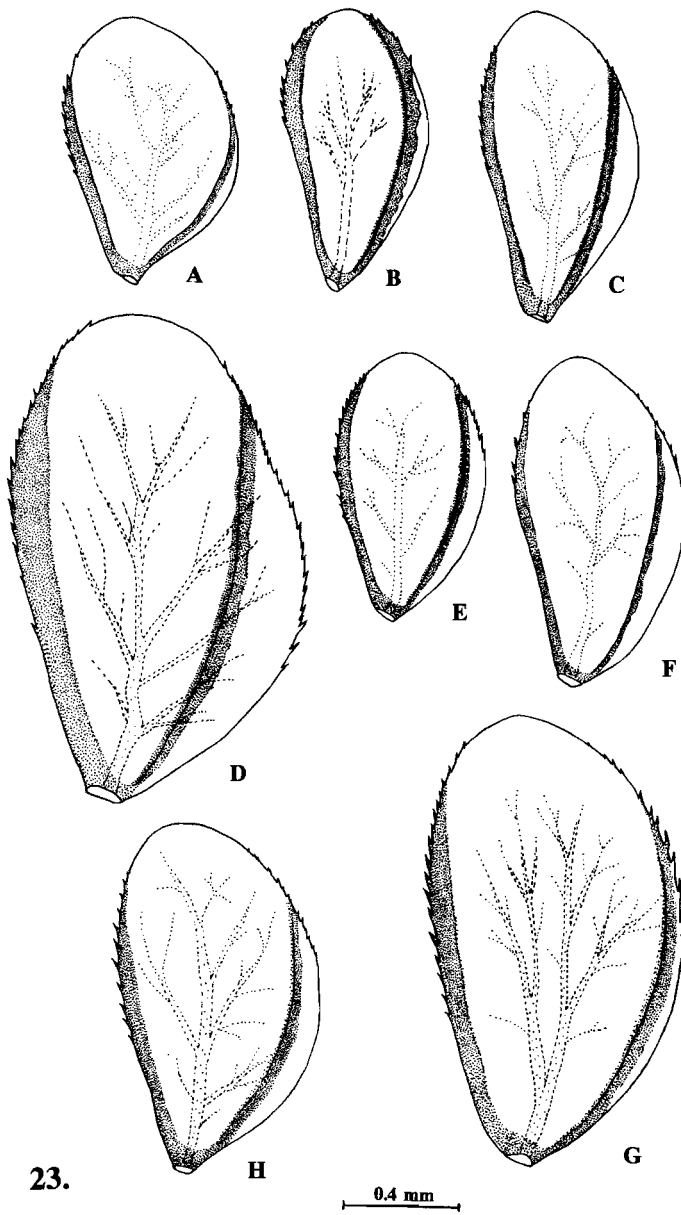
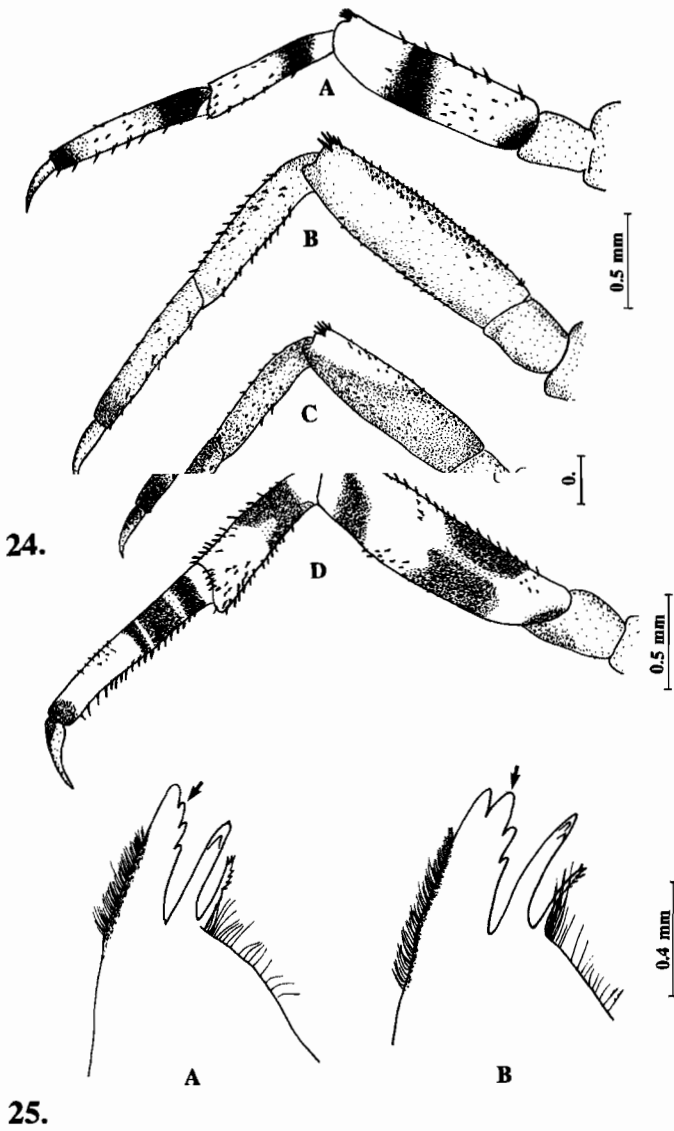
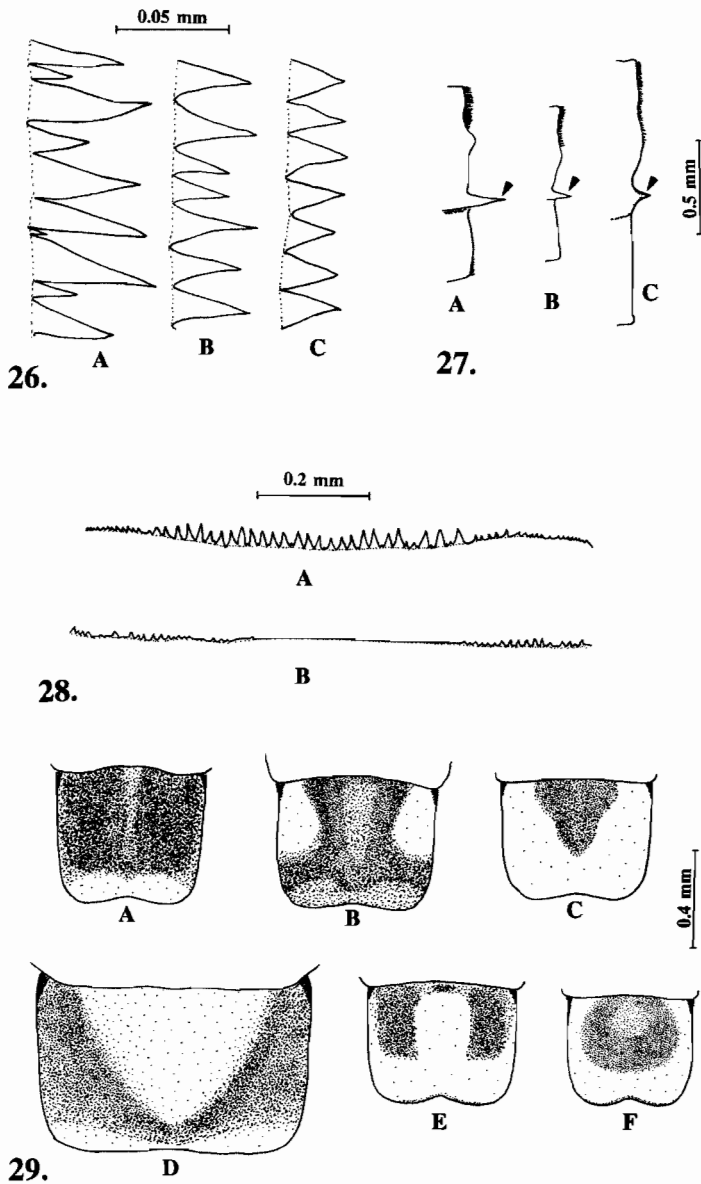


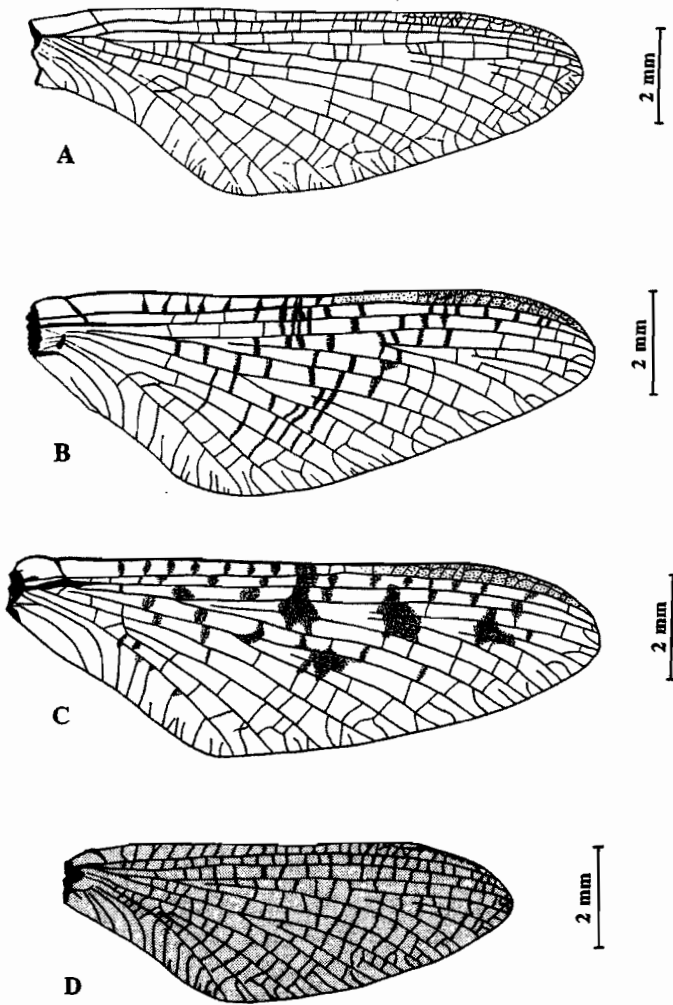
FIG. 23. Abdominal gill 4: A, *Ameletus pritchardi* Zloty, Elbow River, Bragg Creek Prov. Pk., Alberta; B, *A. similior* McDunnough, Ford Creek, Alberta; C, *A. sparsatus* McDunnough, Swan River, Montana; D, *A. subnotatus* Eaton, Green River, Utah; E, *A. suffusus* McDunnough, Elbow River, Bragg Creek Prov. Pk., Alberta; F, *A. validus* McDunnough, Lane Creek, Oregon; G, *A. velox* Dodds, Jumpingpound Creek, Alberta; H, *A. vernalis* McDunnough, Jumpingpound Creek, Alberta.



FIGS. 24-25. 24, right fore legs of larvae [A, *Ameletus validus* McDunnough, Jumpingpound Creek, Alberta; B, *A. celer* McDunnough, Jumpingpound Creek, Alberta; C, *A. bellulus* Zloty, Ford Creek, Alberta; D, *A. oregonensis* McDunnough, Clearwater River, Alberta]; 25, incisor area of larval left mandible [A, *A. bellulus* Zloty, Ford Creek, Alberta; B, *A. majusculus* Zloty, Ford Creek, Alberta].

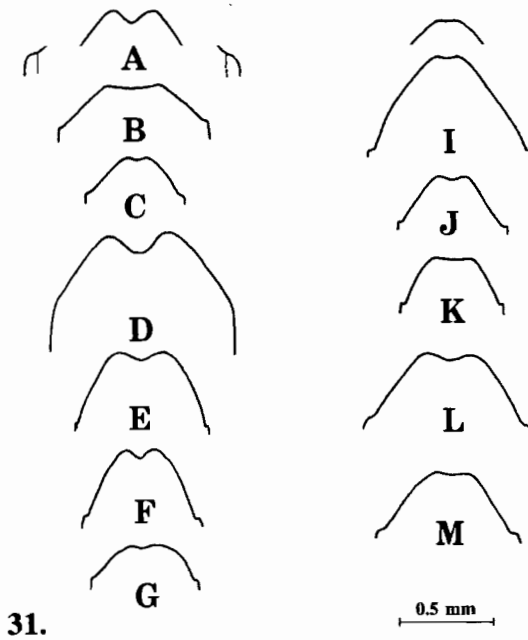


FIGS. 26–29. 26, posterior margin of larval abdominal tergite 8 [A, *Ameletus oregonensis* McDunnough, Jumpingpound Creek, Alberta; B, *A. cooki* McDunnough, Prairie Creek, Alberta; C, *A. similior* McDunnough, Ford Creek, Alberta]; 27, lateral view of larval abdominal segment 8 [A, *A. oregonensis* McDunnough, Jumpingpound Creek, Alberta; B, *A. validus* McDunnough, Jumpingpound Creek, Alberta; C, *A. bellulus* Zloty, Ford Creek, Alberta]; 28, posterior margin of larval abdominal sternite 8 [A, *A. oregonensis* McDunnough, Jumpingpound Creek, Alberta; B, *A. subnotatus* Eaton, Clearwater River, Alberta]; 29, larval labrum [A, *A. similior* McDunnough, Ford Creek, Alberta; B, *A. vernalis* McDunnough, Elbow River, Alberta; C, *A. suffusus* McDunnough, Elbow River, Alberta; D, *A. majusculus* Zloty, Ford Creek, Alberta; E, *A. validus* McDunnough, Jumpingpound Creek, Alberta; F, *A. sparsatus* McDunnough, Oldman River, Alberta].

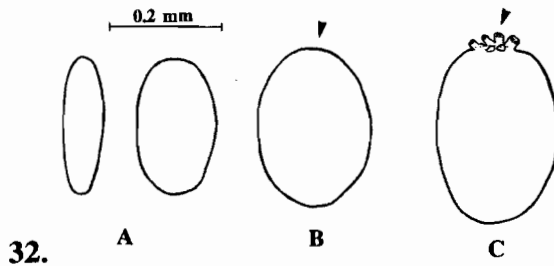


**30.**

FIG. 30. Fore wings of females: A, *Ameletus celer* McDunnough, Ford Creek, Alberta; B, *A. vernalis* McDunnough, Elbow River, Alberta; C, *A. bellulus* Zloty, Ford Creek, Alberta; D, *A. suffusus* McDunnough, Elbow River, Alberta.



31.



32.

FIGS. 31–32. 31, posterior margin of subanal plate in females [A, *Ameletus bellulus* Zloty, Ford Creek, Alberta; B, *A. celer* McDunnough, Ford Creek, Alberta; C, *A. cooki* McDunnough, Prairie Creek, Alberta; D, *A. majusculus* Zloty, Ford Creek, Alberta; E, *A. oregonensis* McDunnough, Jumpingpound Creek, Alberta; F, *A. pritchardi* Zloty, Elbow River, Alberta; G, *A. similior* McDunnough, Ford Creek, Alberta; H, *A. sparsatus* McDunnough, Bow River, Calgary, Alberta; I, *A. subnotatus* Eaton, Clearwater River, Alberta; J, *A. suffusus* McDunnough, Elbow River, Alberta; K, *A. validus* McDunnough, Jumpingpound Creek, Alberta; L, *A. velox* Dodds, Elbow River, Alberta; M, *A. vernalis* McDunnough, Bow River, Calgary, Alberta]; 32, shape of eggs [A, *A. celer* McDunnough (flattened); B, *A. bellulus* Zloty (ovoid without knobs); C, *A. subnotatus* Eaton (ovoid with knobs)].

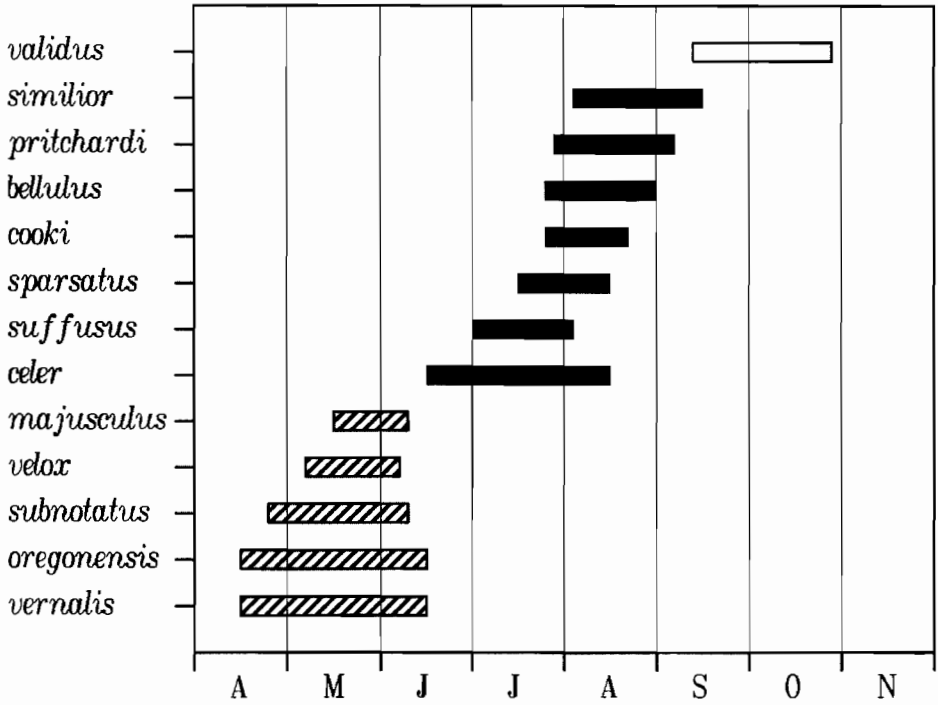


FIG. 33. Adult emergence periods (= presence of final-instar larvae) for Albertan species of *Ameletus*: cross-hatched bars indicate 'spring species', solid bars indicate 'summer species', open bar indicates 'autumn species'.