Chironomidae larvae from the lower Athabasca River, AB, Canada and its tributaries including macroscopic subfamily and tribe keys, indices for environmental tolerance and trait-based information for biomonitoring

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Abstract

Since 2011 the Joint Oil Sands Monitoring (JOSM) program has been conducted in the lower Athabasca River by the Governments of Canada and Alberta to assess the freshwater health in areas associated with oil sands development. The majority of the benthic invertebrate assemblage of the Athabasca River and its tributaries are Chironomidae larvae. Assessments of such benthic assemblages are made difficult because the identification of Chironomidae larvae is costly and time consuming. To facilitate this identification process, we aimed to develop a simple taxonomic key for Chironomidae larvae of this region. This taxonomic reference and identification key makes use of the known taxonomic details on these Chironomidae species. Moreover, we provide details on their geographical distribution, ecology, habitats, environmental tolerance values for species, and trait-based morphological characters. Our main goal was to make this information readily available to both non-specialists and specialists so that biomonitoring programs can more readily utilize these organisms in biomonitoring.

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Introduction

Chironomidae or non-biting midges are a diverse and abundant group of organisms that occur in almost all freshwater habitats. This high species richness provides advantages for ecological investigations and biomonitoring programs. This is because the Chironomidae offer a wide spectrum of possible responses to stressors and environmental variables (Rosenberg, 1992). However, in comparison to other invertebrates which are routinely used as biomonitoring tools, the taxonomy and ecology of Chironomidae species is less developed. For the most part, taxonomic problems associated with the identification of Chironomidae larvae have restricted their use in biomonitoring. For example, the USGS traits database does not include information on the Chironomidae (Vieira *et al*., 2013). Furthermore, chironomids are not good candidates in biomonitoring programs that require the rapid assessment of benthic communities largely because of the difficulty to easily identify this group to genus or species (*i.e*., few have the training to allow proper identification of larvae). In part this is due to the fact that Chironomidae species are traditionally described based on their terrestrial adult males; however, freshwater investigators routinely encounter the aquatic larvae and pupae. In addition to these problems, the attempt to identify different species of Chironomidae is hindered by the problem of coordinating the information from different specialists that are usually scattered across the globe (Cranston, 1990). Based on these constraints, extracting information on tolerance or response of chironomid species' larvae (or pupa) is particularly difficult.

By overcoming constraints associated with the taxonomic identification of Chironomidae, biomonitoring programs can utilize them as a useful biomonitoring tool. This process requires the creation of a taxonomic database that contains the known information about a given species inhabiting the focal freshwater environment. The required information includes taxonomic details of species as well as their geographical distribution, ecology, habitats, and tolerance values to various environmental variables. Additionally, such a resource must be readily available to non-specialists who cannot access scattered taxonomic literature (*e.g*., keys and catalogues) which can be confusing and difficult to understand. Our objective was to create a database that facilitates taxonomic identification of Chironomidae, and to utilize these organisms as a monitoring tool. This approach follows the work of Orendt and Spies (2012) that created an illustrated key to separate larvae subfamilies of Central European Chironomidae. Their effort

was directed mainly to those with little previous experience in chironomid larvae identification, and was intended to enable rapid identifications for bioassessment purposes. The approach represents a cost and time effective way to separate taxa.

In the first part of this manuscript we present a macroscopic illustrated key of Chironomidae larvae. The majority of larvae encountered can be separated into subfamilies and tribes based on characters that are easily detectable by low resolution sorting scopes; this requires no expertise in chironomid taxonomy. In the second section of this manuscript generic taxonomic keys of each subfamily, based on the mounted specimens are provided. These are followed by macroscopic characters for each genus and species, a detailed description of each species or species group, their Nearctic distribution, and their ecology. Therefore, users will have a very comprehensive set of tools available for identification of Chironomidae larvae. Further, we provided detailed environmental tolerance indices and trait-based characters, in table formats, for each species which facilitates the utilization of Chironomidae for biomonitoring.

Study area material and methods

Assessments of benthic biota in the Athabasca River and its tributaries were conducted at site locations designated in the Phase 1(2011) and Phase 2(2012) water quality plan of Environment Canada and Canada/Alberta Implementation Plan for Oil Sands Monitoring (Environment Canada 2012). Samples of invertebrates were collected from 10 reaches in the Athabasca River and 24 reaches in 6 major tributaries of Athabasca River. These include the Dover River, Ells River, Firebag River, Jackpine Creek, Joslyn Creek, Mackay River, and Steep Bank River (Figure 1).

Sampling

Benthic invertebrates were collected from the lower Athabasca River (mainstem and tributaries) in October 2011-13 using the Canadian Aquatic Biomonitoring Network (CABIN) 3 min traveling kick protocol for wadeable streams (Environment Canada, 2010) with a 500 µm D-frame kick net (width of bottom: 30-35 cm). This travelling kick net approach covers a large area as it is done in a zig-zag pattern while continuously disturbing the substrate. Invertebrates are dislodged from the substrate and are carried by the stream flow into the kick net and into the attached collection jar. All biomonitoring programs sample predominantly during low-flow or dry seasons, when flows are most stable and conditions are safest for crews (Buss *et al.,* 2015; Hering *et al.,* 2006; Hughes and Peck 2008; Plafkin *et al.,* 1989). Following these examples sampling was done in the early fall (*i.e*., October) 2011-13, due to high flow from early spring up to late summer in the Athabasca River. Additionally, the majority of benthic invertebrates (insects) tend to have larger body size in the fall which makes identification easier.

Samples were preserved 95% ethanol for later identification. In addition to the Chironomidae larvae collected during the river benthic collection, some pupae, associated with larvae, were also retrieved that further facilitated species level identification. Identification of most larvae was based on the repaired specimens revived from temporary or non-permanent slides found in Environment Canada's samples. In some instances a complete description of specimens was not possible due to poor specimen quality. Nevertheless, taxonomic references are provided for all species. All preserved larvae and pupae specimens were cleared and mounted based on methods described by Epler (2001) and Pinder (1978). Images were obtained by Nikon Digital Sight DS-Ri1 Camera mounted on Leica DM 2500 compound scope and Nikon SMZ 1500 stereoscope. Voucher specimens were taken for all species collected and have been submitted to the Canadian National Collection of Insects, Arachnids and Nematodes in Ottawa, Canada.

Note on the keys and Chironomidae morphology

The species keys and descriptions below are intended for the lower Athabasca River and its tributaries, near Fort McMurray and Fort Mackay, and as such they cannot be used as substitutes for identification of Chironomidae in other parts of the Athabasca River, other tributaries, geographical regions and/or freshwaters. This key is made based on the larvae specimens (*i.e*., some associated with pupae) obtained from 2011-13 biomonitoring program conducted by Environment Canada and the Alberta Ministry of Environment. It is possible that some species occur in this section of the watershed (*i.e*., see section below) that are not presented in this paper. All the keys presented in this study, therefore, must be treated as partial. It is also a good practice for the users to familiarize themselves with the detailed description given for the species and their measurements (Table 1) in order to correctly identify the larvae rather than solely rely on the keys.

It is important that the macroscopic keys be used carefully and readers are encouraged to read the entire paragraph as their guide before making their final identification. We found that tribe Corynoneurini and *Stictocladius* group in subfamily Orthocladiinae can be separated based on some macroscopic characters of their larvae. Tribes Orthocladiini and Metriocnemnini, and *Brillia* group are; however, harder to separate based on their macroscopic characters. Although, many species in tribe Metriocnemini have reduced to absent procercus. Tribes of Orthocladiinae are provisional and are made based on proposal by Sæther (1979). Based on Cranston *et al*., (2012) molecular phylogeny the monophyly of tribes Othocladiini, Metriocnemini and Corynoneurini of Chironomidae are supported. However, monphyly of proposed sister groups *Brillia* and *Stictocladius* remains questionable.

Detailed morphological characters of Chironomidae larvae are provided in Andersen *et al.* (2013), Epler (2001) and Sæther (1980a). Detailed morphological characters of Chironomidae pupae are provided in Sæther (1980a) and Wiederholm (1986).

Abbreviations

All abbreviations for larva and pupa are based on Sæther (1980a) except for $A1_{-8}$, A_I/M, DP, HL, HW, L/W, Ls, VmPR, VmPSR. A_{1-8}, A_I/M, L/W, and Ls are taken from Roback (1976). DP and VP are taken from Andersen *et al*. (2013). HL and HW are head length and width. The VmPR and VmPSR are from Maschewitz and Cook (2000) referering to different ratios of ventromental plates.

Basis for environmental tolerance and morphological adaptations

In addition to the ecology and habitat information provided for each species, we attempted to gather various environmental responses, tolerance indices, and larval morphological traits-based charcters that correspond to their niche and habitats (Table 2). The original environmental tolerance categories were based on Beck (1977). Additional data were collected from various sources (Table 3). Pollution tolerance data are based on Barbour *et al.* (1999), Kless *et al.* (2002) and Mandville (2002). Morphological categorizations are based on the original work of Chernovskii (1949) and reflect on the evolutionary adaptations of larvae to their niche and habitat (Table 2B).

Chernovskii (1949) indicated that the head capsule of many carnivorous larvae, such as those of Tanypodinae and *Cryptochironomus*, are

narrowed anteriorly and this corresponds to where mandibles are inserted. He further indicated that many larvae occurring in, or on sandy substrates, have tubular head capsules. Those larvae that burrow into hard substrate have anteriorly expanded head capsules corresponding to the base of their massive mandibles. Those larvae that mine (*i.e.*, in vegetation or substrates) have wedged-shaped head capsules in general and those that burrow have more compressed or round heads. Antennae of larvae Chironomidae also have several adaptations that reflect on their niche and habitat. Many predatory species such as those of Tanypodinae larvae have retractile antennae and those larvae occurring mainly in semi-terrestrial environment have reduced antennae. The sensory lauterborn organs of antennae are well-developed in case-building larvae of Tanytarsini and many Chironomini. This may suggest a direct interaction of larvae with their environment in order to detect suspended particles. The lauterborn organs are absent in many carnivorous species and psammophile larvae of *Harnischia* complex. The structures of the larvae mandibles are of significant importance as well. In carnivorous species the internal teeth are usually absent whereas the apical tooth is well-developed and saber-like. Presence of well-developed inner teeth suggests the mechanisms of shredding, grinding or chewing which reflect the feeding habits of the larvae. Chernovskii (1949) further indicated that larval bodies also require a significant attention. Most predatory species have bodies suited for fast mobility in their habitats. This includes elongated posterior parapods with large claws. Bodies of most chironomid larvae are cylindrical; however, some mud-dwelling species such as *Procladius* are flattened dorso-ventrally. In stream dwelling larvae posterior parapods are well-developed and proportioned to the body. In most cases posterior parapods' claws are clustered in a single group and can be retractile whereas in case-building Tanytarsini species claws are small and non-retractile. In many psammophile larvae long and slender posterior parapods combined with long and slender body suggest flexibility of movement and slithering through the sand.

Geographical records

Geographical distribution records are taken from Ashe and O'Connor (2009, 2012), Hudson *et al.* (1990) and Oliver *et al.* (1990). We also checked the literature that describes the species taxonomy and ecology for corrections and additional geographical records that are not included in the references above. Symbols used in species geographical distribution data are taken directly from Ashe and O'Connor (2009, 2012) for consistency. A $ (in bold) if precedes the Canadian Territory of Northwest Territories, *e.g.*, $Northwest Territories, denotes that it is not possible to determine whether or not a pre-1990 published record or records for the then larger Northwest Territories now applies to the now much smaller Northwest Territories, to Nunavut or both territories. New geographical records are provided in Table 4.

Additional genera and species reported in this region

Cyphomella cf. *gibbera* Sæther was reported by Barton (1980) in Athabasca River near Fort Mackay Alberta; however, it was not found in this study. The adult male and pupae of *C. gibbera* are described by Sæther (1977). Larvae of genus *Cyphomella* are described by Sæther (1977) and by Epler *et al.* (2013).

Based on the unpublished data obtained from Environment Canada the genera *Hydrobaenus*, *Larsia*, *Limnophyes*, *Parachironomus*, *Pseudodiamesa*, *Saetheria*, *Zavrelia*, *Zavrelemyia* are probably occurring in this region as well. However, we could not obtain specimens (*i.e.*, larva or otherwise) to present in this paper. Larvae of these genera are described in Andersen *et al.* (2013).

We recovered a single mounted specimen of *Metriocnemus (Metriocnemus) fuscipes* (Meigen) larvae from the samples collected from Athabasca River which was in a very bad condition. Therefore, we were not able to present the specimen in this study. Larva of *M. fuscipes* is described by Pankratova (1970), Moller Pillot (1958) and by Epler (2001).

Macroscopic key to the subfamilies, tribes and species groups of Chironomidae

See pages 247-251 for images of the following keys: 1a, 1b, 2a, 3a, 4b, 5a, 5b, 6a, 6b, 7a, 8a.

1a. Eyespots usually well-separated, horizontally parallel or in an oblique angle to each other, if not separated then subdivided to upper and lower spots or partially fused. VmP present, usually wide and distinct, mainly horizontal, VmP could be plate fused to mentum .....**Subfamily Chironominae**

1b. Eyespots not well-separated, could be absent to fade, usually 1, if 2 then usually subdivided or divided into spots mainly in vertical or oblique planes. VmP absent or if present usually narrow or indistinct, positioned vertically, if distinct usually with beard and in oblique angle.....**Subfamilies Orthocladiinae, Tanypodinae, Prodiamesinae, and Diamesinae (2)**

2a. Antenna long and retractile (sometime retracted into the head capsule). Eyespots single, could be emarginated. VmP absent. Both anterior and posterior parapods long.....**Subfamily Tanypodinae**

2b. Antenna not retractile. Eyespots fade, single, and if bifid then subdivided or divided in horizontal, vertical or oblique angle. VmP indistinct, if distinct then in oblique angle. Anterior and posterior parapods are never both long if antennae long.....**Subfamilies Orthocladiinae, Prodiamesina, Diamesinae (3)**

3a. Eyespots bifid and well-separated, parallel. VmP distinct; however, in an oblique angle.....**Subfamily Prodiamesinae**

3b. Eyespots single or subdivided, in oblique or horizontal angles and close. VmP indistinct, if distinct and in oblique angle then eye spots single or subdivided.....**Subfamilies Orthocladiinae, Diamesinae (4)**

4a. Eyespots single or subdivided, if divided in oblique or horizontal angles and close, if single then small or narrowed in anterior. VmP distinct or indistinct.....**Subfamily Orthocladiinae**

4b. Eyespots single and very large (could be faded but still large), if eyespots bifid and Orthocladiinae-like then thick dark occipital region of the head and/or reduced procercus usually separates larva in this subfamily from those in Orthocladiinae. VmP distinct or indistinct.....*__Subfamily Diamesinae__
*All species occurring in Athabasca and its tributaries belong to tribe Diamesini.

5a. Antenna arise from a well-developed pedestals, antenna more than 1/2 of head capsule, A_1 is usually long. VmPs narrow and wide and usually meet medially, if VmPs well-separated and wide then antennae pedestal is well-developed.....**Tribe Tanytarsini**

5b. Antenna does not arise from a well-developed pedestal, if pedestal present then indistinct and reduced, A_1 is usually not very long. VmP leaf shaped or plate like, and well-separated .....**Tribe Chironomini**

6a. Head capsule rounded or oval.....*Tribes Coelotanypodini, Macropelopiini, Procladini, and Tanypodini
*Only genus *Procladius* in the tribe Procladini was found in this study.

6b. Head capsule elongated.....Tribe Pentaneurini

7a. Antennae long, ≥ 1/2 of the head capsule, second antennae usually darker than other segments. Eyespots semidetached or single, teardrop shaped. Head capsule elongated.....Tribe Corynoneurini

7b. Antennae usually short, <1/2 of the head capsule, if longer than head capsule 2nd segment not dark and last segments usually whip like. Eyespots varied in shape if teardrop shaped then large. Head capsule in various shapes 8

8a. Eyespots single. 2nd antennal segment appears hyaline for most of its length. Posterior parapods elongated. Larva elongated and Ceratopogonidae-like (*i.e.*, biting midges).....***Stictocladius* group**

8b. Not with the above combination of characters.....
.....*Tribes Orthocladiini, Metriocnemini and *Brillia* group
*There are no clear macroscopic characters that can separate tribes Othocladiini, Metriocnemini and *Brillia* group. Macroscopic characters for species are given in the sections below. Additionally, using the microscopic keys the genera within subfamily Orthocladiinae can be easily separated.

Description of taxa

Subfamily Tanypodinae

Key to the genera of Tanypodinae

1a. Head round to ovate, drosomental teeth are present and well-developed in diagonal plates (Figure 9G).....Tribe Procladinae (*Procladius*)

1b. Head elongated, dorsomental teeth absent
.....Tribe Pentaneurini (2)

2a. Basal MP with more than 2 segments (Figure 2E and Figure 3F).....
.....(3)

2b. Basal MP with 1 segment.....(4)

3a. Basal MP usually with more than 2 segments (Figure 2E), if 2 then medium claws of posterior parapods not strongly serrated.....
.....*Ablabesmyia*

3b. MP with 2 basal segments (Figure 3F), medium claw of posterior parapod strongly serrated (spines; Figure 3I).....*Nilotanypus*

4a. MP with 3 segmented b-sensilum (Figure 7F), sub-basal setae of posterior parapod bifid (Figure 7J).....*Rheopelopia*

4b. MP with 2 segmented b-sensilum (Figure 5B), sub-basal setae of posterior parapod simple.....(5)

5a. Gular margin of the head pale. Posterior parapods smaller claws not thick and dark. Pupal thoracic horn with plastron (Figure 5F).
.....*Meropelopia*

5b. Gular margin of the head brown. Posterior parapods smaller claws thick and dark. Pupal thoracic horn without plastron (Figure 8A)..
.....*Thienemannimyia*

Tribe Pentaneurini

Ablabesmyia (Ablabesmyia) sp.

Larva (n=2)

Figures 2A-I

Macroscopic characters. Head capsule is elongated (Figure 2A). Eyespots are single and not emarginated, located at anterior 2/3rd of the head capsule (Figure 2A). Anterior and posterior parapods elongated (Figures 2A and I), posterior parapods with 2 darker small claws distinguishable from the rest (Figure 2I).

Description. Larva L=3.1mm. HL/HW=1.4. Cephalic S9, S10 and VP very close forming almost a right angled triangle, VP aligned with SSm and mesial to S10 (Figure 2B), DP located dorsally and S5 posteriorly, lines between S8-S7 and S5-DP diagonal (Figure 2C). Antennae 4 segmented, segments sequentially decrease in size, blade slightly shorter than flagellum (Figure 2D), RO at 3/5th of the 1st antenna segment, AR=2.8. MP 4 segmented (Figure 2E). Mandible apically dark with large inner tooth (Figure 2F), SSd almost curved reaching the lighter base of apical tooth (L=21.0 µm). Pseudoradula with even and parallel-sided granules (Figure 1G). Ligula with 5 light-brown teeth (Figure 2H); median teeth shorter than laterals, paraligula bifid (Figure 2H). Procercus longer than wide, bearing 7 apical setae (Figures 2I). Posterior parapods longer than wide, bearing group of simple claws, each parapod with 2 darker claws (Figure 2I). Anal tubules slender (Figure 2I) dorsal tubules L=64.4 µm, ventral tubules L=40.9 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae of this genus usually occur in small to large rivers. Larvae occur in waters with pH of 4-8, although, they have preference for more alkaline environment (Roback, 1985).

Remarks. The measurements of larvae indicate that they are earlier instars, probably 3rd instars. Number of maxillary palp segments appears to be 4 which make the larvae hard to key out.

Nilotanypus fimbriatus (Walker, 1828)

Larva (n=3)

Figures 3A-J

Macroscopic characters. Larva is very small. Head capsule is very narrow, almost parallel sided, and extended (Figure 3A). Eyespots are not fully emarginated, with a notch (Figure 3A), located close to mid-section of the head. Anterior parapods are very long almost reaching the mid-section of the head (Figure 3A). Anal tubules are very narrow; appear as filamentous setae rather than tubules (Figure 3B). Posterior parapods are very long, bearing light yellow claws (Figure 3B).

Description. Larva L=2.3 mm. HL/HW=1.8. Cephalic S10 is postero-medial to S9, VP close to S10 and large (Figure 3C), SSm far posterior to VP (Figure 3C), S8 posterior to S7 and far, S5 mesal on apotome (Figure 3D). Antennae 4 segmented, segments decrease in size sequentially (Figure 3E), blade slightly longer than flagellum, blade L=55.5 µm, AR=2.8. MP 2 segmented (Figure 3F), b-sensilum 2 segmented, MP L=22.0 µm, A_1/MP=6.9. Mandibles with large inner tooth and accessory tooth (Figure 3G), apical part darker, mandible L=40.8 µm. Ligula with 5 brown teeth, median tooth stands slightly higher than lateral teeth, paraligula bifid (Figure 3H). Procercus longer than wide, bearing 8 apical setae. 2 long anal setae on posterior portion of the body, anal setae L=154.4 µm. Posterior parapods much longer than wide, bearing group of claws, 1 medium claw saw-shaped with strong spines (L=48.0 µm; Figure 3I), largest claw L=69.4 µm, smallest claw L=31.0 µm. Anal tubules long and slender, dorsal tubules L=322.0 µm, ventral tubules 215.0 µm.

Pupae. TH with large clear area, plastron plate absent (Figure 2J). TH L=169.8 µm, TH W=51.0 µm, TH L/W=3.3, CL L=83.8 µm, CL W=38.6 µm, CL L/W=2.2, CL/TH=0.50.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank.

Nearctic distribution. Canada (1st record for Alberta, Québec, New Brunswick, Newfoundland, and Ontario). USA (Connecticut, Georgia, Kansas, New Jersey, New York, Ohio, North Carolina, South Carolina, and Tennessee).

Ecology and habitats. Larvae of this species occur in cool clear sandy areas of the streams. Larvae occur in streams with 16-44 ppm $CaCO_3$ hardness, low alkalinity of <20 ppm $CaCO_3$, conductivity of 32-92 µs/cm and pH of 5.6-7.0 (Roback, 1986). This species is a great indicator for water quality as it cannot tolerate poor environmental conditions (Roback, 1986).

Remarks. Larva and pupa are described by Roback (1986).

Thienemannimyia group

Meropelopia Roback, 1981

Note on the genus *Meropelopia*. Two species from this genus were found in this study, *Meropelopia americana* (Fittkau, 1957) and *Meropelpia flavifrons* (Johannsen, 1905). Larva of *M. americana* is only distinguishable from that of *M. flavifrons* on the basis of their size. The *M. americana* has a larger head capsule characteristics and ratios (Table 1). A fourth instar larva is required for the measurement of these characters. Pupa of *M. americana* is; however, easily distinguishable from that of *M. flavifrons* by the presence of filamentous LS on segment V-VIII (VII-VIII in *M. flavifrons*) and larger thoracic horn. We have obtained a 4th instar larva of *M. americana* with thoracic horn that confirmed our identification. For genus description we have provided the macroscopic characterise of larva and the microscopic characters of head capsule cephalic setae. For the purpose of biomonitoring using genus identification will be sufficient.

Macroscopic characters of the genus. Head is elongated (Figure 4A). Antennae are retractile and long (Figure 4A). Eyespots are single and emarginated, eyespots are located anteriorly close to antenna (Figure 4A). Body has long, erect simple setae, distributed evenly. Anterior and posterior parapods are long. Claws of posterior parapods are large and unicolor brown.

Cephalic setae characters of the genus. S10 lateral to S9 + VP. S9, S10 and VP close forming a triangle, S9-S10 and SSm almost in straight line (Figure 4B), S5 anterior to DP, S8 close to S7, S7 and DP in straight line (Figure 4C).

Meropelopia americana (Fittkau, 1957)

Larva (n=4)

Figures 5A-E

Description. Larva L=7.4 mm. HL=979.1 µm, HL/HW=1.1. Antennae 4 segmented, segments sequentially decrease in size (Figure 5A), A_1L=435.7 µm, A_{2-4}L=88.0 µm, blade L=77.3 µm, AR=4.9. MP with b-sensilla 2 segmented (Figure 5B), RO at 3/4th of the 1st segment, MP=80.8 µm, A_1/ MP=25.0. Mandibles with minuscule curved inner tooth (Figure 5C), mandibles darker apically, mandible L=208.2 µm. Pseudoradula with fine granulation that are parallel sided (Figure 5D). Ligula with 5 dark brown teeth, the inner teeth lower than laterals, ligula L=136.9 µm, paraligula bifid, paraligula L=57.3 µm. Procercus longer than wide, bearing 7 apical setae and 2 sub-apical setae (Figure 5E). Posterior parapods with group of unicolor claws (Figure 5E), largest claw L=197.0 µm, smallest claw L=86.0 µm, setae of posterior parapod long and simple. Anal tubules long and conical, dorsal tubules L=232.6 µm, ventral tubules L=178.9 µm.

Pupae. TH trumpet shaped, plastron plate present and round (Figure 5F). TH L=341.8 µm, TH W=145.1 µm, TH L/W=2.3. Plastron plate L=195.6 µm. Filamentous LS on segments V-VIII, L≈ 216.5 µm. Shagreens (Figure 5G).

Rivers and streams. Athabasca River, Firebag River, Jackpine Creek, Mackay River, Ells River, Steep Bank, and Dover River.

Nearctic distribution. Canada (1st record for Alberta, Ontario). USA (Connecticut, Georgia, Kansas, New Jersey, New York, Ohio, North Carolina, South Carolina, and Tennessee).

Ecology and habitats. Larvae of this species occur in small to large rivers with total hardness preference of 18.8 ppm $CaCO_3$, alkalinity preference of 5.67 ppm $CaCO_3$, conductivity preference of 41 µs/cm, pH preference of 5.64, and temperature preference of 15.9°C (Roback, 1981).

Meropelopia flavifrons (Johannsen, 1905)

Larva (n=-2)

Figures 6A-B

Description: Larva L=5.6-8.3 (6.9) mm. HL=748.8 µm, HL/HW=1.1. Antennae 4 segmented, segments decrease in size sequentially, A_1L=281.7 µm, A_{2-4}L=60.5 µm, blade L=52.2 µm, AR=4.6. MP with b-sensilla 2 segmented, RO at 3/4th of the 1st segment, MP_1=51.2 µm, A_1/ MP=5.5. Mandibles similar to *M. americana*, mandible L=156.8 µm. Pseudoradula similar to *M. americana* (Figure 6A). Ligula and paraligula similar to *M. americana* (Figure 6B), ligula L=98.6 µm, paraligula L=43.1 µm. Procercus similar to *M. americana*. Posterior parapods similar to *M. americana*, longest claw L=211.4 µm, shortest claw L=110.3 µm, setae of posterior parapod long and appear simple. Anal tubules long and conical, dorsal tubules L=207.0 µm, ventral tubules L=166.6 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank.

Nearctic distribution. Canada (Alberta, Québec, New Brunswick, and Saskatchewan). USA (Alaska, California, Connecticut, Florida, Georgia, Idaho, Michigan, New Hampshire, New Jersey, New York, Pennsylvania, South Carolina, and Washington).

Ecology and habitats. Larvae of this species occur in small to large rivers with total hardness preference of 41.8 ppm $CaCO_3$, alkalinity preference of 15.6 ppm $CaCO_3$, conductivity preference of 102.3 µs/cm, pH preference of 6.1, and temperature preference of 14.4°C (Roback, 1981).

Rheopelopia acra group

Larva (n=2)

Figures 7A-J

Macroscopic characters. Head is elongated (Figure 7A). Antennae are retractile and long (Figure 7A). Eyespots are single, located in the mid-section of the head (Figure 7A). Body has long erect, simple setae (Figure 7B). Anterior and posterior parapods are long. Claws of posterior parapods are large and unicolor brown (Figure 7B).

Description. Larva L=3.1 mm. HL/HW=1.3. Cephalic S9, S10 and VP in close proximity forming a triangle, S10 lateral to S9 and VP (Figure 7C), S9-S10 and SSm aligned (Figure 7C), S5 anterior to DP (Figure 7D), S5 aligned with S7, S8 posteromesial to S7 and DP (Figure 7D), S5, S8 and S10 plumose, S7 with 10 branches. Antenna 4 segmented, segments decrease sequentially (Figure 7E), AR=2.9. MP b-sensilum 3 segmented (Figure 7F), A_1/MP=5.7. Mandibles with minuscule inner teeth (Figure 7G), apical tooth darker. Pseudoradula with parallel sided granules widening in mid-section (Figure 7H). Ligula with 5 light brown teeth, median tooth shorter than laterals, the 1st laterals out-turned (Figure 7I), paraligula bifid. Procercus longer than wide, bearing 7 apical setae. Posterior parapods with group of simple claws, largest claw L=96.0 µm, smallest claw L=40.7 µm posterior parapod sub-basal setae bifid (Figure 7J). 4 anal tubules of equal size, L=180.2 µm.

Rivers and streams. Ells River, Firebag River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae of species in this group occur in small to large rivers with total hardness preference of 28-47.7 ppm $CaCO_3$, alkalinity preference of 8-36.3ppm $CaCO_3$, conductivity preference of 54-89.4 µs/cm, pH preference of 6.64-7.0, and temperature preference of 15.3-16.0°C.

Remarks. The measurements of larvae in this study indicate that they are earlier instars, probably 3rd instars. Epler (2001) has separated larvae of this group from other groups in *Rheopelopia* on the basis of bifid subbasal setae of the posterior parapod. Roback (1981) indicated that species in this group are closely resemble each other in all stages and as such are hard to separate based on their morphological characters.

Thienemannimyia senata (Walley, 1925)

Pupae (n=1)

Figures 8A-E

Diagnosis. Pupa TL=5.5 mm. TH (Figure 8A), respiratory atrium semi-amoeboid, about 7ostia above apical disc, TH L=306.4 µm, TH W=127.9 µm, L/W=2.4. Scar of segment I (Figure 8B). Shagreens (Figure 8C). 5 filamentous LS on segments VII-VIII (Figure 8D), Ls=386.0-559.2 (495.1) µm. Genital sac reach 1/4th of the anal lobes in female (Figure 8E), 2 long macrosetae, L=459.5 µm, anal lobe L=498.2 µm.

Rivers and streams. Ells River.

Nearctic distribution. Canada (Alberta, New Brunswick, Nova Scotia, Ontario, Québec, and Saskatchewan). USA (California, Florida, Georgia, Illinois, Iowa, Kansas, Michigan, Minnesota, New Jersey, New York, Rhode Island, South Dakota, and Washington).

Ecology and habitats. Larvae of this species occur mainly in large rivers with total hardness preference of 131.6 ppm $CaCO_3$, alkalinity preference of 103.2 ppm $CaCO_3$, conductivity preference of 380.0 µs/cm, pH preference of 7.76, and temperature preference of 24.4°C (Roback, 1981).

Remarks. Single pupa specimen of this species was obtained in this study. Larva is described by Roback (1981).

Tribe Procladini

Procladius (Holotanypus) sp.

Larva (n=4)

Figures 9A-H

Macroscopic characters. Head is round (Figure 9A). Antennae are retractile but not long (Figure 9A). Eyespots are single and emarginated, eyespots are located at anterior 1/3rd of head capsule (Figure 9A). Dorsomental teeth are large and visible in transverse rows (Figure 9B). Body has long, erect, simple setae distributed evenly. Anterior and posterior parapods are long. Claws of posterior parapods are large and unicolor (brown).

Description. Larva L=5.2-7.8(6.4) mm. HL=563.0 µm, HL/HW=1.01. Cephalic S10, SSm and VP are not quiet aligned, SSm medial to S9 and S10 (Figure 9C), DP posterior to S7 and S8 (Figure 9D), S5 quiet anterior. Antenna 4 segmented, blade shorter than flagellum (Figures 9E), AR=4.4. MP with 2 segmented b-sensilum, A_1/MP=2.5. Mandible with large basal tooth (Figure 9F). Ligula with 5 dark teeth (Figure 9G), median tooth shorter and smaller than laterals, paraligula multitoothed with outer tooth long. Dorsomental plate well-developed with 6 pairs of teeth. Procercus longer than wide, bearing 13-14 apical setae (Figure 9H). Posterior parapods longer than wide, bearing group of claws, smaller claws simple and without expanded base (L=44.4 µm Figure 9H), larger claws anteriorly whip-like (L=197.0 µm; Figure 9H).

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae of *Procladius (Holotanypus)* occur in muddy substrate of standing or running waters (Cranston and Epler 2013). Larvae are reported in waters with pH of 4.1-8.0, total hardness of <50-260 ppm CaCo3, alkalinity of <40-200, conductivity of <100-500 µS/cm, and water temperature of <8-28°C (Roback, 1980).

Remarks. This subgenus can be separated from *Psilotanypus* based on whip or hair-like extension of larger claws of posterior parapod, non-expanded base of smaller claws of posterior parapods, and angled or posteriorly positioned DP of head capsule.

Subfamily Diamesinae

Key to the genera of Diamesinae

1a. Mentum toothless (Figure 13F). Premandible with ≥ 15 teeth (Figure 13D). Mandible without seta interna..... .....***Potthastia longimanus* group**

1b. Mentum toothed (Figure 10F, Figure 11E and Figure 12E). Premandible with ≤13 teeth (Figure 10D and Figure 12D). Mandible with or without seta interna.....**(2)**

2a. Pecten epipharyngis with 5-9 scales. Mentum with ≥ 15 dark teeth .....***Diamesa***

2b. Pecten epipharyngis with 3 scales. Mentum with ≤15 dark teeth (Figure 11E and Figure 12E).....**(3)**

3a. Mentum with 4-6 ridge-like median projection instead of teeth (Figure 11E), SSm closer to occipital region than to mentum (Figure 11E) .....***Pagastia***

3b. Mentum with wide dome-shaped median tooth (Figure 12E), SSm closer to mentum (Figure 12E) .....***Potthastia gaedii* group**

Diamesa sp.

Larva (n=1)

Figures 10A-F

Macroscopic characters. Head is reddish-brown (Figure 10A); occipital region is thick and dark. Eyes are double (Orthocladiinae-like) attached with a small line between them (Figure 10A), located close to mid-section of the head capsule. Procercus are well-reduced bearing 4 apical setae (Figure 10B). Posterior papapods have large dark claws. Anal tubules are semi-circular and are much smaller than posterior parapods.

Description. Larva L=7.4 mm. HL/HW=0.9. Antenna 5 segmented, 3rd segmented annulated, 5th segment slightly longer than 4th (Figure 10C), AR=2.7. SI-SII simple and small, SIII bifid (Figure 10D). Pecten epipharyngis with 5 scales. Premandible with about 7 teeth (Figure 10D). Mandible dark with 1 apical tooth and 4 inner teeth, seta interna with about 20 serrated branches (Figure 10E). Mentum (Figure 10F). Procercus reduced wider than long, bearing 4 thick dark setae. Posterior parapod longer than wide, bearing group of large dark claws. Anal tubules much smaller than posterior parapods, dorsal tubules L=236.8 µm, ventral tubule L=86.2 µm.

Rivers and streams. Ells River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae of *Diamesa* are generally inhabitant of cool stenothermic running waters.

Remarks. Single larval specimen was obtained in this study that has a worn mentum and a damaged body. We could not produce better images based on this specimen, and further we were unable to identify the larva to species.

Pagastia orthogonia Oliver, 1959

Larva (n=1)

Figures 11A-E

Macroscopic characters. Head is yellow with dark thick occipital region (Figure 11A). Eyes are bifid and attached in oblique angle

(Figure 11A), located at anterior 1/4th of the head capsule. Posterior parapods not much longer than wide. Procercus developed but small. Anal tubules conical smaller than posterior parapods (Figure 11B).

Description. Head light yellow and without marking, head capsule elongated, HL/HW=1.5. Antenna 5 segmented, 1st segment slightly longer than 2nd, 3rd segment annulated (Figure 11C) AR=0.71, LO as long as 3rd segment, RO at the base. SI and SIII simple. Pecten epipharyngis with 3 narrow scales. Premandible with 5 teeth and small spine. Mandible with elongated apical tooth and 4 inner teeth, apical tooth slightly longer than combined length of inner teeth, SSd small (Figure 11D), seta interna with 5 branches. Mentum with no median tooth, 4-6 projections and 6-7 lateral teeth (Figure 11E), VmP well-developed covering the lateral teeth (Figure 11E). Body with long erect setae. Procercus present with 7-8 apical setae and 2 sub-apical setae. Dorsal anal tubules slightly longer than ventral tubules, ventral tubules are wider, dorsal tubules L=85.8 µm, ventral tubules L=75.0 µm.

Remarks. According to Epler (2001) *P. orthogonia* is the only known species from southeast USA. The teeth of the mentum are often difficult to detect because of the dark and over bearing ventromental plates. Epler (2001) notes that mandible of *P. orthogonia* is similar to that of the western Nearctic species, *Pagastia sequax* (Garrett, 1925). Lack of marking on head capsule separates the larva of *P. orthogonia* from *P. sequax*. *P. orthogonia* AR is <1.2 which separates it from other known Holarctic species (Makarchenko and Makarchenko, 2000).

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (1st record for Alberta, Nunavut, and Prince Edward Island). USA (Alaska, Georgia, Michigan, North Carolina, North Dakota, Ohio, and Tennessee).

Ecology and habitat. Larvae of *Pagastia* usually inhibit the small streams.

Remarks. We could only obtain a mounted specimen of this species in this study. Macroscopic characters provided in this study are based on a specimen from Prince Edward Island.

Potthastia Kieffer, 1922

Note on genus *Potthastia*. This genus has 2 quiet distinct larval types. However, according to Serra-Tossio (1971) adults and pupae of the groups resemble each other and therefore, belong to the same genus. The key to the genera of Diamesinae can partially separate the two larval types.

Potthastia gaedii group

Larva (n=1)

Figures 12A-F

Macroscopic characters. Head capsule is yellowish-brown, occipital regions are thick and dark (Figure 12A). Eyes are large (faded in this specimen) (Figure 12A), located at anterior 1/3rd of the head capsule. Mandibles are large. Mentum is well-developed and visible (Figure 12B). Procercus is small and reduced. Anal tubules are conical and shorter than posterior parapods.

Description. Larva L=5.3 mm. HL/HW=1.1. Antennae 5 segmented, 3rd segment annulated, 1st segment longer than 2nd, 4th shorter than 5th (Figure 12C), blade slightly shorter than flagellum, AR=1.6. SI simple and large, SII-SIII simple and small. Premandible simple (Figure 12D). Mandibles with 4 inner tooth, apical tooth about the same size as total width of inner teeth (Figure 12C), seta interna with about 15 serrated branches. Mentum with 1 broad median tooth and 8 pairs of lateral teeth (Figure 12E), median and 1st lateral teeth lighter than remaining laterals, median tooth 11X the 1st laterals, VmP well-developed slightly covering the lateral teeth, SSm posteriad to mentum. Body with simple short setae. Procercus reduced about the same length as wide, bearing 7 apical setae and 2 sub-apical setae. 2 long anal setae on posterior end (L=143.0 µm). Posterior parapods 1.4X longer than wide, bearing group of large simple claws (Figure 12F). Dorsal tubules L=134.5 µm, ventral tubules L=104.7 µm.

Rivers and streams. Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae of this species usually occur in sandy substrate of lotic environment (Sæther and Andersen, 2013).

Remarks. This larva is probably the *Potthastia gaedii* (Meigen, 1838). The *P. gaedii* is not reported in Canada. In USA it has been reported in Michigan, North Carolina, and Tennessee. This species may also occur in Georgia.

Potthastia longimanus group

Larva (n=4)

Figures 13A-G

Macroscopic characters. Head capsule is yellow, occipital regions are thick and dark (Figure 13A). Eyes are single and very large (Figure 13A), located at anterior 1/3rd of the head capsule. Mandibles are small. Mentum is not developed (Figure 13B). Procercus are small and reduced (Figure 13C). Anal tubules are conical and shorter than posterior parapods.

Description. Larva L=4.6 mm. HL/HW=1.3. Antennae 5 segmented, 3rd segment annulated, 1st segment shorter than 2nd (Figure 13C), blade shorter than flagellum, AR=0.50. SI bifid with spine, SII-SIII simple. Premandibles with 1 outer spine, 1-2 large spine-like teeth and several smaller spine-like teeth (Figure 13D). Mandibles with 2 inner tooth, apical tooth much longer than the combine width of inner teeth (Figure 13E). Mentum toothless consisting of single wide plate and fused VmPs, SSm almost attached to mentum (Figure 13F). Body with simple short setae. Procercus well-developed, bearing 5 apical setae and 2 sub-apical setae. 2 long anal setae on posterior end (L=158.8 µm). Posterior parapods 1.4X longer than wide, bearing group of large simple claws (Figure 13G). Anal tubules shorter than posterior parapods (Figure 13G), dorsal anal tubules slightly longer than ventral tubules, dorsal tubules L=64.12 µm, ventral tubules L=50.8 µm.

Rivers and streams. Athabasca River, Ells River, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larva of *Potthastia longimanus* Kieffer usually occurs in sandy substrate of both lotic and lentic environments (Sæther and Andersen, 2013a).

Remarks. The *Potthastia longimanus* Kieffer has not been reported in Alberta. In Canada occurs in Ontario, Québec, and Saskatchewan and in USA occurs in Georgia, Michigan, New York, North Carolina, Ohio, South Carolina, and Tennessee.

Subfamily Prodiamesinae

Monodiamesa Kieffer, 1921

Note on the genus of *Monodiamesa*. We recognized 2 separate larval types (*i.e.*, species) of *Monodiamesa* occurring in Athabasca River and its tributaries. They can be partially separated based on the key below. However, for the purpose of monitoring genus identification will be sufficient.

Macroscopic characters of genus. Eyespots well-divided in two, eyespots in vertical angle to each other, located close to mid-section of the head capsule. VmP distinct but in oblique angle (Figure 14A). Posterior parapods slightly longer than wide. 4 long anal setae. Procercus well-developed (Figure 14B).

Ecology and habitat. Larvae of Monodiamesa are mainly lentic. They occur in sandy substrate of mesotrophic to oligotrophic lakes (Sæther and Andersen, 2013b).

Key to species of *Monodiamesa*

1a. Posterolateral margin of VmP close to or almost covers the large genal seta (Figure 15E) ..... ***Monodiamesa* sp. 1**

1b. Posterolateral margin of VmP does not cover the large genal seta (Figure 16C) ..... ***Monodiamesa* sp. 2**

Monodiamesa sp. 1

Larva (n=2)

Figures 15A-F

Description. Larva L=6.4-8.5 (7.4) mm. HL/HW=1.1. Antennae 4 segmented, blade longer than flagellum, RO close to mid-section of the 1st segment (Figure 15A), AR=1.7. SI with dissections (Figure 15B), SII-SIII simple. labral lamellae broad and plumose (Figure 15B). Premandible simple and hook like (Figure 15C). Mandible with 1 apical tooth and 2 inner teeth (Figure 15D), apical tooth about 3X the combined width of inner teeth, SSd simple reaches the tip of 2nd inner teeth, setae interna with 9-10 serrated branches. Mentum with 1 broad concave nipple-shaped median tooth and 6 pairs of lateral teeth (Figure 15E), VmP well-developed sickle shaped and round posterolaterally with 5 setae in cardinal beard (Figure 15E), VmPL=134.1 µm, VmPL $_{\text{apex last mental teeth to VmP apex}}$=94.6 µm, VmP W=26.0 µm. VmP L $_{\text{apex last mental teeth to VmP apex}}$ /mentum W=0.74. Procercus slightly longer than wide, bearing 7 apical setae and 2 sub-apical setae (Figure 15F). 4 long anal setae L=474.7 µm. Posterior parapod not much longer than wide, bearing group of simple claws. 4 conical anal tubules, dorsal tubules slightly longer than ventrals, dorsal tubules L=89.0 µm, ventral tubules L=86.2 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta)

Remarks. Larva resembles the *Monodiamsa* sp. described by Sæther (1973). Sæther (1973) indicated that latter possibly belongs to *Monodiamesa prolilobata* Sæther, 1973. *Monodiamesa prolilobata* has only been reported in British Columbia.

Monodiamesa sp. 2

Larva (n=2)

Figures 16A-D

Description. Larva L=5.0 mm. HL/HW=1.1. Antennae 4 segmented, blade slightly longer than flagellum, RO close to mid-section of the 1st segment (Figure 16A), AR=1.1. SI with dissections, SII-SIII simple. Labral lamellae broad and plumose. Premandible simple and hook like. Mandible with 1 apical tooth and 2 inner teeth (Figure 16B), apical tooth about 2.6X the combined width of inner teeth, SSd simple reaches the tip of 2nd inner teeth, setae interna with 9-10 serrated branches. Mentum with 1 broad concave nipple-shaped median tooth and 6 pairs of lateral teeth (Figure 16C), VmP well-developed sickle shaped and round posterolaterally with 5 setae in cardinal beard (Figure 16C), VmPL=62.7 µm, VmPL $_{\text{apex last mental teeth to VmP apex}}$=44.5 µm, VmP W=12.5 µm. VmP L $_{\text{apex last mental teeth to VmP apex}}$/mentum W=0.60. Procercus slightly longer than wide, bearing 7 apical setae and 2 sub-apical setae (Figure 16D). 4 long anal setae L=256.8 µm Posterior parapod not much longer than wide, bearing group of simple claws. 4 conical anal tubules, anal tubules L=98.3 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Remarks. The measurements of the larvae in this study indicate that they are 3rd instars. Larva resembles the description given by (Sæther, 1973) for 3rd instar larva of *Monodiamesa tuberculata* Sæther, 1973. However, study larvae examined have lower AR and their procercus lengths and widths are shorter compared to Sæther (1973) description. Larvae of *M. tuberculata* mainly occur in the deep waters of the oligotrophic lakes (Sæther, 1973). The *M. tuberculata* has been reported in British Columbia, Manitoba, Nunavut, and Ontario. In USA it has been reported in Illinois, Indiana, Michigan, and Ohio.

Subfamily Orthocladiinae

Key to the genera of Orthocladiinae

1a. Antenna elongated, at least 1/2 of the head capsule **2**

1b. Antennae not elongated, <1/2 of the head capsule **5**

2a. Antennae longer than head capsule **3**

2b. Antennae 1/2 to 2/3rd of head capsule **4**

3a. Antennae 4 segmented, last segment short, much shorter than 2 preceding segments (Figure 20B).Mentum without hypopharyngeal scales ..... ***Corynoneura***

3b. Antennae 5 segmented, last antennae segment long, longer than 2 preceding segments (Figure 34D).Mentum with 4 hypopharyngeal scales (Figure 34Fand G) ..... ***Lopescladius***

4a. Second segment of the antennae about 3/5th un-sclerotized (Figure 50D). Premandible simple (Figure 50E) ..... ***Stictocladius***

4b. Second segment of the antennae well-sclerotized (Figure 50B). Premandible with multiple inner teeth ..... ***Thienemanniella***

5a. Procercus absent, or vestigial tubercle present, procercus if absent then anal seta present ..... ***Hydrosmittia***

5b. Procercus present, maybe reduced, if reduced anal setae present **6**

6a. Procercus with at least 1 setae longer than remaining setae, setae at least about 1/4th of body (Figure 33B) ..... ***Krenosmittia***

6b. Procercus setae if long then not longer than 1/4th of body..... **7**

7a. Mentum is strongly arched, with only 4-8 median teeth and lateral teeth aligned along the axis of the arch (Figure 28E). Body with long dark prominent setae on abdominal segments ..... ***Epoicocladius***

7b. Mentum not strongly arched, if triangular in shape then lateral teeth not aligned with mentum arch.Body may have long setae but never dark and prominent..... **8**

8a. Cardinal beard present, below or adjacent to VmP (sometime only few setae are visible) **9**

8b. Cardinal beard absent..... **11**

9a. SI usually palmate (Figure 47B), trifid or with 4 long branches, could be bifid, if bifid then with 1 long and 1 short branch ..... ***Psectrocladius* (in part)**

9b. SI simple or bifid with branches of same size (Figure 27B and Figure 48) **10**

10a. SI simple and long ..... ***Doncricotopus***

10b. SII bifid with branches of same size ..... ***Rheocricotopus***

11a. VmPs well-developed and extend beyond the lateral margin of mentum **13**

11b. VmPs if well-developed not extending beyond the margin of mentum **12**

12a. Antennae 7 segmented, 7th segment hair-like, 3rd segment <1/3rd of the 4th segment ..... ***Heterotrissocladius***

12b. Antennae 4, 5 or 6 segmented but never 7 ..... **14**

13a. All labrum's S setae simple.Mentum with pair of median teeth that are usually broad and well-separated, VmPs are usually very long ..... ***Nanocladius*** **(in part)**

13b. All S setae not simple. Mentum not with above characters **15**

14a. VmPs appear double (Figure 46F), SSm anterior to margin of VmPs ..... ***Parametriocnemus***

14b. VmPs never appear double (Figure 41E), SSm near the margin of VmPs ..... ***Parakiefferiella*** **(in part)**

15a. Antennae 6 segmented, 6th segment hair-like (Figure 42A and Figure 45B) ..... ***Parakiefferiella*** **(in part)**

15b. Antennae 4 or 5 segmented, last segment not hair-like **16**

16a. Abdominal segment with long simple setae, setae about 1/2 of the segment bearing them **17**

16b. Abdominal segments usually without long setae, if long setae present in bundles or branches of multi setae **18**

17a. SI simple.Inner margin of mandible without spines (Figure 40C) ..... ***Paracricotopus***

17b. SI coarsely branched. Inner margin of mandible with spines (Figure 52C) ..... ***Tvetenia***

18a. Inner margin of mandible with spines **19**

18b. Inner margin of mandible without spines **21**

19a. Anal end deflexed ventrally (Figure 19A). Antennae segment 4 much longer than 3rd (Figure 19B) ..... ***Cardiocladius*** **(in part)**

19b. Anal end not deflexed ventrally.Antennae segment 4 about the same size as 3rd **20**

20a. Mentum with 6 pairs of lateral teeth (Figure 23D) ..... ***Cricotopus*** **(in part)**

20b. Mentum with 5 pairs of lateral teeth (Figure 29E) ..... ***Eukiefferiella***

21a. SI simple. Median teeth/tooth of mentum deeply recessed ..... ***Metriocnemus*** **(in part)**

21b. SI bifid, serrated or plumose.Median teeth/tooth of mentum deeply recessed **22**

22a. SI bifid. Premandible simple **23**

22b. SI plumose or finely serrated.Premandible weakly to strongly bifid **29**

23a. Premandible with brush (Figure 24B) ..... ***Cricotopus*** **(in part)**

23b. Premandible without brush or vestigial brush **24**

24a. Head capsule reddish-brown to dark brown (Figures 36A-B). Mandibles evenly dark (Figure 36E) ..... ***Orthocladius*** **(in part)**

24b. Head capsule yellow or lighter in color. Mandible not evenly dark **25**

25a. Premandible notched (Figure 38C) ..... ***Orthocladius*** **(in part)**

25b. Premandible not notched **26**

26a. Mandible with rogues to slightly crenulated outer ridge (Figure 39D), VmP narrow extends beyond the line drawn by SSm (Figure 39E) ..... ***Orthocladius*** **(in part)**

26b. Mandible smooth on outer ridge.VmP not extending beyond the line drawn by SSm **27**

27a. LO not robust (Figure 25C) **28**

27b. LO robust, LO covers the entire 3rd segment (Figure 37B) ..... ***Orthocladius*** **(in part)**

28a. Head capsule dark brown.Mandible with 2-3 dorsal teeth (Figure 26G) ..... ***Cricotopus*** **(in part)**

28b. Head capsule yellow. Mandible without dorsal teeth (Figure 22D and Figure 25E) ..... ***Cricotopus*** **(in part)**

29a. Antennal segment 2 divided in two at the base (Figure 17D) ..... ***Brillia***

29b. Antennal segment 2 not divided at the base (Figure 30B) ..... ***Euryhapsis***

Brillia Keiffer, 1913

Note on genus *Brillia*. Presence of two-segmented antennal segment 2 differentiates this genus from that of *Euryhapsis* Oliver. Larvae of the two *Brillia* species in this study can partially be separated based on the key below.

Key to species of *Brillia*

1a. Labral Sc2 in 3 parts (Figure 17C). Mentum with 3 median teeth (Figure 17G) ..... ***Brillia flavifrons***

1b. Labral Sc2 in 1 part. Mentum with 2 median teeth (Figure 18E) ..... ***Brillia parva***

Brillia flavifrons (Johannsen, 1905)

Larva (n=1)

Figures 17A-G

Macroscopic characters. Head is yellowish-white with thin dark occipital region (Figure 18A). Eyes are single, narrows anteriorly (Figure 17A), located at anterior 1/4th of the head capsule. Procercus are well-developed. Anal tubules are almost a same size as posterior parapods (Figure 17B).

Description. Larva L=6.5 mm. HL/HW=1.2. Frons and clypeal sclerites separated, labral Sc2 divided into 3 sclerites with middle sclerite confluent with the other 2 in mid-section (Figure 17C), distance between the outer Sc2 sclerites 6.0 µm, Sc1 in 2 parts (Figure 17C), distance between Sc1 sclerites 4.0 µm. Antennae 4 segmented, segments decrease in size sequentially, 2nd segment divided in two at the base, RO at the base of the 1st segment, AR=1.7 (Figure 17D). SI plumose, SII-SIII simple. Premandible bifid with accessory tooth (Figure 18E). Mandibles with 1 apical tooth and 3 inner teeth (Figure 17F), mandible apical 2/3rd is dark, SSd small. Mentum with trifid median tooth and 5 pairs of lateral teeth (Figure 17G), 1st median tooth retracted about 1/2 of the others, mentum dark , VP not visible. Procercus well-developed and sclerotized bearing 6 apical setae and 2 sub-apical setae. Posterior parapods not much longer than wide, bearing group of simple claws, 4 anal tubules of equal size (L=140.6 µm).

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest territories, Ontario, Québec, and Saskatchewan). USA (Alabama, Arkansas, Florida, Georgia, Kansas, Louisiana, Maryland, Michigan, Minnesota, Montana, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Virginia, Wisconsin, and Wyoming).

Ecology and habitats. Larvae of this species occur mainly in lotic environment and are xylophagous (Oliver and Roussel, 1983).

Brillia parva Johannsen, 1934

Larva (n=1)

Figures 18A-E

Macroscopic characters. Head is reddish-brown with thin dark occipital regions (Figure 19A). Antennae are slightly bent (Figure 18A). Eyes spots are bifid with smaller spot attached horizontally to the large one (Figure 18A), eyespots are located at anterior 1/3rd of the head capsule. Body has thick erect setae. Procercus has sclerotized part located ventrally (Figure 18B). Anal tubules are almost the same size as posterior parapods.

Description. Larva L=4.8 mm. HL/HW=1.5. Labral Sc2 as a quadrate plate and undivided, Sc1 divided in two. Antennae 4 segmented, segments sequentially decrease in size (Figure 18C), blade shorter than flagellum, RO at basal 1/6th of 1st segment, AR=1.4. SI plumose, SII-SIII simple. Premandible bifid with accessory tooth. Mandible dark with 1 apical tooth and 3 inner teeth, SSd long reaching the base of 2nd inner teeth (Figure 18D). Mentum with bifid median teeth and 5 pairs of lateral teeth (Figure 18E), median teeth stands higher than remaining teeth, 6th lateral teeth stands higher and attached to 5th. Procercus well-sclerotized, ventrally bearing 6 apical setae. Posterior parapods 2X as long as wide, bearing group of dark large claws. 4 anal tubules of equal size (L=160.7 µm).

Rivers and streams. Steep Bank River.

Nearctic distribution. Canada (1st record for Alberta, New Brunswick, Newfoundland and Labrador, Ontario, and Québec). USA (California, Maine, Massachusetts, New Hampshire, New York, North Carolina, Ohio, Pennsylvania, South Carolina, and Vermont).

Ecology and habitats. Larvae of this species are mainly shredders and are commonly found in woodland streams. They pupate in silk cases (Oliver and Roussel, 1983).

Cardiocladius cf. *albiplumus* Sæther, 1969

Larva (n=1)

Figures 19A-E

Macroscopic characters. Head is reddish-brown, almost squared (Figure 19A). Eyespots appear bifid with 1 very small spot attached to a much larger one, located at the anterior of the head (Figure 19A). Anal end is deflexed ventrally (Figure 19A).

Description. Larva L=1.5 mm. HL/HW=0.82, Antenna 5 segmented, 4th segment about 1.8X the 3rd segment (Figure 19B), blade slightly shorter than flagellum, RO at the basal 1/4th of the 1st segment, AR=0.65. SI-SIII simple. Premandible simple. Mandible with 1 apical tooth and 3 inner teeth (Figure 19C), seta interna with 2-3 simple branches of which 1 is much longer than remaining. Mentum with 1 wide median tooth (worn) and 5 pairs of lateral teeth (Figure 19D), VmP visible, triangular and small, SSm located well posterior to mentum. Body with simple setae. Procercus present but reduced, as long as wide, bearing 5-6 apical setae (Figure 20F). Supranal setae are present (L=41.8 µm; Figure 19E). Posterior parapods 1.5X as long as wide, bearing group of simple claws (Figure 19E). 4 Anal tubules of same size, L=27.1 µm.

Rivers and streams. Ells River, Jackpine River, and Steep Bank River.

Ecology and habitats. Larvae of this species are reported to occur in fast flowing water among the moss and algae that are attached to gravel and stones. Larvae can often be ectoparasitic on Hydropsychidae pupae (Oliver and Bode, 1985).

Remarks. According to Epler (2001) *C. albiplumus* has a nipple like median tooth that might be worn. Other distinguishing characters for its larva are presence of supra-anal setae that is absent in other species, and 3rd antenna segment being half of the 4th (Andersen *et al.,* 2013 and Epler 2001). Larva is described by (Oliver and Bode, 1985). The measurements of the larva in this study indicate that it is an earlier instar, probably 3rd instar. *Cardiocladius albiplumus* has not been reported in Alberta. In Canada it has been reported in British Columbia, Ontario, and Québec. In USA occurs in Georgia, Michigan, New York, North Carolina, Ohio, South Carolina, and Tennessee.

Corynoneura Winnertz, 1846

Note on genus *Corynoneura*. Presence of 4 segmented antennae separates larvae of this genus from those of *Thienemanniella* Kieffer.

Macroscopic characters of the genus. Head capsule is extended and narrow (Figure 20A). Eyespots are simple and teardrop shaped, located on posterior 1/3rd of the head capsule (Figure 20A). Antennae are longer than head capsule, 2nd segment darker than remaining segments (Figure 20A).

Ecology and habitat. Larvae of *Corynoneura* occur in both lotic and lentic habitat. In fast flowing lotic habitats, larvae usually occur in cracks of submerged stones (Andersen *et al.,* 2013).

Corynoneura sp. 1

Larva (n=3)

Figures 20A-G

Description. Larva L=1.7 mm. Head capsule sculpturing present but faint, HL=172.5, HL/HW=1.4. Antennae 4 segmented longer than head capsule AL/HL=1.5, A_1L/HL=0.72, A_1 light and segments 2-3 dark brown (Figure 20B), AR=0.89. SI-SIII simple, SII larger and on small tubercle (Figure 20C). Premandible multi-toothed. Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth (Figure 20D). Mentum with 3 median teeth and 5 pairs of lateral teeth (Figure 20E), 1st lateral teeth reduced, SSm well posterior. Procercus as long as wide, bearing 4 apical setae. Posterior parapods much longer than wide (Figure 20F), sub-basal setae of posterior parapod split at the base with 1 long branch extending to mid-section of the main stem (Figure 20G), L=46.0 µm. 4 anal tubules of equal size, anal tubules about 1/2 the posterior parapods.

Rivers and streams. Ells River.

Nearctic distribution. Canada (Alberta).

Remarks. Shape of the mentum and AL to HL ratio of this larva resembles that of *Corynoneura ascenca* Fu *et* Sæther. However, head length, head sculpturing, shape and size of sub-basal setae of posterior parapods resembles that of *Corynoneura lobata* Edwards.

Corynoneura sp. 2

Larva (n=1)

Figure 21A-B

Description. Larva L=1.2 mm. Head capsule smooth, HL=178.5 µm, HL/HW=1.5. Antennae 4 segmented, 3rd segment longer than 2nd segment, AL/HL=1.6, A_1L/HL=0.67, A_1 light and the remaining segments dark brown (Figure 21A), A_1W=18.7 AR=0.72. Premandible multi-toothed. Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth. Mentum with 2 median teeth and 5 pairs of lateral teeth (Figure 21B), 1st lateral teeth reduced, Procercus as long as wide, bearing 4 apical setae. Posterior parapods much longer than wide, sub-basal setae of posterior parapods split at basal 1/3rd (L=43.0 µm). 4 long tube like anal tubules of equal size, anal tubules about 1/2 the posterior parapods.

Rivers and streams. Jackpine River.

Nearctic distribution. Canada (Alberta).

Remarks. Larvae keys out to couplet (8) of Fu and Sæther (2012) as *Corynoneura* sp. 12 (Bolton); however, we cannot be certain.

Cricotopus van der Wulp, 1874

Note on genus *Cricotopus*. Larvae of *Cricotopus* resemble some *Orthocladius* and *Paratrichocladius* species. There are no clear characters separating *Cricotopus* larvae from those of *Orthocladius*. *Paratrichocladius* can be partially recognized by constricted first lateral teeth of mentum, presence of minute spines at the base of seta subdentalis and sclerotized area laterad to mentum. Larvae of *Orthocladius* in this study can partially be separated from those of *Cricotopus* based on the key given for genera of subfamily Orthocladiinae. Subgenera and species of *Cricotopus* in this study and can be partially separated based on the key given below.

Ecology and habitats. Larvae of *Cricotopus* are inhabitant of all freshwater environments. They usually occur in association with aquatic plants, these include algae and macrophytes (Andersen *et al.,* 2013).

Key to subgenera and species of *Cricotopus*

1a. Pecten epipharyngis with median scale shorter than lateral scales. SI simple. Mandible with 2-3 dorsal teeth in outer margin (Figure 26G). Head capsule conical and extremely dark (Figure 26B) ....***Cricotopus (Nostocladius) nostocicola***

1b. Pecten epipharyngis with 3 equal scales. SI bifid. Mandible without dorsal teeth. Head capsule squared and yellow to light brown ....***Cricotopus (Cricotopus)* (2)**

2a. Median tooth of mentum about 2X as wide as 1st lateral (Figure 24E). Premandible with brush present (Figure 24B) ....***Cricotopus (Cricotopus) tremulus* group**

2b. Median tooth of mentum about 3X as wide as 1st lateral (Figure 23D, Figure 25G). Premandible with brush absent or vestigial.....**3**

3a. Inner margin of mandible with spines or serrations ....***Cricotopus (Cricotopus) mackenziensis***

3b. Inner margin of mandible without spines or serrations **4**

4a. Galea of maxilla with numerous pectinate lamellae (Figure 22E). Body with simple setae L≈100 µm ....***Cricotopus (Cricotopus)* cf. *albiforceps***

4b. Galea of maxilla without numerous pectinate lamellae (Figure 25F). Body with simple setae L≈60 µm ....***Cricotopus (Cricotopus) trifascia***

Cricotopus (Cricotopus) cf. *albiforceps* (Kieffer, 1916)

Larva (n=2)

Figures 22A-G

Description. Larva L=3.8 mm. HL/HW=1.0. Antennae 5 segmented, LO developed, blade shorter than flagellum (Figure 22A), RO at the base of the 1st segment, AR=1.6. SI bifid (Figure 22B), SII-SIII simple. Pecten epipharyngis with 3 equal scales (Figure 22B). Premandible simple (Figure 22C). Mandible with 1 apical tooth and 3 inner teeth (Figure 22D), outer ridge smooth, SSd large extend to the base of 2nd inner teeth, seta interna with 5 branches of which two are serrated. Galea of maxilla with numerous pectinate lamellae (Figure 22E). Mentum with 1 wide median tooth and 6 pairs of lateral teeth, median tooth 3X the 1st lateral teeth (Figure 22F), SSm posterior to mentum, VmP narrow and not extending below the mentum (Figure 22F). Body with simple setae (L=99.0 µm). Procercus well-developed not much longer than wide, bearing 5 apical setae and 2 sub-apical setae (Figure 22G). Posterior parapods slightly longer than wide with group of large simple claws (Figure 22G). 4 Anal tubules of equal size, L=68.5 µm, tubules long and tube-like.

Rivers and streams. Jackpine River, Mackay River and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae occur in potamal regions of streams where current are slow, water is more turbid and substrate are mainly sand and silt (Orendt, 2003). Adults of this species reported to have emergence from mid-May till late July (Krasheninnikov, 2012).

Remarks. Two mounted larvae were obtained in this study as such we could not provide macroscopic characters for this species. *C. albiforceps* has not been reported in the Nearctic with certainty. Epler (2001) reported this species in North Carolina with skepticism.

Cricotopus (Cricotopus) mackenziensis Oliver, 1977

Larvae (n=1)

Figures 23A-D

Description. HL/HW=0.90. Antenna 5 segmented, blade shorter than flagellum (Figure 23A), LO covers 2/3rd of the 3rd segment, blade shorter than flagellum, AR=1.4. SI bifid, SII-SIII simple. Pecten epipharyngis with 3 equal scales. Premandible simple (Figure 23B), L=61.5 µm. Mandible with 3 inner teeth, inner ridge with spines (Figure 23C), outer ridge smooth, SSd prominent, seta interna with 5 branches, mandible L=114.6 µm. Mentum with 1 light and wide median (*i.e.*, worn in this specimen) tooth and 6 pairs of darker lateral teeth (Figure 23D), median tooth 3.8X the 1st lateral teeth, mentum $W/W_{median\ tooth}$=4.6. Postmentum L=156.8 µm, mentum L=43.2, W=116.5, postmentum light.

Pupa. TH is small, L=82.5 µm, apically blunt without spines (Figure 25E).

Rivers and streams. Ells River.

Nearctic distribution. Canada (1st record for Alberta, Northwest Territories).

Ecology and habitat. Rosenberg *et al.* (1976a) reported this species to be multivoltine with 3 generations per year. Larvae overwinters as 2nd instars. Fourth instars are abundant in mid to late June with water temperature around 17°C. Emergence occurs from June to September with pick in mid-July. Larvae are reported to tolerate crude oil contamination, though in lesser degree than *C. bicinctus* (Rosenberg *et al.,* 1976b).

Remarks. Single mounted specimen of this species was obtained which has a damaged abdomen. Therefore, we could not obtain the larval posterior end's characters. There is a considerable overlap of characters between the *C. mackenziensis* and *Cricotopus (Cricotopus) bicinctus* (Meigen, 1818). The two species can be partially separated

based on size of the head, antennae length and ratio, mentum width, and mandible length. However, characteristic of TH on the 4th instar larva easily separates this species from that of *C. bicinctus*.

Cricotopus (Cricotopus) tremulus group

Larva (n=3)

Figures 24A-F

Description. Larva L=3.7 mm. HL/HW=0.86. Antennae 5 segmented, LO narrow covering the 3rd segment, blade sub-equal to flagellum (Figure 24A), RO at the base of the 1st segment, AR=1.6. SI bifid (Figure 24B), SII-SIII simple. Pecten epipharyngis with 3 equal scales (Figure 24B). Premandible simple, brush present (Figure 24B). Mandible with 1 apical tooth and 3 inner teeth (Figure 24C), outer ridge crenulated, SSd reaching the base of 3rd inner teeth, seta interna with 5 branches of which 2 are serrated. Maxilla (Figure 24D). Mentum with 1 median tooth and 6 pairs of lateral teeth, median tooth 2X the 1st lateral teeth (Figure 24E) 1st and 2nd lateral teeth partially fused, 2nd lateral teeth smaller, SSm posterior to mentum, VmP narrow and not extending below the mentum (Figure 24E). Body with simple setae (L=148.53 µm). Medium sized and smaller claws of anterior parapod serrated (Figure 24F). Procercus well-developed not much longer than wide, bearing 6 apical setae and 2 sub-apical setae (Figure 24F). Posterior parapods with group of large simple claws (Figure 24F).

Rivers and streams. Steep Bank River.

Nearctic distribution. Canada (Alberta).

Remarks. Three mounted larvae were obtained in this study as such we could not provide macroscopic characters for this species. Larvae in this study key out to *Cricotopus (Cricotopus) tremulus* (Linnaeus) based on Hirvenoja (1973); however, mandible of the species is lighter than the description given for *C. tremulus* larva by Epler (2001). It is possible that larvae are *Cricotopus (Cricotopus) luciae* Lesage *et* Harrison which is very similar to *C. tremulus*; however, with lighter mandibular base. Without associated adult is difficult to separate the two species.

Cricotopus (Cricotopus) trifascia Edwards, 1929

Larva (n=8)

Figures 25A-G

Macroscopic characters. Head capsule is yellow (Figure 25A). Eyespots are bifid with smaller eyespot circular and close to 1larger eyespots in a horizontal line (Figure 25A), eyespots located in anterior 1/3rd of the head capsule. Procercus are small. Dorsal anal tubules are much larger and longer than ventral tubules; dorsal tubules are also longer than posterior parapods (Figure 25B).

Description. Larva L=5.2 mm. HL/HW=1.0. Antenna 5 segmented, 5th segment slightly longer than 4th, blade shorter than flagellum (Figure 25C), LO not well-developed, RO at basal 1/10th of the 1st segment, AR=2.1. SI bifid, SII-SIII simple and long. Pecten epipharyngis with 3 scales of equal size (Figure 25D). Premandible simple (Figure 25D). Mandible with 1 apical tooth and 3 inner teeth (Figure 25E), smooth on outer ridge, SSd small. Maxilla (Figure 25F). Mentum with 1 wide median tooth and supposedly 6 lateral teeth (Figure 25G), 1st and 2nd lateral teeth attached and stand higher than other laterals, 6th lateral teeth may be worn (Figure 25G). Claws of posterior parapods serrated. Procercus short, slightly wider than long, bearing 6 apical setae. Posterior parapods not much longer than wide, bearing group of large simple claws. Dorsal anal tubules longer than posterior parapods and ventral tubules, dorsal tubules L=206.0 µm, ventral tubules L=156.5 µm.

Rivers and streams. Athabasca River, Ells River, Steep Bank River and Mackay River.

Nearctic distribution. Canada (1st record for Alberta, Ontario, Saskatchewan). USA (Arizona, California, Florida, Georgia, New York, New Mexico, North Carolina, Ohio, Pennsylvania).

Remarks. Larva is described by Hirvenoja (1973) and by Epler (2001).

Cricotopus (Nostocladius) nostocicola Wirth, 1957

Larva (n=5)

Figures 26A-H

Macroscopic characters. Larva has bulged abdominal segments, Tipulidae-like (Figure 26A). Head capsule is very dark and conical in shape (Figure 26B) with patch of lighter spot around the eyespots. Eyespots are bifid though hard to detect, smaller eyespots in a vertical axis located close to larger spot, eyespots are located in anterior 1/3rd of the head (Figure 26B). Procercus, posterior parapods, and anal tubules are reduced (Figure 26C).

Description. Larva L=4.4 mm. HL/HW=1.1. Antennae short, 5 segmented, segments decrease in size sequentially (Figure 26D), 1st segment 1.2X longer than wide. LO narrow covering the 3rd segment, RO at mid-section of the 1st antennal segment, blade slightly longer than flagellum. AR=1.6. SI-SIII simple (Figure 26E). Pecten epipharyngis with 3 scales of which median scale is shorter. Premandible simple with large accessory tooth (Figure 26F). Mandible with 3 dorsal teeth, 1apical tooth and 3 inner teeth (Figure 26G), outer ridge strongly rugose, SSd small and narrow. Mentum with 1 large median tooth and 6 pairs of lateral teeth (Figure 26H), median tooth 5X the 1st lateral teeth and stands higher then lateral teeth, VmP developed but not visible extend posteriorly to the line of SSm (Figure 26H). Procercus developed bearing 5 short apical setae. Posterior parapods longer than wide, bearing group of simple large claws. 4 narrow, tube-like anal tubules of equal size, L=69.3 µm.

Rivers and streams. MacKay River and Steep Bank River.

Nearctic distribution. Canada (Alberta). USA (California, Georgia, Montana, New York, North Carolina, Ohio, Oregon, South Carolina).

Ecology and habitat. Larvae of this species live, mine, and also feed in filaments of gelatinous sheets made by cyanobacteria *Nostoc*. Larva completes all 4 instars and also pupates in the blue-green algae with incapability for free-living (Brock, 1960).

Remarks. Larva is described by Johannsen (1937) as *Spaniotoma* sp. G and by Epler (2001).

Doncricotopus sp.

Larva (n=1)

Figures 27A-F

Description. Larvae L=4.3 mm. HL/HW=0.84. Eyespots large simple located at anterior 1/3rd of the head. Antenna 5 segmented, LO prominent covering the 3rd segment, blade shorter than flagellum (Figure 27A), RO at basal 1/5th of the 1st segment, AR=1.9. All S setae simple (Figure 27B). Pecten epipharyngis with 3 long sub equal scales. Premandible simple (Figure 27C). Mandible with 1 light apical tooth and 3 darker inner teeth (Figure 27D), apical tooth 1.7X the combined width of inner teeth, SSd robust, seta interna with 4 long branches. Mentum with 1 wide bifid or double nipple median tooth and 5 pairs of lateral teeth (Figure 27E), Median tooth lighter than lateral teeth, VmP narrow, cardinal beard with about 7 setae, SSm anterior to apex of VmP. Claws of anterior parapods serrated, larger claws serrated at the tips. Procercus with small spurs bearing 6 apical setae (Figure 27F). Posterior parapods not much longer than wide, bearing group of large dark claws. Anal tubules tube-like, Dorsal tubules L=116.3 µm, ventral tubules L=77.0 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Remarks. Only two species in this genus are so far described, *Doncricotopus bicaudatus* Sæther from Northwest Territories and Nunavut and *Doncricotopus dentatus* Tuiskunen from Finland and

Norway (Sæther, 1981; Tuiskunen, 1985). Larva in this study resembles the larva of *Doncricotpus* displayed by Cranston (2010) from Lake Superior.

Epoicocladius sp. #3 Jacobsen, 1992

Larva (n=1)

Figures 28A-E

Macroscopic characters. The distinguishing macroscopic characters of the larva are the presence of 2 large yellowish-red coloured conical anal tubules on their posterior portion (Figure 28A) and presence of multiple long setae on the abdominal segment, especially the middle segments.

Description. Larva L=3.9 mm. HL/HW=1.2. Antennae 4 segmented, 4th segment longer than 3rd, RO at the base of 1st segment (Figure 28B), AR=1.9. Premandible apically bifid (Figure 28C). Mandible with 1 long apical tooth and 3 inner teeth (Figure 28D), 1st inner teeth right-angle triangle shape and semi-attached to the 2nd inner teeth, SSd long and thin extending to the base of 2nd inner teeth. Mentum with 6 inner teeth in a horizontal plane and 5 pairs of lateral teeth (Figure 28E). 1st and 2nd lateral teeth squared and wider than remaining lateral teeth. 1-4th inner teeth lighter than remaining median teeth, VmP developed. Postmentum L=163.7 µm. Body with ~20 long dark setae on mid abdominal segment, Ls=59.5-145.1(115.0) µm. Procercus well-sclerotized wider then long, bearing 7 long dark apical setae and 2 sub-apical setae. Posterior parapods longer than wide, L=130.5, bearing 5 amber coloured claws. Anal tubules L=90.0 µm, L/W=2.3.

Rivers and streams. Ells River.

Nearctic distribution. Canada (1st record for Alberta, Ontario). USA (Maryland, Pennsylvania and West Virginia).

Ecology and habitat. Larvae of this specie live symphoretically on nymphal gills of *Ephemera guttulata* Pictet, *Ephemera simulans* Walker and *Ephemera varia* Eaton (Jacobsen 1992).

Remarks. AR of larva examined is similar to that of *Epoicocladius* sp. #4 Jacobsen. However, the combination of lower postementum length, mental median teeth coloration, lengths of posterior parapods, and color of posterior parapods claws identifies the species as *Epoicocladius* sp. #3 Jacobsen. Larva is described by Jacobsen (1992).

Eukiefferiella gracei group

Larva (n=2)

Figures 29A-F

Macroscopic characters. Head capsule is dark brown (Figure 29A) with patches of lighter color around the eyespots. Eyespots are bifid and attached horizontally, located in anterior 1/3rd of the head capsule (Figure 29A). Procercus is reduced, apical setae as long as posterior parapods.

Description. Larva L=5.9 mm. HL/HW=0.98. Antenna 5 segmented, 3rd segment longer than wide, blade longer than second segment reaching the 4th segment (Figure 29B), AR=1.9. SI-SIII simple. Premandible simple (Figure 29C). Mandible with 3 inner teeth and dark (Figure 29D), inner ridge with spines. Mentum with 1 wide flat median tooth and 5 pairs of lateral teeth (Figure 29E), VmP not visible. Mid abdominal setae L=122.8 µm, setae L/segment L=0.23. Procercus wider than long, bearing 5 apical (Figure 29F) setae. Posterior parapods about 2X as long as wide, bearing group of large dark claws (Figure 29F).

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Bode (1983) reported larvae of species in this group to occur in filamentous algae of cold swift -flowing streams.

Remarks. Larvae of species in this group are described by Bode (1980, 1983).

Euryhapsis cilium Oliver, 1981

Larva (n=1)

Figures 30A-F

Description. Larva L=5.1 mm. HL/HW=1.1. Labral Sc2 as a quadrate plate and undivided, Sc1 divided in two (Figure 30A). Antennae 4 segmented, 2nd segment well-sclerotized and not divided (Figure 30B), RO at the basal 1/4th of the 1st segment, blade longer than flagellum. SI plumose, SII-SIII simple. Premandible bifid with large accessory tooth (Figure 30C). Mandible with 3 inner teeth (Figure 30D). Mentum with trifid median tooth and 5 pairs of lateral teeth (Figure 29E), 1st median tooth retracted about 1/2 of the others, 5th and 6th lateral teeth sit lower than other teeth and on a same plane, mentum light brown, VP not visible. Procercus well-sclerotized bearing 7 apical and 2 sub-apical setae (Figure 30F). Posterior parapod not much longer than wide, bearing group of claws (Figure 30F). 4 long and conical anal tubules of equal size, L=126.8 µm.

Rivers and streams. Firebag River.

Nearctic distribution. Canada (Alberta, Northwest Territories, Yukon Territory, Labrador, and Nunavut).

Ecology and habitat. Larvae of this species inhabit medium sized streams (Oliver, 1981).

Remarks. Larva is described by Oliver (1981).

Heterotrissocladius marcidus group

Larva (n=1)

Figures 31A-D

Description. Larva=2.8 mm. HL/HW=0.97. Antennae 7 segmented, 7th segment long and hair-like, blade shorter than flagellum (Figure 31A), AR=0.78. SI plumose. SII-SIII simple (Figure 31B). Premandible simple (Figure 31B). Mandible dark brown with 3 inner teeth. SSd large, reaching the tip of the 3rd inner teeth (Figure 31A). Mentum with 2 median teeth and 5 pairs of lateral teeth, VmP large extends slightly beyond the mentum, postmentum darker than remainder of head capsule (Figure 31C). Procercus well-sclerotized bearing 4 apical setae (Figure 31D).

Rivers and streams. Athabasca River

Nearctic distribution. Canada (Alberta)

Ecology and habitat. Larvae of species in this group are found in springs, streams, rivers and the littoral zones of lakes, usually restricted to cold waters (Sæther, 1975a).

Remarks. This larva keys out to couplet 10 in Sæther (1975a), ending as either *Heterotrissocladius marcidus* (Walker, 1856) or as *Heterotrissocladius latilaminus* Sæther, 1975. The characters given to separate the two species may not hold up, given the range of variation in the pigmentation of the submentum, and also width of SSm may only work for the 4th instar larva. The measurements of the larva indicate that it is an earlier instar, probably 3rd instar.

Hydrosmittia sp.

Larva (n=1)

Figures 32A-E

Description. Larva L=2.5 mm. HL/HW=1.0. Antennae 4 segmented and very short (Figure 32A), 1st segment wider than long (W=10.0 µm), blade slightly longer than flagellum (L=8.2 µm; Figure 32B). AR=0.72. SI-SIII simple. Pecten epipharyngis with 3 scales. Premandible simple. Mandible with 3 inner teeth, all teeth dark brown (Figure 32C), seta interna is absent. Mentum with 1 wide median tooth and 4 pairs of lateral teeth, SSm well posterior to mentum and simple. VmP well-developed and crescent shape (Figure 32D). Procercus absent. Anterior parapods absent. Posterior parapods are reduced or absent with about 12 claws (Figure 32E), largest claw of posterior parapod are serrated, largest claw L=44.7 µm, smallest claw L=23.6 µm.

Rivers and streams. Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Hydrosmittia* occur in moss and algal growths on stones in lotic and lentic environment. The species in this genus tend to be cold-stenotherm (Andersen *et al.,* 2013).

Remarks. Larvae of some species are described by Ferrington and Sæther (2011).

Krenosmittia sp.

Larva (n=2)

Figures 33A-G

Macroscopic characters. Head capsule is almost rectangular (Figure 33A). Eyespots are single, located at mid-section of the head capsule (Figure 33A). Body is long and slender. Each procercus has 1 very long anal seta (Figure 33B).

Description. Larva L=2.3 mm. HL/HW=0.96. Antennae 5 segmented, 5th segment longer than 4th and hair-like (Figure 33C), RO at mid-section of 1st antennal segment, blade shorter than flagellum, style well-developed (L=17.5 µm), AR=1.4. SI dissected in apparently 3 branches, SII-SIII simple. Pecten epipharyngis with 3 scales. Premandible bifid with small accessory tooth (Figure 33D). Mandibles with 1 long apical tooth and 3 inner teeth (Figure 33E), apical tooth 2X the combined width of inner teeth. Palpiger of MP long. Mentum with 1 dome shaped median tooth and 6 pairs of lateral teeth (Figure 33F), VmP visible, SSm located more posteriorly. Procercus well-sclerotized bearing 6 apical setae and 2 sub-apical setae (Figure 33G), 1 apical setae long ~1/2 of the body length (L=1.4 cm). Posterior parapods longer than wide, bearing group of light simple claws (Figure 32J). 4 anal tubules of equal size (L=42.8 µm).

Rivers and streams. Steep Bank River.

Ecology and habitat. Thienemann (1944) has described *Krenosmittia* as terrestrial to hygopteric with some occurrence in springs. According to Epler (2001) larva of *Krenosmittia* occur in sandy substrate of springs and streams.

Remarks. Previously Namayandeh *et al.* (2016) have described a similar larva from Nunavut and Labrador, Canada.

Lopescladius (Cordiella) cf. *hyporheicus* Coffman *et* Roback, 1984

Larva (n=2)

Figures 34A-G

Macroscopic characters. Head is yellowish-golden (Figure 34A). Eyespots are large and close to mid-section of the head (Figure 34A). Antennae are longer than head capsule, last segment whip like (Figure 34A). Larva is tubular (Figure 34B). Apical and anal setae are long. Posterior parapods are elongated (Figure 34C).

Description. Larvae L=3.8. HL=152.8 µm. Antennae 5 segmented, 5th segment longer than 2nd-4th segments and whip-like, blade shorter than flagellum (Figure 34D), AR=0.47, Antennae L=250.2 µm. SI-SIII appear simple. Mandible with 5 inner teeth, apical tooth same size as inner teeth (Figure 34E). Mentum with wide bifid median tooth (or notched) and 4 lateral teeth, 4 hypopharyngeal scales, 2 median scales bifid and the 2 outer scales with 4 teeth, SSm well posterior to mentum (Figures 34FandG). Procercus bearing 5 apical setae and 2 sub-apical setae, at least 2 apical setae very long. 4 long anal setae, L=121.6 µm. Posterior parapod longer than wide. Anal tubules conical and shorter than posterior parapod.

Rivers and streams. Athabasca River, Ells River, and Steep Bank River.

Ecology and habitat. Larvae of this species occur in erosional and depositional lotic habitats (Andersen *et al.,* 2013). According to Coffman and Roback (1984) larvae of this species occurs in hyperheos of riffles in depth of 10 cm or more. In this study larvae were abundant in the sandy substrates of the Athabasca River and its tributaries.

Remarks. Larva of *Lopescladius (Cordiella) hyporheicus* Coffman *et* Roback is described by Coffman and Roback (1984). The only reports of species are available from Pennsylvania, and Virginia in USA. However, Andersen *et al.* (2013) suggest that species is widespread in North America.

Nanocladius (Nanocladius) dichromus group

Larva (n=4)

Figures 35A-G

Macroscopic characters. Head capsule is yellowish-white (Figure 35A). Eyespots are single and large, teardrop shaped (Figure 35A), located at anterior 1/3rd of the head capsule. Anal tubules are slender, longer than posterior parapods (Figure 35B).

Description. Larva L=2.6 mm. HL/HW=0.83. Antennae 4 segmented, blade shorter than flagellum, LO well-developed, covering 2/3rd of 3rd segment (Figure 35C), AR=1.5. SI-SIII weak and simple. Pecten epipharyngis with 3 equal scales (Figure 35D). Premandible simple with small accessory tooth (Figure 35D). Mandible with 1 long apical tooth and 3 inner teeth, apical tooth length 2X the combined width of inner teeth (Figure 35E). Mentum with 1 broad median tooth notched or bifid and 6 pairs of lateral teeth (Figure 35F), 1st and 2nd lateral teeth wider and lighter than 3-5 lateral teeth, 6th lateral teeth very small and lighter, VmP long and rounded at the apex, striation of VmP random and along vertical axis of VmP (Figure 35F). Claws of anterior parapods weakly serrated (Figure 35G). Procercus well-sclerotized, not much longer than wide, bearing 4 apical setae. Posterior parapod not much longer than wide, bearing group of large light claws.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Some larvae of *Nanocladius (Nanocladius)* species live symphoratically on immature stages of Corydalidae (Gotceitas and Mackay, 1980), others are free-living. Larvae of species in this subgenus occur in both lentic and lotic habitats (Andersen *et al.,* 2013).

Remarks. The long, apically rounded ventromental plate places the larvae in the subgenus *Nanocladius*. The weakly serrated anterior parapods' claws put the larvae in *dichromus* group. The measurements of the larvae indicate that they are earlier instars, probably 3rd instars.

Orthocladius van der Wulp, 1874

Note on the genus *Orthocladius*. A detailed key to the subgenera and species of *Orthocladius* are given by Sæther (2005) and by Soponis (1977, 1990). We partially separated three subgenera of *Orthocladius* in this study using the key below.

Key to the subgenera of *Orthocladius*

1a. Head capsule reddish-brown to dark reddish-brown (Figures 36A-B). Mental extension not exceeding the line drawn between the SSms (Figure 36F) .....***Orthocladius (Eudactylocladius)***

1b. Head capsule yellow to brown but never reddish. Mental extension may exceed the line drawn between the SSms **2**

2a. LO robust (Figure 37B). Head capsule yellowish-brown.....
.....***Orthocladius (Euorthocladius)***

2b. LO small (Figure 38A and Figure 39A). Head capsule yellow.....
.....***Orthocladius (Orthocladius)***

Orthocladius (Eudactylocladius) dubitatus Johannsen, 1942

Larva (n=1)

Figures 36A-G

Macroscopic characters. Head capsule is reddish-brown to dark brown; head darkens from younger instars to 4th instar (Figure 36A) to 4th instar (Figure 36B). Eyespots are bifid and attached horizontally, located toward the anterior 1/3rd of the head capsule; smaller eyespot appears emarginated (Figures 36AandB). Posterior paprapods are not much longer than wide. Dorsal anal tubules almost the same size as posterior parapods to longer than posterior parapods in some earlier instar.

Description. Larva L=3.5 mm. HL/HW=1.0. Antennae 5 segmented, segments sequentially decrease in size, blade longer than flagellum (Figure 36C), AR=1.7. SI bifid, SII-SIII simple. Pecten epipharyngis with 3 equal scale. Premandible simple with accessory tooth (Figure 36D). Mandibles dark with 1 apical tooth and 3 inner teeth, outer ridge strongly crenulated (Figure 36E), SSd small. Mentum with 1 small median tooth and 6 pairs of lateral teeth, 1st and 2nd lateral teeth attached with 2nd much smaller (Figure 36F), VmP extended posteriorly, SSm located posterior to mentum. Claws of anterior parapods serrated. Procercus small, wider than long, bearing 5 apical and 2 sub-apical setae (Figure 36G). Posterior parapods 1.4X longer than wide, bearing group of large dark claws (Figure 36G). Dorsal anal tubules almost the same size as posterior parapods, dorsal tubules L=62.3 µm, ventral tubules L=43.65 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, British Columbia, Manitoba, and Ontario). USA (Alabama, Alaska, Arizona, California, Colorado, Florida, Georgia, Maine, and New Mexico).

Remarks. According to Epler (2001) larva of this species resemble that of *Cricotopus (Cricotopus) fugax* (Johannsen). However, premandible of *O. dubitatus* has an accessory tooth that is absent in *C. fugax*. Additionally, the 3rd and 4th antennal segments are about as wide as long in this species, compared to *C. fugax* that are about twice as long as wide.

Orthocladius (Euorthocladius) rivicola Kieffer, 1921

Larva (n=1)

Figures 37A-F

Macroscopic characters. Head capsule is yellowish-gray, darker posteriorly (Figure 37A), the sclerite band running from antro-lateral margin of the head to posterior margin of the mentum on hypostoma plate is thick and dark (Figure 37A), occipital margin of the head dark. Eyespots are double and attached horizontally, located in anterior 1/3rd of the head capsule (Figure 37A). Ventral anal tubules are longer than dorsal tubules and posterior parapods.

Description. Larva L=4.3 mm. HL/HW=0.91. Antenna 5 segmented, 4th segment slightly longer than 3rd, LO well-developed covering the 3rd segment, blade shorter than flagellum (Figure 37B), RO at basal 1/4th of the 1st segment, AR=1.7. SI bifid, SII-SIII simple (Figure 37C). Premandible simple. Mandible with 3 inner teeth, SSd large, seta interna present with 7 branches, some branches weakly serrated (Figure 37D). Mentum with 1 median tooth and 6 pairs of lateral teeth, median tooth 1.3X the lateral teeth (Figure 37E), VmP extends anteriorly to 2nd lateral teeth SSm posterior to mentum. Procercus wider than long, bearing 5 short apical setae (Figure 37F). Posterior parapods about 2X as long as wide, bearing group of dark claws (Figure 37F).

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, Manitoba, Northwest Territories, Nunavut, Ontario, Québec, Saskatchewan, Yukon Territory). Greenland. USA (Alaska, Arizona, Arkansas, Colorado, Georgia, Idaho, Kansas, Minnesota, Montana, New York, North Carolina, Ohio, Pennsylvania, South Carolina, South Dakota, Tennessee, Virginia, Washington)

Ecology and habitat. Larvae are reported to live on stones in springs, streams and rivers (Thienemann, 1935; Thienemann 1941; Thienemann, 1954; Dittmar, 1955; Lehman, 1971). Larvae make gelatinous tubes covered with sand grains and detritus segmented along their length axis attached to the stones. Larvae are rheophilous and eurythermal (Thienemann, 1912; Dittmar, 1955).

Orthocladius (Orthocladius) cf. *clarkei* Soponis, 1977

Larva (n=2)

Figures 38A-F

Description. Larva L=4.7 mm. HL/HW=0.87. Antenna 5 segmented, LO developed but small covering the 3rd segment, blade shorter than flagellum (Figure 38A), AR=1.8. SI bifid, SII-SIII simple (Figure 38B). Premandible simple, notched at the tip (Figure 38C). Mandible with 3 inner teeth (Figure 38D) smooth on outer ridge, SSd prominent, seta interna with 6-7 serrated branches. Mentum with 1 wide median tooth and 6 pairs of lateral teeth (Figure 38E), median tooth 3.3 X the 1st lateral teeth, VmP narrow extends beyond the line drawn by SSm. Procercus wider than long, bearing 5 apical setae. Posterior parapods longer than wide with group of large claws (Figure 38F).

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of this species occur in bog-fed streams of deciduous forests and build tubes. Species is most probably univoltine (Soponis, 1977).

Remarks. Larva of *Orthocladius (Orthocladius) clarkei* Soponis described by Soponis (1977) and by Epler (2001). The combination of smooth outer ridge of mandible and larger (≥ 3X) median tooth of mentum can partially separate the larvae of this species from that of *Orthocladius (Orthocladius) obumbratus* Johannsen. *O. clarkei* has not been reported in Alberta. In Canada it has only been reported in Ontario. In USA it has been reported in Illinois, Iowa, Minnesota, Pennsylvania, and Texas. According to Epler (2001) geographical reports from North and South Carolinas are doubtful.

Orthocladius (Orthocladius) obumbratus Johannsen, 1905

Larva (n=2)

Figures 39A-D

Description. Larva L=5.1 mm. HL/HW=0.86, Antenna 5 segmented, LO developed but small covering the 3rd segment, blade shorter than flagellum (Figure 39A), RO at basal 1/5th of the first segment, AR=1.7. SI bifid, SII-SIII simple (Figure 39B). Premandible simple (Figure 39C). Mandible with 3 inner teeth (Figure 39C) slightly crenulated on outer ridge, SSd prominent, seta interna with 6 branches. Mentum with 1 median tooth and 6 pairs of lateral teeth (Figure 39D), median tooth 2.7X the 1st lateral teeth, VmP narrow extends beyond the line drawn by SSm. Procercus wider than long, bearing 5 apical setae. Posterior parapods longer than wide with group of large claws.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, Labrador, Manitoba, New Brunswick, Northwest Territories, Nunavut, Ontario, Québec, and Saskatchewan). USA (Alabama, Alaska, Arkansas, California, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, South Dakota, South Carolina, Texas, Utah, Vermont, and Virginia).

Ecology and habitat. Species is reported to have univoltine to multivoltine life cycle depending on the latitude that it occurs (Soponis, 1977).

Remarks. Larva is described by Soponis (1977) and by Epler (2001).

Paracricotopus sp.

Larva (n=1)

Figures 40A-E

Description. Larvae L=1.2 mm. HL/HW=1.0. Antenna 5 segmented, 5th segment longer than 4th (Figure 39A), blade shorter than flagellum, LO slightly shorter than 3rd segment, RO at the base of 1st segment, AR=0.95. SI-SIII simple. Premandible simple (Figure 40B). Mandible with 3 inner teeth (Figure 40C). Mentum with 1 dome shaped median tooth and 5 pairs of lateral teeth (Figure 40D). Body segments with robust, simple setae. Procercus without spurs bearing 5 apical setae 2 short (L=113.0 µm), and 3 longer setae (L=218.8 µm) and 2 sub-apical setae. 2 anal setae present, L=98.7 µm. Posterior parapods longer than wide, bearing ~10 claws (Figure 40E). 4 anal tubules of equal size (L=32.3 µm).

Rivers and streams. Athabasca River and Ells River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of species in this genus live in algae and moss in streams and bogs (Andersen *et al.,* 2013).

Remarks. Spurs of procercus are not detectable in this species; however, other characters such as simple SI, absence of beard on VmP and simple abdominal setae match that of *Paracricotopus* species. This larva could be a 3rd instar larva of *Paracricotopus milkronensis* Caldwell.

Parakiefferiella Thienemann, 1936

Note on the genus *Parakiefferiella*. According to Andersen *et al.* (2013) *Parakiefferiella* is characteristically a variable genus. However, the combination of 6th segmented antennae, hair-like 6th antennal segment, usually serrated (may be bifid) SI, and well-developed VmP that may extend beyond margin of the mentum can partially separate this genus from other Orthocladiinae. Five distinct larvae were obtained in this study that may partially be separated based on the key below. *Parakiefferiella* sp. 1 was the most commonly encountered species in this study.

Ecology and habitat. Larvae of *Parakiefferiella* mainly occur in standing waters.

Key to species of *Parakiefferiella*

1a. Mentum with large dome shaped median tooth, VmP covering the lateral teeth (Figure 43E) ..... ***Parakiefferiella* sp. 3**

1b. Mentum with small dome shaped or nipple shaped median tooth, VmP variable **2**

2a. Mandible with apical tooth longer than combined width of inner teeth ..... ***Parakiefferiella* sp. 2**

2b. Mandible with apical tooth about the same size as combined width of inner teeth **3**

3a. VmP squared at apex, median tooth of mentum stand slightly higher than lateral teeth (Figure 44D) ..... ***Parakiefferiella* sp. 4**

3b. VmP round at the apex, median tooth not much higher than lateral teeth **4**

4a. Mentum with 6 pairs of lateral teeth (Figure 41E) ..... ***Parakiefferiella* sp. 1**

4b. Mentum with 5 pairs of lateral teeth (Figure 45F) ..... ***Parakiefferiella* cf. *gracillima***

Parakiefferiella sp. 1

Larva (n=3)

Figures 41A-F

Macroscopic characters. Head capsule is yellow (Figure 41A). Eyespots are single and teardrop shape, located at anterior 1/3rd of the head. Posterior parapods are not much longer than wide. Procercus has long apical setae.

Description. Larvae L=2.6 mm. HL/HW=1.1. Antennae 6 segmented, 6th segment long and hair-like (Figure 40B), blade shorter than flagellum (L=15.7 µm), RO at basal 1/6th of the 1st segment, AR=1.2. SI with 5-6 branches (Figure 41C), SII-SIII simple. Pecten epipharyngis with 3 sub-equal scales. Premandible simple, L=53.0 µm (Figure 41C). Mandible with 1 apical tooth and 3 inner teeth, apical tooth same size as combined width of inner teeth, SSd prominent with spines at the base (Figure 41D). Mentum with 1 median tooth and 6 pairs of lateral teeth (Figure 40E), median and the 1st laterals lighter in color and stand slightly higher than remaining teeth giving an appearance of tripartite median teeth, VmP well-developed not exceeding the margins of mentum posteriorly reaching the line drawn by SSms, SSm long (L=52.0 µm), beard absent, mentum L=39.3 µm, mentum W=80.4 µm, VmPL=46.5 µm. Procercus longer than wide, bearing 7 long apical setae (L=671.5 µm; Figure 41F). Posterior parapods longer than wide. 4 conical anal tubules of equal size, L=55.1 µm

Remarks. Barton (1980) reported an abundant species of *Parakiefferiella* complex in this region of the Athabasca River that he named Orthocladiinae B. The *Parakiefferiella* sp. 1 was the most abundant species of *Parakiefferiella* obtained in this study. However, we could not examine any specimens from Barton's original collection. Additionally, the size of *Parakiefferiella* sp. 1 larvae obtained were on average 2.6 cm which is greater than 1.9 cm reported by Barton (1980) for Orthocladiinae B. Therefore, it is not clear whether these species are the same or otherwise. The mentum and mandible of this species resemble those of *Paratrichocladius* and *Cricotopus*; however, combination of 6th segmented antenna and branched SI places the larva in *Parakiefferiella*.

Rivers and streams. Athabasca River and Ells River.

Nearctic distribution. Canada (Alberta).

Parakiefferiella sp. 2

Larva (n=1)

Figures 42A-D

Description. Larva L=2.2 mm. HL/HW=0.91. Antenna 6 segmented, blade shorted than flagellum (Figure 42A), AR=0.83. SI appears with serrated tips, SII simple prominent and long, SIII simple and small (Figure 42B). Premandible simple. Mandible with 3 inner teeth, apical tooth about 1.5X as the combined width of inner teeth (Figure 42C). Mentum with 1 dome shaped median tooth that could be notched and 6 pairs of lateral teeth (Figure 42D), median tooth slightly lighter than lateral teeth, VmP prominent extending to the line drawn by SSms. Procercus well-sclerotized longer than wide, bearing 5 apical and 2 sub-apical setae. Posterior parapods not much longer than wide, bearing group of simple claws.

Rivers and streams. Steep Bank River.

Nearctic distribution. Canada (Alberta).

Remarks. This larva resembles the *Parakiefferiella bathophila* (Kieffer); however, the median tooth of mentum is paler than lateral teeth and SI does not appear to be bifid with serration.

Parakiefferiella sp. 3

Larva (n=1)

Figures 43A-F

Macroscopic characters. Head capsule is yellow with occipital regions light (Figure 43A). Eyespots are single, large, and conical shape (Figure 43A).

Description. Larvae L=2.6 mm. HL/HW=0.90. Antennae 6 segmented, 6th segment hair-like, 4th segment longer than 3rd, RO at the basal 1/2 of 1st segment (Figure 43B), blade shorter than flagellum, AR=0.89. SI with multiple branches, SII-SIII simple. Pecten epipharyngis consist of 3 sub-equal scales. Premandible single with apparently two notches (Figure 43C). Mandible with 1 long apical tooth and 3 inner teeth (Figure 43D), apical tooth length is 1.3X the combined width of the inner teeth, SSd long reaching the tip of 3rd inner teeth, seta interna with 8 long simple branches. Mentum with single pale, large, dome shaped median tooth and 6 pairs of lateral teeth (Figure 43E), VmP large, covers the lateral teeth (Figure 43E), SSm anterior to apices of VmP. Procercus not well-sclerotized bearing 4-5 setae, with at least 1 setae longer than the rest (Figure 43F). Posterior parapods slightly shorter than wide, bearing group of simple claws.

Rivers and streams. Ells River.

Nearctic distribution. Canada (Alberta).

Remarks. Larva resembles the couplet 2(1) of *Parakiefferiella* section in Epler (2001) for *Parakiefferiella* sp. A; however, we cannot be certain. This larva could also be the larva that described by Hoffman (1971) and by Chernovskii (1949) as *Cricotopus triquetrus* and by Pankratova (1979) as *Paratrichocladius triquetrus*. The *Parakiefferiella* sp. A Epler is only reported in Florida, North and South Carolinas, USA.

Parakiefferiella sp. 4

Larva (n=1)

Figures 44A-D

Description. Larva L=2.3 mm. HL/HW=0.90. Antennae 6 segmented, 6th segment hair-like (Figure 44A), blade shorter than flagellum, RO at basal 2/5th of the 1st segment, AR=0.77. SI not serrated at the tip, SII simple and large, SIII not discernable. Pecten epipharyngis with 3 sub-equal scales. Premandible bifid (Figure 44B). Mandible with 3 inner teeth, apical tooth about the same length as combined width of inner teeth (Figure 44C), SSd hook-like, seta interna with 5 branches. Mentum with 1 dome shaped median tooth and 6 pairs of lateral teeth, median tooth slightly higher than lateral teeth, median and 1st two pairs of lateral teeth lighter (Figure 44D), SSm posterior to mentum, VmP developed and squared at apex. Procercus wider than long, bearing 5 apical setae. Posterior parapods longer than wide. 4 long anal tubules, dorsal tubules L=49.3 µm, ventral tubules L=32.7 µm.

Rivers and streams. Steep Bank River.

Nearctic distribution. Canada (Alberta).

Remarks. Larva resembles the couplet 5(4') of *Parakiefferiella* section in Epler (2001) for *Parakiefferiella* sp. G; however, we cannot be certain. According to Epler (2001) *Parakiefferiella* sp. G is based on the figures by Dr. S.C. Mozley in an unpublished, undated manuscript recorded in Wake County, North Carolina. The *Parakiefferiella* sp. G Epler is reported in North Carolina, USA.

Parakiefferiella cf. *gracillima* (Kieffer, 1922)

Larva (n=3)

Figures 45A-G

Macroscopic characters. Head is yellowish-white with occipital region dark (Figure 45A). Eyespots are conical shape, large, and single (Figure 45A); located at anterior 1/3rd of the head.

Description. Larva L=2.8 mm. HL/HW=0.81. Antenna 6 segmented, 6th segment long and hair-like (Figure 45B), blade shorter than flagellum, RO at basal 1/3rd of the 1st segment, AR=0.93. SI with 4 branches (Figure 45C), SII-SIII simple, SII large. Pecten epipharyngis with 3 sub-equal scales. Premandible simple (Figure 45D). Mandible with 3 inner teeth, apical tooth length equal to combined width of inner teeth (Figure 45E), SSd prominent, seta interna with 5 branches. Mentum with 1 light dome shaped median tooth and 5 pairs of darker lateral teeth (Figure 45F), VmP prominent not exceeding the margins of mentum, SSm well posterior to mentum, VmPL=44.7 µm, mentum W=73.3 µm, mentum L=35.7 µm. Procercus well sclerotized and wider than long, bearing 7 apical setae (Figure 45G). Posterior parapods longer than wide, bearing group of claws. 4 conical anal tubules (Figure 45G), dorsal anal tubules slightly longer and larger than ventrals, dorsal tubules L=50.1 µm, ventral tubules L=40.5 µm.

Rivers and streams. Ells River.

Ecology and habitat. Wülker (1957) reported the larvae of *Parakiefferiella gracillima* (Kieffer) in high altitude springs.

Remarks. Larvae examined in this study match the description given by Wülker (1957) for *P. gracillima*. Median tooth of mentum described in Wülker (1957) has a notch whereas the specimens in this study have apparently worn median tooth. However, Schmid (1993) reported the species with single median tooth. *Parakiefferiella gracillima* (Kieffer) has not been reported in Alberta. A similar species in larval form was reported in Nunavut Canada (Namayandeh *et al.,* 2016). In USA it has been reported in Alaska.

Parametriocnemus lundbecki (Johannsen, 1905)

Larva (n=2)

Figures 46A-G

Macroscopic characters. Head is yellowish-golden (Figure 46A). Eyespots are bifid and vertically attached (Figure 46A), located at anterior 1/4th of the head capsule. Anal tubules are longer than posterior parapods; tubules are constricted in the middle.

Description. Larva L=4.0 mm. HL/HW=0.91. Antennae 5 segmented, LO prominent covering the 3rd segment (Figure 45B), blade shorter than flagellum, RO at the basal 1/4th of 1st antennal segment, AR=1.6. SI plumose, SII-SIII simple (Figure 46C). Premandible trifid with accessory tooth (Figure 46D). Mandible with 3 inner teeth, SSd prominent extending to the base of 2nd lateral teeth (Figure 46E), seta interna with 6 branches that are serrated at apex. Mentum with wide bifid median tooth and 5 pairs of lateral teeth (Figure 46F). VmP prominent and appear double, VmP extend beyond the margin of mentum (Figure 46F), SSm located anteriorly. Procercus longer than wide, bearing 5 apical setae (Figure 46G). Posterior parapods longer than wide. Dorsal anal tubules L=130.0 µm, ventral anal tubules L=112.3 µm. At least 2 long anal setae on posterior portion of the body.

Pupae. TH as (Figure 46H), TH L=303.8 µm, TH W=38.5 µm. Pc_1L=107.1 µm, 10.0 µm from Pc_2, Pc_2L=99.0 µm, Pc_3 L=107.7 µm, 11.6 µm from Pc_2. Shagreens present on tergites II-VIII. Integument of tergites and sternites with polygons (Figure 46I). Pedes spuri long (Figure 46J). Tergites II-VII with posterior spines. Anal lobe with few bristle and spines at the apex, lobe with 3 long macrosetae, inner macrosetae L=166.90, median macrosetae L=186.8, outer macrosetae L=193.61. Genital sac shorter than anal lobe in female (Figure 46K).

Rivers and streams. Athabasca River, Joslyn Creek, and Steep Bank River.

Nearctic distribution. Canada (Alberta, Québec, Saskatchewan, and Ontario). Greenland. USA (Alabama, Arizona, California, Florida, Georgia, Michigan, New Mexico, New York, North Carolina, Ohio, South Carolina, and Texas).

Ecology and habitat. Larvae of this species occur in clean streams of piedmont and mountains. This species is not tolerant of high turbidity or low oxygen (Simpson and Bode, 1980).

Remarks. Larva and pupa described by Sæther (1969).

Psectrocladius (Psectrocladius) limbatellus (Holmgren, 1869)

Larva (n=1)

Figures 47A-E

Description. Larva L~5.9 mm. HL/HW=1.0. Antenna 5 segmented, blade shorter than flagellum (Figure 48A), RO at the base of the first segment, AR=2.9. SI palmate, SII-SIII simple (Figure 47B). Apical setae of palpiger L=6.70 µm. Premandible simple (Figure 47B). Mandible with 3 inner teeth, apical tooth 1.2 X the combined width of inner teeth (Figure 47C), SSd prominent, seta interna with 6-7 serrated branches. Mentum with wide bifid median tooth and 5 pairs of lateral teeth (Figures 47D-E), VmP prominent extending anteriorly to base of median teeth and posteriorly to line drawn by SSm, cardinal beard with 8-9 short setae (Figure 47DandE).

Pupa description. TH clubbed shape, covered in spinules (Figure 47F), TH L=406.8 µm, TH W at the base=42.73 µm, TH W=95.6 µm, Pc_1-Pc_3 Ls=27.6, 162.93, 156.1 µm. Tergite I bare, tergite II with posterior spines on protuberance (Figure 47G), tergites III-VI with posterior spines, tergites IV-VI with double patch of median spines (Figure 47H). LS on segments V hair-like, 4LS on segments VI with each pair having1 hair-like setae and 1 lamellate, 4 lamellate LS on segments VII and 5 on VIII (Figure 47I), lamellate LS Ls=201.0-346.0 (265.1) µm. Anal lobe L=383.02 µm, W=261.5 µm, anal lobes with fringe of setae (~50 on each) and 3 long macrosetae (Figure 47J), inner macrosetae L=427.3 µm, median macrosetae L=477.94 µm, outer macrosetae L=506.3 µm. Female genital sac shorter than anal lobe, L=277.3 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (1st record for Alberta, Manitoba, and Nunavut). Greenland. USA (South Dakota).

Ecology and habitats. According to Langton (1980) larvae of this species occur in ditches, cattle troughs, and ponds on sheltered parts or on submerged vegetation of these habitats. Larvae also occur in lakes and reservoirs and sometimes in streams. In this study larva was obtained in sandy substrate of the Athabasca River.

Remarks. Larval posterior characters are not discernible in this puparium specimen. Mentum was damaged in this specimen, so we reconstructed the shape of mentum. Presence of 2 patches of dorsomedial spines in tergites IV-VI places the species in *limbatellus* group. The pupa characters match the description given by Langton (1980) for *P. limbatellus*.

Rheocricotopus (Psilocricotopus) chalybeatus group

Larva (n=2)

Figures 48A-D

Description. HL/HW=1.0. Antenna 5 segmented, segments sequentially decrease in size, LO prominent covering the 3rd segment (Figure 49A), blade shorter than flagellum, RO at the base of 1st segment, AR=. SI bifid, SII-SIII simple (Figure 48B). Pecten epipharyngis with 3 equal scales (Figure 48B). Premandible simple with accessory tooth (Figure 48B). Mandible with 3 inner teeth (Figure 48C), SSd thin reaching the base of 2nd inner teeth, seta interna with 5 serrated branches. Mentum with 1 wide median tooth and 6 lateral teeth, 1st lateral partially fused to median tooth and stand higher than other lateral teeth giving a tripartite appearance (Figure 48D), VmP well-developed posteriorly reaching the line drawn by SSm, cardinal beard with 10-11 setae (Figure 48D). Procercus bearing 5 apical and 2 sub-apical setae. Posterior parapods longer than wide, bearing group of large claws. Anal tubules long and tube-like, dorsal tubules longer than ventral tubules.

Rivers and streams. Athabasca River and Steep Bank River.

Nearctic distribution. Canada (Alberta, and Nunavut).

Ecology and habitat. Larvae of genus *Rheocricotopus* are most abundant in lotic environment, although some occur in standing waters.

Remarks. All larvae obtained in this study were younger instars, mainly 2nd instars. The largest larvae obtained, probably a 3rd instar, had missing abdomen. Head capsule characters and measurements are based on this specimen. The posterior parapods characters; however, are based on an earlier instar larva (probably a 2nd instar). Namayandeh *et al.* (2016) reported similar larvae from Nunavut, Canada.

Stictocladius sp. G Sæther *et* Cranston, 2012

Larva (n=5)

Figures 49A-G

Macroscopic characters. Head capsule is yellow (Figure 49A). Eyespots are single and small, located at anterior 1/3rd of the head capsule (Figure 49A). Antennae are long with much of 2nd segment appearing hyaline (Figure 49A). Body is tubular and Ceratopogonidae-like (Figure 49B). Posterior parapods are elongated (Figure 49C).

Description. Larvae L=5.7 mm. HL/HW=1.1. Antenna 5 segmented, 5th segment longer than 4th and hair-like, 2nd segment with 3/5th of the segment un-sclerotized, sclerotized portion /A_2 L=0.4. LO prominent covering the 2/3rd of the 3rd segment, blade shorter than flagellum, RO at of the basal 1/4th of the 1st segment (Figure 49D), 1st segment W=19 µm, AR=0.55. SI-SIII simple. Premandible simple with prominent accessory tooth (Figure 49E). Mandible with 3 inner teeth (Figure 49F), SSd small. Mentum with single dome shaped median tooth (W=14.2 µm) and 5 pairs of lateral teeth, 3rd lateral teeth sits lower than 4th in almost a same plane as 5th lateral, SSm posterior to mentum (Figure 49G). Procercus with 3 apical and 2 sub-apical setae. Posterior parapods much longer than wide, bearing 12 simple claws. 4 conical anal tubules of equal size, L=63.3 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. 1st record for Canada (Alberta). USA (Idaho, Montana, and New Mexico).

Ecology and habitat. In Idaho larvae were found in hyporheic zone and in sandy substrates, similar to some *Harnischia* complex species (Sæther and Cranston 2012). In this study larvae were found mainly in sand substrate of the Athabasca River and its tributaries. Larvae resemble species in *Harnischia* complex and were found also in the same habitat.

Remarks. Larvae match the description given by Sæther and Cranston (2012) for the un-associated North American larvae called *Stictocladius* sp. G.

Thienemanniella xena (Roback, 1957)

Larva (n=1)

Figures 50A-D

Macroscopic characters. Head capsule is elongated (Figure 50A). Antennae are long, about 1/2 of the head capsule, 2nd segment is darker than other segments (Figure 50A). Eyespots are semidetached and teardrop shaped (Figure 50A).

Description. Larva L=2.3 mm. HL/HW=1.2. Antennae 5 segmented, LO developed but small, 2nd segment brown about 0.9X of the 3rd segment (Figure 50B), blade shorter than flagellum, RO close to basal 1/3rd of the 1st segment, AR=1.5. SI-SIII simple. Premandible with multiple inner teeth. Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth (Figure 50C). Mentum with 3 median teeth and 5 pairs of lateral teeth, 1st lateral not partially fused to median teeth, SSm well posterior to mentum (Figure 50D). Postmentum L=160.7 µm. Procercus slightly wider than long, bearing 4 apical setae. Posterior parapods longer than wide, bearing small simple claw, sub-basal setae L=30.4 µm. Anal tubules shorter than posterior parapods and equal in size, L=49.1 µm.

Rivers and streams. Athabasca River, Ells River, Firebag River and Steep Bank River.

Nearctic distribution. Canada (Alberta, Manitoba, Northwest

Territories, and Ontario). USA (Alaska, Florida, Georgia, Illinois, Michigan, New York, North Carolina, Ohio, Pennsylvania, South Carolina, and South Dakota).

Ecology and habitat. This species occurs in streams (Hudson *et al.,* 1990). Larvae reported in alkaline fen in Ohio (Bolton, 1992).

Remarks. Larva is described by Hestenes and Sæther (2000).

Tvetenia Kieffer, 1922

Note on the genus *Tvetenia*. The combination of serrated to partially serrated SI of the labrum and lighter head capsule usually separate the larvae of *Tvetenia* from those of *Eukiefferiella* Thienemann. Two species of *Tvetenia* were found in this study that can be partially separated based on the key below.

Macroscopic characters. Head capsule is yellow (Figure 52A), occipital region dark in *Tvetenia tshernovskii* (Pankratova) and lighter in *Tvetenia paucunca* (Sæther). Eyespots are bifid with much smaller spot attached to much larger spot (Figure 52A). Body with long erect setae, setae on mid body segments at least 2/3rd of the segments bearing them.

Key to species of *Tvetenia*

1a. Mentum with bifid median tooth, antennal 4th segment 1.5X the 3rd segment.....***Tvetenia paucunca***

1b. Mentum with single median tooth, antennal 4th segment 7X the 3rd segment .....***Tvetenia tshernovskii***

Tvetenia paucunca (Sæther, 1969)

Larva (n=5)

Figures 51A-E

Description. Larva L=4.0 mm. HL/HW=1.1. Antennae 5 segmented, 4th segment about 1.5X of the 3rd segment, LO prominent covering the 3rd segment, blade shorter than flagellum (Figure 51A), RO at of the 1st segment, AR=1.8. SI coarsely branched, SII-SIII simple. Premandible simple (Figure 51B). Mandible with 3 inner teeth, SSd prominent, inner ridge with 2-3 spines (Figure 51C), seta interna with 7 branches. Mentum with bifid median tooth and 5 pairs of lateral teeth, VmP narrow and hard to detect, SSm well posterior to mentum (Figure 51D). Mid body setae L=185.3 µm. Procercus well-sclerotized bearing 6 apical setae (Figure 51E). 2 long anal setae, L=236.0 µm. Posterior parapods longer than wide, bearing large simple claws.

Pupa. TH as (Figure 51F), TH L=331.8 µm, TH W=62.7 µm, bulbus part L=96.3 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, Northwest Territories, Nunavut, Manitoba, Ontario, and Yukon Territory). USA (Georgia, Michigan, North Carolina, Ohio, and South Carolina).

Remarks. Larva and pupa are described by Sæther (1969) as *Eukiefferiella paucunca*.

Tvetenia tshernovskii (Pankratova, 1968)

Larva (n=1)

Figures 52A-E

Description. Larva L=3.6 mm. HL/HW=1.2. Antennae 5 segmented, 4th segment 0.7X of the 3rd segment, LO developed (Figure 52B), blade shorter than flagellum, AR=1.9. SI coarsely branched or plumose, SII-SIII simple. Premandible simple. Mandible with 3 inner teeth, inner ridge with 3 spines (Figure 52C). Mentum with single median tooth and 5 pairs of lateral teeth, SSm posterior to mentum (Figure 52D). Procercus well-sclerotized bearing 5 apical and 2 sub-apical setae (Figure 52E). Posterior parapod longer than wide (Figure 52E). Dorsal anal tubules longer than ventral tubules, dorsal tubules L=94.3 µm, ventral tubules L=69.91 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (1st record for Alberta, Ontario, and Saskatchewan). USA (Arizona, California, Florida, Georgia, Michigan, New York, North Carolina, and South Carolina).

Ecology and habitat. According to Epler (2001) this species appears to be more common on the Coastal Plain than in the mountains in Carolinas and occurs where *T. paucunca* is more common. This species is tolerant of high organic nutrient levels. In this study the species was the most commonly collected Chironomidae species in Athabasca and its tributaries.

Remarks. Larva is described by Epler (2001) as *Tvetenia vitracies* and by Bode (1983) as *Eukiefferiella discoloripes* group.

Subfamily Chironominae

Tribe Chironomini

Note on the key to tribe Chironomini: The genera presented in this study can also be separated based on the macroscopic key given by Orendt and Spies (2012).

Key to the genera of Chironomini

1a. VmP without well-defined striae, fused to mentum (Figure 73G) .....***Stenochironomus***

1b. VmP with well-defined striae, well-separated from mentum.....**2**

2a. Antennae with 6 segments, LOs alternatively on segments 2 and 3 (Figure 60B).....**3**

2b. Antennae with 4-8 segments, LOs not as above if antennae 6 segmented **6**

3a. Mentum with a single large pale median tooth standing higher than lateral teeth (Figure 64E) .....***Paralauterborniella***

3b. Mentum with 1 or more median teeth, if 1 then not with above color and charcters **4**

4a. Mentum with 2-3 pale median teeth, usually same height as 2nd lateral teeth (Figure 60E and Figure 61B) .....***Microtendipes***

4b. Mentum with 1 dark median tooth, if 2 median teeth then pale and sit lower than lateral teeth **5**

5a. Inner median teeth of mentum light, outer median teeth lower or same height as median pair, median teeth lower than lateral teeth (Figure 65D). SI base fused.....***Paratendipes***

5b. Inner median teeth of mentum dark (same color as laterals), outer median teeth higher than remaining lateral teeth (Figure 74D). SI base not fused .....***Stictochironomus***

6a. SI simple. SII much larger than SI. labral lamellae usually absent. Mandible without dorsal tooth. Pecten epipharyngis consist of a single plate which could be round or sub-triangular in shape ....***Harnischia* complex (in part) (7)**

6b. SI plumose, comb-like, or serrated. SII not much larger than SI.

Labral lamellae well-developed. Mandible usually with dorsal tooth. Pecten epipahryngis consist of separate plates.....**12**

7a. Mentum concave, median tooth lighter. VmPs at least 3X wider than long.....**8**

7b. Mentum convex or flat, median tooth vary in color. VmPs at the most 2X wider than long **9**

8a. Antenna 5 segmented (Figure 57C).....***Cryptochironomus***

8b. Antenna 7 segmented (Figure 58C).....***Demicryptochironomus***

9a. Antenna 8 segmented, antennal segments weakly sclerotized (Figure 54A). Mandible usually without inner teeth (1 inner tooth or notch; Figure 54E).....***Chernovskiia***

9b. Antenna 5-7 segmented, antennal segments sclerotized variably. Mandible with 2 or more inner teeth **10**

10a. Antenna 5 segmented, 2nd segment much longer than 3rd..... .....***Paracladopelma***

10b. Antenna 6-7 segmented, 2nd segment not much longer than 3rd... .....**11**

11a. Mentum with even number of teeth (Figure 71H and Figure 72G) .....***Robackia***

11b. Mentum with odd number of teeth (Figure 53D) .....***Beckidia***

12a. 8th abdominal segment with 1-2 pairs of ventral tubules (Figure 55C) .....***Chironomus* (in part)**

12b. 8th abdominal segment without ventral tubules.....**13**

13a. Mentum with 4 median teeth, distinct line running from the posterior margin of the outer median teeth (Figure 66D)..... .....***Phaenopsectra***

13b. Mentum with 1-3 median teeth, no distinct line running from the posterior margin of the outer median teeth.....**14**

14a. Mentum with 2 median teeth, median teeth same height or higher than 1st lateral teeth (Figure 67E, Figure 68E, Figure 69D and Figure 70D).....***Polypedilum***

14b. Mentum with 1 or 3 median teeth, at least 1st median tooth the same height as 1st lateral teeth.....**15**

15a. Mentum with 3 median teeth (Figure 56G) ....***Chironomus* (in part)**

15b. Mentum with 1 median tooth that could be notched (Figure 59E) .....***Glyptotendipes* (in part)**

Beckidia tethys (Townes, 1945)

Larva (n=4)

Figures 53A-E

Macroscopic characters. Larvae resemble other larvae in *Harnischia* complex (especially those of *Robackia*, *Chernovskiia* and *Paracladopelma*). Larva is long and Ceratopogonidae-like, with posterior parapods long and slender. Head is wider at the base and almost parallel-sided anteriorly. Key macroscopic feature of the larvae is its long dorsal anal tubules that are as long as posterior parapods or are slightly longer.

Description. Larva L=4.5 mm. HL/HW=0.85. Antenna 7 segmented, weakly sclerotized, blade longer than flagellum originates from the base of 3rd segment (Figure 53A), large style on 4th segment L=8.7 µm. AR=0.60. SI-SIII simple, SI small and hair-like, SII-SIII long and large. Premandible with 4 teeth and accessory tooth (Figure 53B). Mandible small with 2 inner teeth (Figure 53C). Mentum with trifid median tooth and 4 pairs of lateral teeth, mentum slightly concave (Figure 53D), VmP with well-developed striation, VmP W/ mentum W=0.68. Procercus absent. 2 short anal setae present L=24.7 µm. Posterior parapods long and slender toward apex with few small claws. Dorsal anal tubules longer than posterior parapods (Figure 53E), dorsal tubules L=195.8 µm, ventral tubules L=158.5 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (1st record for Alberta, Saskatchewan, Ontario, and Québec) USA (South Dakota, and New Mexico).

Ecology and habitat. Larvae of *Beckidia* occur on sandy substrates of lakes and rivers.

Remarks. We obtained 4 mounted specimens of this species. Macroscopic figures are not available for these species. Larva is described by Sæther (1977) as *Beckiella tethys* (Townes) and by Epler *et al.* (2013). Larva which is described by Sæther (1977; Figure 42F) has a bifid premandible whereas Epler *et al.* (2013) described larva of this species with 4 teeth.

Chernovskiia orbicus (Townes, 1945)

Larva (n=2)

Figures 54A-G

Description. Larva L=7.8 mm. HL/HW=1.0. Antenna 8 segmented, weakly sclerotized basal segments, blade shorter than flagellum originates from approximately the mid-section of 3rd segment (Figure 54A), large style on 5th segment L=12.5 µm, RO at basal 2/5th of the 1st segment, AR=1.0. SI-SIII simple, SI small and hair-like, SII long and large (Figure 54B). Maxilla Palp as in (Figure 54C). Premandible with 4 teeth and no brush (Figure 54D). Mandible with outer spine or projection, 1 apical tooth and inner notch, mola expanded, (Figure 55E). Mentum with a wide and flat median tooth and 4 pairs of lateral teeth, 1st and 4th lateral wider than 2nd and 3rd, mentum slightly concave (Figure 54F), VmP with 9 well-developed striation not much wider than long, VmP W/ mentum W=0.57. Procercus reduced as long as wide, bearing 3 apical and 2 subapical setae (Figure 54G). 2 anal setae present, L=56.0 µm. Body appears 20 segmented. Posterior parapod long and slenders toward apex with few small claws. Anal tubules shorter than posterior parapods, dorsal tubules L=157.2 µm, ventral tubules L=146.1 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta). USA (Iowa, Kansas, Nebraska, North Carolina, South Carolina, and South Dakota).

Ecology and habitats. Larvae of the species in this genus prefer sandy substrate of large rivers (Sæther 1977).

Remarks. We only obtained 2 mounted specimens of this species. Larva is described by Sæther (1977). Epler *et al.* (2013), Epler (2001) and Sæther (1977) described the larvae without mandibular inner teeth; however, it appears that specimens in this study have a notch in inner mandible. Sæther (1977) description of the antenna's segment length, position of blade and AR are not correct.

Chironomus Meigen, 1803

Note on the genus *Chironomus*. Identification of the larvae of *Chironomus* species has been traditionally done using cytotaxonomic methods. Identification using morphological methods is done mainly for western European species of *Chironomus*. Epler (2001) and Martin

(2012) have described many Nearctic species using morphological features. In this study larvae from two species group were present that can be partially separated based on the key below.

Key to species group of *Chironomus*

1a. Two pairs of ventral tubules present on anterior abdominal segment (Figure 55C). Mandible with 2 dark and 1 light inner teeth (Figure 55D).....***Chironomus (Chironomus) decorus* group**

1b. Ventral tubules absent on anterior abdominal segment (Figure 56C). Mandible with all inner teeth dark (Figure 56F) .....
.....***Chironomus (Chironomus) salinarius* group**

Chironomus (Chironomus) decorus group

Larva (n=1)

Figures 55A-F

Macroscopic characters. Most of ventral side and postmentum of the head capsule are dark brown (Figure 55A), dorsal and lateral sections are lighter. Mentum with trifid median tooth and 2 large leaf-shaped VmPs (Figure 55A). Eyespots are bifid; horizontally parallel (Figure 55B). Head has indistinct antennal pedestals. Abdominal 8th segment with 2 pairs of lateral tubules (Figure 55C).

Description. Larvae L=1.3cm. HL/HW=1.0. Antenna is 5 segmented, blade shorter than flagellum (Figure 55D); LO narrow covers 2/3rd of 3rd segment, RO at basal 1/4th of the 1st segment. AR=2.0. SI comb-like, SII long and simple, SIII short and simple (Figure 55E). labral lamellae well-developed with 60 branches. Pecten epipharyngis with 14 teeth (Figure 55E) with. Premandible bifid, with brush (Figure 55E). Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, 3rd inner teeth lighter than remaining teeth (Figure 55D), pecten mandibularis with 12 branches, SSd reaches the base of 2nd inner teeth, seta interna with 6 branches. Mentum with trifid median tooth and 6 pairs of lateral teeth (Figure 55F), VmP wider than long, VmP W/ mentum W=0.99. Procercus developed bearing 7 apical and 2 sub-apical setae. Posterior parapods longer than wide. Ventral anal tubules longer than dorsal tubules, dorsal tubules L=270.5 µm, ventral tubules L=302.8 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitats. Larvae of species in this group are found in both lotic and lentic habitats and usually are indicative of low water quality.

Remarks. The *C. decorus* group includes several species that are mainly separable by molecular methods.

Chironomus (Chironomus) salinarius group

Larva (n=2)

Figures 56A-G

Macroscopic characters. Head capsule is white (Figure 56A). Mentum with trifid median tooth and 2 large leaf-shaped VmPs (Figure 56A). Eyespots are bifid, horizontally parallel (Figure 56B). Head has indistinct antennal pedestals. Abdominal 8th segment without lateral tubules (Figure 56C).

Description. Larvae L=5.7 mm. HL/HW=0.90 . Antenna 5 segmented (Figure 57D), RO at of 1/4th of the 1st segment, AR=2.3, SI-SIII simple and long. Labral lamellae well-developed with 84 branches (Figure 56E). Pecten epipharyngis with 14 teeth (Figure 56E). Premandible bifid with well-developed brush. Mandible with 1 light dorsal tooth, 1 dark apical tooth and 3 dark inner teeth (Figure 56F), pecten mandibularis with 6 branches, SSd reaches the base of 3rd inner teeth. Mentum with trifid median tooth and 6 pairs of lateral teeth (Figure 56G), VmP wider than long, VmP W/ mentum W=1.1. Procercus developed bearing 7 apical and 2 sub-apical setae. Posterior parapods longer than wide. Ventral anal tubules longer than dorsal tubules.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Remarks. Absence of caudolateral and ventral tubules on abdominal segment places the larvae in *salinarius* group. Larva has a white head capsule with no pigmentation and all inner teeth of mandible are dark.

Cryptochironomus blarina (Townes, 1945)

Larva (n=3)

Figures 57A-H

Macroscopic characters. Head capsule is reddish-yellow to yellow (Figure 57A). Eyespots are bifid in oblique angle (Figure 58A) located at anterior 1/6th of the head. VmPs are long extending to a point parallel to the mid-section between the eyes (Figure 57A), mentum's median tooth is wide and pale (Figure 57B).

Description. Larva L=9.3 mm. HL/HW=1.1. Antenna 5 segmented, 5th segment slightly longer than 4th segment (Figure 57C), blade shorter than flagellum originating at the base of second segment, RO at anterior 1/3rd of the 1st segment, AR=0.90. SI-SIII simple, SII 2X longer than SI and larger (Figure 57D). Pecten epipahryngis trifid with small serrations on the sides (Figure 57D). Premandible with 6 teeth, brush present (Figure 57D). Maxilla (Figure 57E). Mandible with 2 inner teeth, apical tooth 2.7X the combined width of inner teeth (Figure 57F) Mentum with wide pale median tooth that has 2 spines in the middle and 7 pairs of lateral teeth, mentum slightly concave (Figure 57G). VmP very wide extend well beyond the ventral margin of the head, VmP W/mentum W=1.8. Procercus as long as wide, bearing 6 apical setae and 2 sub-apical setae (Figure 57H). 2 long anal setae present L=226.0 µm. Posterior parapods longer than wide. 2 conical anal tubules present, L=123.0 µm (Figure 57H).

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, British Columbia, Saskatchewan, Manitoba, and Ontario). USA (Connecticut, Delaware, Florida, Georgia, Maryland, Michigan, Minnesota, New Jersey, New Mexico, New York, North Carolina, South Carolina, Pennsylvania, Virginia, and West Virginia)

Ecology and habitat. Larvae of this species occur mainly in lakes. They occur in coastal plains and piedmont plateaus (Hudson *et al.,* 1990). Curry (1958) reported the larvae to occur in bottom deposits of pulpy peat and sands and in association with species of *Certophylum* and *Potomogeton*. Adult emerge in early July (Curry, 1958).

Remarks. Larva of this species is described by Curry (1958) and by Sæther (2012).

Demicryptochironomus cuneatus (Townes, 1945)

Larva (n=2)

Figures 58A-G

Macroscopic characters. Macroscopic characters. Head capsule is yellowish-white, wide at the base (Figure 58A). Eyespots are large and parallel at an oblique angle (Figure 58B). VmP reaches the base of lower eyespots (Figure 58B).

Description. Larva L=6.5 mm. HL/HW=1.2. Antenna 7 segmented (Figure 58C), 2nd segment wider than long, 2nd segment W=13.62 µm, blade shorter than flagellum originating at the base of 3rd segment, RO at anterior 1/3rd of the 1st segment, AR=1.2. SI-SIII simple, SI hair-like, SII 2X longer than SI and much larger (Figure 58D). Premandible with 5 teeth, 3rd inner teeth much wider than remaining teeth, brush present (Figure 58D). Mandible with 2 inner teeth, apical tooth 2X the com-

bined width of inner teeth (Figure 58E). Mentum with wide pale median tooth and 7 pairs of lateral teeth, median tooth W=32.4 µm, mentum concave (Figure 58F), VmP very wide extend well beyond the ventral margin of the head, VmP W/ mentum W=1.4. Procercus as wider than long, bearing 6 apical setae and 2 sub-apical setae (Figure 58G). 2 long anal setae present, L=351.1 µm. Posterior parapods longer than wide. 2 conical anal tubules present, L=90.3 µm (Figure 58G).

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (1st record for Alberta, Manitoba, and Québec). USA (Iowa, North Carolina, New Jersey, and South Carolina).

Ecology and habitat. Larvae of this species occur in sandy substrate of rivers and lakes.

Remarks. Larva is described by Sæther (1977) and Epler (2001).

Glyptotendipes (Glyptotendipes) sp.

Larva (n=1)

Figures 59A-E

Description. Larva L=2.8 mm. HL/HW=1.0, Antenna 5 segmented, segments sequentially decrease in size, LO developed but small covers 2/5th of the 3rd segment (Figure 59A), blade longer than flagellum, RO at basal 1/4th of the 1st segment, AR=0.70. SI plumose, SII simple and long, SIII simple. Labral lamellae comb-like with around 60 teeth (Figure 59B). Pecten epipharyngis with 16 teeth with 5 teeth smaller in size (Figure 59B). Premandible bifid with accessory tooth and developed brush (Figure 59C). Mandible with 1 light sub-apical tooth, 1 dark apical tooth, 2 dark and 1 light inner teeth, pecten mandibularis with 10 branches, SSd large reaches the base of 2nd inner teeth (Figure 59D). Mentum with 1 median tooth notched on the side and 6 pairs of lateral teeth, 4th-6th lateral teeth sit lower than 1st three lateral teeth (Figure 59E), distance between VmPs is 1.7X the width of median tooth, VmP W/ mentum W=1.0. Procercus wider than long, bearing 6 apical setae. Posterior parapods longer than wide with group of large simple claws. Anal tubules L=75.0 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Glyptotendipes* Kieffer, 1913 generally occur in detritus-rich littoral sediments in and in overgrowths of lakes, ponds and running waters (Epler *et al.,* 2013).

Remarks. Single mounted specimen was obtained in this study that is probably a 3rd instar larva.

Microtendipes Kieffer, 1915

Note on the genus *Microtendipes*. Two species group were found in this study. The two species group can be partially separated based on the key below.

Ecology and habitat. Larvae of *Microtendipes* occur mainly in sediments of lentic habitats. However, they may also occur in overgrowths and moss of running waters.

Key to species group of *Microtendipes*

1a. Mentum with pale trifid median tooth of which 1st median is much smaller (Figure 60E). Pecten epipharyngis with 3 equal teeth. Premandible trifid..... .....***Microtendipes (Microtendipes) pedellus* group**

1b. Mentum with pale trifid median tooth of which all are equal in size (Figure 61B). Pecten epipharyngis with several teeth of varying size. Premandible with 5 teeth..... .....***Microtendipes (Microtendipes) rydalensis* group**

Microtendipes (Microtendipes) pedellus group

Larva (n=3)

Figures 60A-F

Macroscopic characters. Head is yellow with postmentum region darker and extending posteriorly to lateral portion of the head (Figure 60A). Eyespots are bifid, large, and equal in size and parallel, located at anterior 1/5th of the head (Figure 60A).

Description. Larva L=6.9 mm. HL/HW=1.0. Antenna 6 segmented, 2nd segment shorter and wider than 3rd segments, blade shorter than flagellum, LOs alternatively on segment 2 and 3 (Figure 60B), RO at basal 1/4th of the 1st segment, AR=1.4. SI coarsely plumose on both sides (Figure 60C), SII finely serrated, SIII simple and small. Labral lamella comb-like, with 16 teeth (Figure 60C). Pecten epipharyngis with 3 equal teeth (Figure 60C). Premandible trifid, well-developed, brush present (Figure 60C). Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, all mandibuar teeth evenly dark (Figure 60D), pecten mandibularis with 10 branches, SSd long reaching the base of 1st inner teeth. Mentum with 3 median teeth and 6 pairs of lateral teeth (Figure 60E), 1st median tooth very small, 2nd lateral teeth stand higher than remaining lateral teeth, VmP W/ mentum W=0.88. Procercus wider than long, bearing 6 apical setae (Figure 60F). 2 long anal setae present, L=286.2 µm. Posterior parapods. Dorsal anal tubules longer than ventral tubules, dorsal tubules L=169.2 µm, ventral tubules L=140.0 µm.

Rivers and streams. Athabasca River, Ells River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Microtendipes (Microtendipes) rydalensis group

Larva (n=1)

Figures 61A-C

Description. Larva L=2.1 mm. HL/HW=1.1. Antenna 6 segmented, 2nd segment shorter and wider than 3rd segments, blade shorter than flagellum (Figure 61A), LOs alternatively on segment 2 and 3, RO at basal 1/7th of the 1st segment, AR=0.849. SI plumose, SII finely serrated, SIII simple and small. Labral lamella comb-like. Pecten epipharyngis with around 10 unequal teeth. Premandible with 5 teeth, well-developed brush present. Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, all mandibuar teeth evenly coloured, pecten mandibularis with 10 branches (Figure 62A), SSd long reaching the base of 1st inner teeth. Mentum with 3 equal-sized light median teeth and 6 pairs of darker lateral teeth (Figure 61B), 2nd lateral teeth stand higher than remaining lateral teeth, VmP W/ mentum W=0.81. Procercus wider than long, bearing 6 apical setae (Figure 61C). 2 anal setae present, L=91.1. Posterior parapods. Dorsal anal tubules longer than ventral tubules, dorsal tubules L=79.7 µm, ventral tubules L=59.6 µm.

Rivers and streams. Athabasca River

Nearctic distribution. Canada (Alberta).

Remarks. The measurements of the larva in this study indicate that it is an earlier instar, probably 3rd instar.

Paracladopelma Harnisch, 1923

Note on the genus *Paracladopelma*. Two species of *Paracladopelma* were found in this study. Combination of 1st antennal segment main seta fused to the 2nd segment and lack of inner teeth in stout claws of posterior parapods places both species in *capmtolabis* group, according to Jackson (1977). *Paracladopelma* cf. *rolli* Kirpichenko is *Cryptochironomus* cf. *rolli* Kirpichenko described by Sæther (1977). Sæther (1977) indicated that species is identical to *Cryptochironomus rolli* Kirpitshenko described by Chernovski (1949). Cranston (2010) suggested that both species presumably belong to *Paracladopelma*. Key below can partially separate the two species in

this study. Macroscopic characters of larval head capsules and posterior ends are distinguishable in both species.

Ecology and habitat. Larvae of *Paracladopelma* occur on sandy substrate of large rivers and lakes.

Key to species of *Paracladopelma*

1a. Head capsule yellow (Figures 63A-B). Mentum concave (Figure 63G). Posterior parapods very long, anal tubules long and tube like (Figure 63C) ..... ***Paracladopelma* cf. *rolli***

1b. Head capsule yellowish-brown (Figure 63A). Mentum flat (Figure 63F). Posterior parapods not very long, anal tubules short and conical (Figure 63B) ..... ***Paracladopelma nereis***

Paracladopelma cf. *rolli* Kirpichenko, 1949

Larva (n=3)

Figures 62A-H

Macroscopic characters. Larva is similar to most larvae in *Harnischia* complex, long and slender, Ceratopogonidae-like. Head yellow, widened at the base (Figures 62AandB). Eyespots bifid and attached in an oblique angle, upper eyespots looks subdivided giving an appearance of trifid eyespots (Figure 62A). Posterior parapods long (Figure 62C).

Description. Larva L=7.9 mm. HL/HW=1.0. Antenna 5 segmented, basal segments sclerotized, blade shorter than flagellum originates from 1st segment (Figure 62D), large style on 2nd segment L=11.9 µm, AR=1.4. SI-SIII simple, SI small and hair-like, SII long and large. Maxilla palp as in (Figure 62E). Premandible with 4 teeth, accessory tooth and brush (Figure 62F). Mandible with outer spine or projection, 1 apical tooth and 3 triangular inner teeth and strong mola (Figure 62G), seta interna with 4 serrated branches. Mentum with a wide, flat, light median tooth and 7 pairs of lateral teeth, mentum slightly concave (Figure 62H), VmP with well-developed striation wider than long, VmP W/ mentum W=0.89. Procercus longer than wide, bearing 8 apical and 2 sub-apical setae. 2 anal setae present L=479.4 µm. Posterior parapod long and slender with few small claws. Anal tubules shorter than posterior parapods, dorsal tubules L=195.0 µm, ventral tubules L=176.2 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Remarks. *Paracladopelma rolli* Kirpitshenko, 1949 has not been reported in Canada. In USA it has been reported only in Michigan.

Paracladopelma nereis (Townes, 1945)

Larva (n=4)

Figures 63A-G

Macroscopic characters. Larva is not similar to other *Harnischia* complex larvae. Head is yellowish-brown, wider than long, widens at the base (Figure 63AandB). Eyespots are bifid attached obliquely and equal in size (Figure 63B). Anal tubules are conical (Figure 63C). Posterior parapods are not elongated (Figure 63C).

Description. Larva L=5.2 mm. HL/HW=0.87. Antenna 5 segmented, 1st segment sclerotized, 2nd segment much longer than 3rd, blade shorter than flagellum originates from 1st segment (Figure 63D), RO at basal 1/3rd of 1st segment, AR=1.1. SI-SIII simple, SI small, SII long and large (Figure 63E). Premandible with 4 teeth, accessory tooth and brush (Figure 63E). Mandible with outer spine or projection, 1 apical tooth and 3 triangular inner teeth (Figure 63F), SSd, long reaching the base of 2nd inner teeth, seta interna with 4 serrated branches. Mentum with a wide, flat, light median tooth and 7 pairs of lateral teeth, 1st lateral teeth lighter than remaining lateral teeth, mentum flat (Figure 63G), VmP with 32 well-developed striation, wider than long, VmP W/ mentum W=0.78. Procercus longer than wide, bearing 8 apical and 2 sub-apical setae. Anal setae present L=340.5 µm. Posterior parapod longer than wide, bearing group of simple claws. 4 conical anal tubules that are shorter than posterior parapods, anal tubules L=121.6 µm

Remarks. Larva is described by Epler (2001) and by Jackson (1977).

Rivers and streams. Athabasca River.

Ecology and habitat. Larvae of this species occur on sandy sediments of both oligotrophic lakes and streams; however, apparently the larva is more rheophilic than limnophilic (Jackson, 1977).

Nearctic distribution. Canada (1st record for Alberta, Saskatchewan). USA (Georgia, Michigan, Minnesota, North Carolina, and South Carolina).

Paralauterborniella nigrohalteralis Malloch, 1915

Larva (n=3)

Figures 64A-F

Macroscopic characters. Larva is yellowish-red (Figure 64A). Head is reddish-brown (Figure 64A) semicircular. Eyespots are bifid and divided in parallel angle, upper eyespots are slightly emarginated (Figure 64A).

Description. Larva L=1.9 mm. HL/HW=1.1. Antennae 6 segmented, 5th segment longer than 4th, blade shorter than flagellum (Figure 64B), LO alternatively on 2nd and 3rd segments, RO at basal of the 1st segment, AR=0.81. SI plumose, SII on pedestal with few hair-like extensions (Figure 64C). Premandible bifid with brush. Mandible with 1 apical tooth and 3 inner teeth, pecten mandibularis with 3 branches (Figure 64D). Mentum with 1 wide light median tooth and 5 pairs of darker lateral teeth (Figure 64E), mentum convex, VmP striation very coarse, VmP W/ mentum W=1.5. Procercus as long as wide, bearing 5 apical setae (Figure 64F). 2 long anal setae present, L=192.6 µm. Posterior parapods longer than wide. 4 conical anal tubules, L=24.4 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (1st record for Alberta, Ontario, and Yukon Territory). USA (Colorado, Florida, New York, and Texas).

Ecology and habitat. According to Epler *et al.* (2013) larvae of this species occur on soft sediments of lakes' littoral zone and overgrowths on stones. In this study larvae occurred in abundance in both gravel and sandy substrates.

Remarks. *Paralauterborniella* is monotypic with *P. nigrohalteralis* being the single known species in North America. All larvae obtained in this study were younger instars.

Paratendipes cf. *basidens* Townes, 1945

Larva (n=1)

Figures 65A-D

Description. Larva L=6.2 mm. HL/HW=1.3. Antenna 6 segmented, 3rd segment longer then 2nd, LO alternatively on 2nd and 3rd segment, style on segment 3 (Figure 65A), LO on 3rd segment originates near the apex, blade sub-equal to flagellum, RO at basal 1/3rd of the 1st segment, AR=0.92. SI and SII plumose. Labral lamella comb-like (Figure 65B). Pecten epipharyngis with 3 simple plates (Figure 65B). Premandible bifid with well-developed brush (Figure 65B), L=55.3 µm. Mandible widens at the base with 1 light dorsal tooth, 1 apical tooth and 2 inner teeth, apical tooth and inner teeth dark (Figure 65C), mandible L=85.3 µm. pecten mandibularis with around 10 branches, SSd long and slender reaching the base of 1st inner teeth (L=22.0 µm). Mentum with 4 light inner teeth and 6 pairs of lateral teeth, 1st lateral teeth lighter than remaining lateral teeth, 2nd lateral teeth longer than remaining lateral teeth (Figure 65D), VmP very wide with very fine striations, VmP W/ mentum W=1.6. Procercus slightly wider than long, bearing 6 apical setae. 2 long anal setae present L=175.0 µm. Posterior parapod

longer than wide, bearing group of simple claws. 2 conical anal tubules, tubules L=46.5 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *P. basidens* prefer sandy substrates of rivers and streams (Hayford 1998). They have been collected in capillary fringe habitats in Cimarron River, Kansas, USA. Adult have been collected in mid-summer (July-August) from open-water and epirheic regions (Goldhammer and Ferrington, 1992).

Remarks. Larva is described by Epler and Ferrington (1994) and by Hayford (1998). Single mounted specimen of this species was obtained in this study. The structure and character of VmP, position of LO on antennal segments, and 3rd antennal segment being longer than 2nd segment identifies the larvae as *Paratendipes basidens*, based on Hayford (1998). However, 2nd antennal segment is shorter (*i.e.*, 11.7 µm vs. 15.0 µm) than the description given by Hayford (1998) which increases the AR in this larva. Additionally, median tooth of mentum does not exactly match the description, posterior parapods are longer and procercus are much shorter than the description given by Hayford (1998). *Paratendipes basidens* Townes has not been reported in Canada. In USA occurs in Alabama, Arkansas, Florida, Georgia, Iowa, Kansas, New Hersey, North Carolina, New Mexico, and Ohio.

Phaenopsectra punctipes group

Larva (n=1)

Figures 66A-D

Description. Larva L=2.1 mm. HL/HW=. Clypeus absent on frontoclypeal sclerite (Figure 66A). Antenna 5 segmented, blade shorter than flagellum, AR=0.89 (Figure 66B), SI and SII plumose, SIII simple. Labral lamellae comb-like. Pecten epipahryngis with 3 toothed scales. Premandible bifid with accessory tooth and brush. Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, large notch at base of inner teeth (Figure 66C), SSd long and thin reaching the base of 2nd inner teeth. Mentum with 4 median teeth and 5 pairs of lateral teeth (Figure 66D), 2nd median teeth longer than remaining teeth with line running from their base to VmP, VmP W/ mentum W=0.95. Procercus longer than wide, bearing 8 apical setae. Posterior parapods longer than wide, bearing group of simple claws. 4 anal tubules L=46.0 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Phaenopsectra* occur in sand and muddy substrates of lentic and lotic habitats.

Remarks. A single mounted specimen was found in this study that is a younger instar. Presence of large notch at the base of the inner teeth and 14 toothed mentum places the larvae in *punctipes* group. This larva is probably *Phaenopsectra flavipes* (Meigen) based on the description of Epler (2015). *P. flavipes* has a widespread geographic distribution in Canada and USA.

Polypedilum Kieffer, 1912

Note on the genus *Polypedilum*. The distinctive mentum with bifid median tooth and second lateral teeth being usually longer than first lateral teeth, 5 segmented antenna and tripartite pecten epipharyngis distinguishes the species of this genus from others in tribe Chironomini. Four distinct species and species group were found in this study that can be partially separated based on the key below.

Key to species of *Polypedilum*

1a. Mentum with all teeth about the same height **2**

1b. Mentum with 1st lateral teeth lower than median teeth.....**3**

2a. Antenna segments 3-5 about same size as 2nd segment.....
.....***Polypedilum (Polypedilum) fallax* group**

2b. Antenna segments 3-5 longer than 2nd segment.....
.....***Polypedilum (Polypedilum) laetum* group**

3a. 3rd antennal segment <1/3rd of the 2nd segment, VmP without posterior lobe .....***Polypedilum (Tripodura) scalaenum* group**

3b. 3rd antennal segment > 1/3rd of the 2nd segment, VmP with posterior lobe.....***Polypedilum (Uresipedilum) flavum***

Polypedilum (Polypedilum) fallax group

Larva (n=3)

Figures 67A-E

Description. Larvae L=8.6 mm. HL/HW=1.0. Antennae 5 segmented, 3rd-5th segment about the same size as 2nd segment, blade shorter than flagellum (Figure 67A), LO narrow, RO at basal 1/3rd of the 1st segment, AR=1.6. SI plumose and broad (Figure 67B), SII-SIII plumose and narrow. Labral lamellae with 32 teeth (Figure 67B). Pecten epipharyngis with 3 scales and 6, 3, 5 teeth formation. Premandible trifid and with well-developed brush (Figure 67C). Mandible with 1 apical tooth and 3 inner teeth (Figure 67D), all mandibular teeth evenly dark, SSd reaches the base of the 3rd segment, seta interna with 1 long stalk and about 14 branches stem out of it. Mentum with 2 median teeth and 7 pairs of lateral teeth, teeth more or less in the same plane (Figure 67E), VmP with more than 25 striated plates, VmPR=2.85, VmPSR=3.0, VmP W/ mentum W=1.0. Procercus wider than long, bearing 5 apical and 2 sub-apical setae. Posterior parapod longer than wide, bearing group of simple claws. Dorsal anal tubules longer than ventral tubules, anal tubules constricted in the middle, dorsal tubules L=190.8 µm, ventral tubules L=174.34 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Polypedilum (Polypedilum) fallax* (Johannsen, 1905) in this group occur on submerged wood in lentic and lotic habitats (Johannsen, 1937; Roback, 1953). Larvae of *P. fallax* build muddy tubes attached to submerged stones (Maschwitz and Cook, 2000). *P. fallax* larvae are also reported to be associated with the petioles of *Nuphar varigatum* Engelm *et* Durand. Webber (1973) reported *P. fallax* to be facultative in its tolerance to organic pollution.

Remarks. The characteristic of mentum and antenna place the larva in *fallax* group. Larvae of species in this group are described by Maschwitz and Cook (2000). Larva in this study is probably the *P. fallax* based on the description given by Maschwitz and Cook (2000). In Canada *P. fallax* has only been reported in Ontario and Saskatchewan. In USA it is fairly common in the eastern and southeastern states.

Polypedilum (Polypedilum) laetum group

Larva (n=3)

Figures 68A-F

Macroscopic characters. Larvae are red when not preserved. Head capsule is reddish-brown (Figure 68A). Eyespots are bifid, separated and parallel (Figure 68A), eyespots located at anterior 2/5th of the head.

Description. Larva L=7.2 mm. HL/HW=0.99. Antennae 5 segmented, 3rd-5th segment longer than 2nd segment, blade shorter than flagellum (Figure 68B), LO very narrow, RO at basal 1/3rd of the 1st segment, AR=1.2. SI-SIII plumose and narrow (Figure 68C). Labral lamellae with 32 teeth (Figure 68C). Pecten epipharyngis with 3 scales and 5, 3, 5 teeth formation (Figure 68C). Premandible trifid and with well-developed brush (Figure 68C). Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth (Figure 68D), all mandibular teeth evenly dark, SSd reaches the base of the 2nd segment, seta interna with 1 long stalk and about 14

branches stem out of it, inner ridge with spines. Mentum with 2 median teeth and 7 pairs of lateral teeth, median and 1-2nd lateral teeth more or less in the same plane and stand slightly higher than remaining lateral teeth (Figure 68E), VmPR=2.4, VmPSR=2.4, VmP W/ mentum W=0.99. Procercus wider than long, bearing 5 apical and 2 sub-apical setae (Figure 68F). Posterior parapod longer than wide, bearing group of simple claws. Dorsal anal tubules longer than ventral tubules, anal tubules constricted in the middle, dorsal tubules L=199.2 µm, ventral tubules L=139.0 µm.

Rivers and streams. Athabasca River, Ells River, Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Brundin (1949) and Sæther (1975b) reported the larvae of *Polypedilum (Polypedilum) laetum* (Meigen, 1818) of this group in eutrophic lakes. Reiss (1968) reported the *P. laetum* in bottom mud of littoral zone of eutrophic lakes. Lehman (1971) reported the larvae of *P. laetum* on silted moss and stones.

Remarks. Larvae key out to couplet 7(6) of Maschwitz and Cook (2000) as *Polypedilum (Polypedilum) laetum* (Meigen, 1918). The AR of specimens in this study is higher than the described species of *P. laetum* by Maschwitz and Cook (2000); however, other characters match the description. *P. laetum* is reported in Manitoba, New Brunswick, and Ontario. In USA it has been reported in California, Colorado, Maryland, Massachusetts, Minnesota, Nevada, New York, Oregon, Utah, Washington, Wisconsin, and Wyoming.

Polypedilum (Tripodura) scalaenum group

Larva (n=1)

Figures 69A-D

Macroscopic characters. Eyespots are bifid and attached in parallel angle, located at anterior 1/4th of the head (Figure 69A).

Description. Larvae L=3.3 mm. HL/HW=1.1. Antennae 5 segmented, 3rd-5th segment shorter than 2nd segment, 3rd segment 1/5th of the 2nd segment, blade slightly longer than flagellum (Figure 69B), LO narrow covering the 3rd segment, RO at basal 1/3rd of the 1st segment, AR=1.0. SI-SIII plumose and narrow. Labral lamellae comb-like. Pecten epipharyngis with 3 scales and 6, 3, 7 teeth formation. Premandible trifid and with well-developed brush. Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth (Figure 69C), all mandibular teeth evenly dark, SSd reaches the base of the 2nd segment, seta interna with 1 long stalk and about 14 branches stem out of it, inner ridge with spines. Mentum with 2 median teeth and 7 pairs of lateral teeth, median teeth stand higher than 1st lateral teeth (Figure 69D), VmPR=2.3, VmPSR=5.3, VmP W/ mentum W=1.3. Procercus longer than wide, bearing 5 apical and 2 sub-apical setae. 2 long anal setae, L=317.6 µm. Posterior parapod longer than wide, bearing group of simple claws. Dorsal anal tubules slightly longer than ventral tubules, anal tubules constricted in the middle, dorsal tubules L=46.6 µm, ventral tubules L=40.3 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of this group were the most common *Polypedilum* larvae in this study and occurred in all habitats (*i.e.*, sand and gravel).

Remarks. All larvae obtained of this group were younger instars. Combination of very short antennal segment 3, antennal segments 3-5 being shorter than 2nd segment places the larvae in *scalaenum* group.

Polypedilum (Uresipedilum) flavum (Johannsen, 1905)

Larvae (n=1)

Figures 70A-E

Description. Larva L=4.9 mm. Antenna 5 segmented (Figure 70A), segments 3-5 slightly longer than 2nd segment, blade shorter than flagellum, AR=1.4. SI plumose, SII serrated at tip. Pecten epipharyngis with 3 scales each with 4-5 teeth. Premandible trifid and with well-developed brush (Figure 70B). Mandible with 1 dorsal, 1 apical and 3 inner teeth, inner ridge with scattered spines (Figure 70C). Mentum with constricted bifid median tooth and 7 pairs of lateral teeth (Figure 70D), median teeth and 2nd laterals stand higher than 1st lateral teeth, VmP with posterior lobe (Figure 70D). VmPR=1.8, VmPSR=1.8, VmP W /mentum W=0.73. Procercus slightly wider than long, each bearing 6 anal and 2 sub-apical setae (Figure 70E). 2 anal setae present, L=218.9 µm Posterior parapods longer than anal tubules each bearing group of simple claws (Figure 70E). 4 Anal tubules of equal size constricted at 1/3rd from the base, tubules L=118.1 µm.

Rivers and streams. Ells River and Firebag River.

Nearctic distribution. Canada (1st record for Alberta, Ontario, Québec, Nunavut, and Saskatchewan). USA (Arizona, Illinois, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New York, Ohio, Pennsylvania, South Dakota, and Texas).

Ecology and habitats. Larvae frequently occur in streams where they live on rocks in the riffles. Adults have bimodal emergence pattern in north temperate regions with first emergence occurring in the first two weeks of June and the second in mid-July. However, in Florida a year around emergence also occurs (Harper and Cloutier, 1979; Maschwitz and Cook, 2000; Soponis, 1982).

Remarks. Larva is described by Maschwitz and Cook (2000).

Robackia Sæther, 1977

Key to species of *Robackia*

1a. Mandible 3rd and 4th inner teeth longer than other inner teeth (Figure 71G). Mentum concave, 2 median teeth are receded (Figure 71H).....***Robackia claviger***

1b. Mandible 3rd and 4th inner teeth same height as other inner teeth (Figure 72F). Mentum flat, 2 median teeth almost the same height as remaining teeth (Figure 72G).....***Robackia demeijerei***

Robackia claviger (Townes, 1945)

Larva (n=4)

Figures. 71A-H

Macroscopic characters. Head capsule is yellow, almost squared, gradually widening at the base (Figure 71A). Eyespots are bifid well-separated in oblique angle (Figure 71B), very close to anterior portion of the head. Body is elongated and Ceratopogonidae-like. Pospertior parapods are long and slender. Anal tubules are about 1/2 as long as posterior parapods (Figure 71C).

Description. Larva L=7.4 mm. HL/HW=1.3. Antenna 7 segmented, long style on the 5th segment (L=24.4 µm), blade shorter than flagellum originates on 4/5th of the 2nd segment (Figure 71D), AR=0.50. SI-SIII simple, SI and SIII hair-like, SII long and large. Maxillary palp (Figure 71E). Premandible with 4 teeth and small brush (Figure 71F). Mandible curved with 1 long apical tooth and 4 inner teeth, 1st inner teeth small, 3rd and 4th fused and longer than other teeth (Figure 71G), SSd long reaching the tip apical tooth. Mentum concave with 2 wide median teeth and 7 pairs of smaller lateral teeth (Figure 71H), VmP not wider than long with coarse striation (Figure 71H), VmP W/mentum W=0.84. Procercus wider than long, 2 long apical setae, L=133.9 µm, 4 anal tubules, L=123.0 µm.

Rivers and streams. Athabasca River, Ells River, and Steep Bank River.

Nearctic distribution. Canada (1st record for Alberta, Saskatchewan). USA (Alaska, Indiana, Minnesota, Mississippi, Nebraska, New Mexico, South Carolina, South Dakota, Florida, Washington).

Ecology and habitat. In this study larvae occurred on both sandy and gravel substrate.

Remarks. Larva is described by Sæther (1997).

Robackia demeijerei (Kruseman, 1933)

Larva (n=1)

Figures 72A-G

Macroscopic characters. Head capsule is yellow (Figure 72A). Eyespots are bifid well-separated in oblique angle (Figure 72A), very close to anterior portion of the head. Body is elongated and Ceratopogonidae-like (Figure 72B). Pospertior parapods are long and slender. Anal tubules are about 1/2 as long as posterior parapods (Figure 73C).

Description. Larva L=4.4 mm. HL/HW=1.4. Antenna 7 segmented, long style on the 5th segment (L=11.8 µm), blade shorter than flagellum originates on 4/5th of the 2nd segment (Figure 72D), AR=0.54. SI-SIII simple, SI and SIII hair-like, SII long and large. Maxillary palp (Figure 72E). Premandible with 4 teeth and small brush. Mandible curved with 1 long apical tooth and 4 inner teeth, (Figure 72F), 3rd and 4th inner teeth fused and about same height as other teeth, SSd long. Mentum flat with 2 median teeth and 7 pairs of lateral teeth (Figure 72G), median teeth same size as lateral teeth, VmP wider than long with coarse striation (Figure 72G), VmP W /mentum W=1.0. Procercus wider than long, bearing 5 long apical setae. 2 long anal setae, L=176.7 µm. 4 anal tubules, L=94.4 µm.

Rivers and streams. Athabasca River, Ells River, Jackpine River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, Yukon Territory, and Northwest Territories). USA (Florida, Kentucky, Mississippi, Michigan, Montana, North Carolina, Ohio, South Carolina, Tennessee, and Wyoming).

Ecology and habitat. In this study larvae occurred only on sandy substrate and were the most common species on sandy substrate of the Athabasca River.

Remarks. Larva is described by Sæther (1997).

Stenochironomus (Stenochironomus) sp.

Larva (n=3)

Figures 73A-G

Macroscopic characters. Head capsule and thoracic segments are large in contrast to rest of the body (Figure 73A). Dorsal side of the head capsule has a large reddish-brown Y (Figure 73B). Eyespots are bifid and well-separated. VmPs consist of two squared like plates (Figure 73C). Anal tubules are much longer than posterior parapods and constricted in mid-section (Figure 73A).

Description. Larva L=1.4cm. HL/HW=1.0. Antenna 5 segmented, 4th segment longer than 3rd, 1st segment L/W=2.8. RO at basal 1/4th of the 1st segment (Figure 73D), AR=1.8. SI-SIII pinnate (Figure 73E). Labral lamella with 15 branches. Premandible trifid with brush (Figure 73E). Mandible wider than long apically dark, 1 apical tooth and 2 inner teeth (Figure 73F), SSd minuscule. Mentum slightly concave, with 2 median teeth and 4 pairs of lateral teeth, 3rd lateral teeth stand higher than remaining teeth, 4th lateral teeth small and semi-attached to 3rd, VmP plate like separated by the width of the mentum (Figure 73G), SSm long and simple. Procercus absent. Posterior parapods with ~10 simple claws, 4 long and constricted anal tubules, L=326.3 µm.

Rivers and streams. Athabasca River, Ells River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Stenochironomus* species are miners in barks of woods and vegetation submerged in streams, rivers and lakes (Borkent, 1984; Epler *et al.,* 2013).

Remarks. All larvae examined in this study key out to couplet 8(7) page 47 of Borkent (1984) and match the description given for the larva of *S. unictus* by Borkent (1984). However, Borkent (1984) identified the species as strictly an Eastern Nearctic species. Additionally, there were no associated pupae or adult specimens available to confirm larval identification. The *S. unictus* is not reported in the western provinces of Canada. In Canada it has only been reported from southern Québec. In USA it has been reported in Alabama, Connecticut, Delaware, Florida, Georgia, Kentucky, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New York, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, and West Virginia.

Stictochironomus sp.

Larva (n=1)

Figures 74A-D

Description. Larva L=6.8 mm. HL/HW=0.74. Antenna 6 segmented, 4th segment longer than 3rd, LO alternatively on segment 2 and 3, blade sub-equal to flagellum, RO at basal of the 1st segment (Figure 74A), AR=1.3. SI plumose, SII long and plumose, SIII small and simple (Figure 74B). Labral lamella with 48 branches. Pecten epipharyngis consist of 3 scale and 5, 3, 5 teeth (Figure 74B). Premandible bifid, with well-developed brush. Mandible with 1 dark dorsal tooth, 1 apical and 2 inner teeth that are lighter, pecten mandibularis with 10 branches, SSd long reaching the base of apical tooth (Figure 74C). Mentum with 4 inner teeth and 6 pairs of lateral teeth, median inner teeth smaller, 2nd lateral teeth stand slightly higher than remaining lateral teeth, VmP separated by 1/2 of the mentum width (Figure 74D), VmPW/mentum W=0.50. Procercus slightly longer than wide, bearing 5 apical setae and 2 sub-apical setae. 2 anal setae present, L=152.3 µm. Posterior parapod wider than long, bearing group of simple claws. Anal tubules absent.

Rivers and streams. Athabasca River and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Stictochironomus* usually occur on soft and sandy substrates in profundal zone of the lakes and also in rivers (Epler *et al.,* 2013).

Remarks. Larvae of *Stictochironomus* cannot be identified to species without associated adult males.

Tribe Tanytarsini

Key to the genera of Tantrasini

1a. Larvae build transportable cases (Figure 77A and Figure 82A). VmPs broad, separated by at least the width of 3 median teeth (Figure 77E and Figure 82F) **2**

1b. Larvae build non-transportable cases (Figure 76A and Figure 79A). VmPs narrow, meet or almost meet medially (Figure 76G and Figure 79G) **4**

2a. Antennae segment 2 with LO at base and apex (Figure 82C). Clypeal setae S3 simple ..... ***Stempellinella***

2b. Antennae segment 2 with LO arise apically (Figure 77C and Figure 81F). Clypeal setae S3 bifid or apically divided (Figure 77B and Figure 81E) **3**

3a. Antennae with multispined process and spur (Figure 77C) ..... ***Neostempellina***

3b. Antennal with multispined process only (Figure 81D) ..... ***Stempellina***

4a. Premandible with 3 or more teeth **5**

4b. Premandible bifid **6**

5a. Pedicels of LO short (Figure 75A). Claws of posterior parapods with serration or inner teeth internal to apex of claw (Figure 75D) ....*Cladotanytarsus*

5b. Pedicels of LO long (Figure 83B). Claws of posterior parapods usually simple, if serrated then external to main apex of the claws ....*Tanytarsus*

6a. Pecten epipharyngis a single 3-5 lobed plate (Figure 78B)..... .....*Paratanytarsus*

6b. Pecten epipharyngis with multi-toothed plates or single plate with multi-tooth.....**7**

7a. LO on long pedicels (Figure 76C). Pecten epipharyngis with 3 multi-toothed plates (Figure 76D) .....*Micropsectra*

7b. LO on short pedicels (Figure 79C). If LO on long pedicels then pecten epipharyngis a single multi-toothed plate or comb (Figure 79D).....*Rheotanytarsus*

Cladotanytarsus sp.

Larva (n=2)

Figures 75A-D

Description. Larva L=3.7 mm. HL/HW=1.0. Antenna 5 segmented, 3rd segment longer than 2nd, LO on shorts pedicels located on 2nd segment (Figure 75A), blade shorter than flagellum, LO L=18.71 µm, RO at the base of 1st segment, AR=1.1. SI brush like, SII plumose and long, SIII simple. Labral lamella well-developed with 18 branches. Pecten epipharyngis with 3 distally serrated scales. Premandible with 4 teeth and well-developed brush. Mandible with 1 small dorsal tooth, 1 long apical tooth and 3 inner teeth (Figure 75B), SSd long reaching beyond apical tooth, pecten mandibularis with 15 setae. Mentum with trifid median tooth and 5 pairs of lateral teeth (Figure 75C), VmP wide, VmPs almost touch at the mid-section of mentum, VmP W/mentum W=1.2, SSm posterior to mentum. Procercus wider than long, bearing 7 apical setae. Posterior parapods wider than long, bearing group of claws, some claws with inner teeth (Figure 75D).

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Cladotanytarsus* occur in various freshwaters.

Micropsectra polita (Malloch, 1919)

Larva (n=5)

Figures 76A-H

Macroscopic characters. Larvae construct cases made from silt and organic matters (Figure 78A). Head capsule is yellow, almost squared (Figure 76B). Eyespots bifid and well-separated, upper eyespots at the least 1.5X larger than lower eyespot (Figure 76B). Antennae are long with long antennal pedicels. Posterior parapods with dense horseshoe claws.

Description. Larva L=4.9 mm. HL/HW=0.91. Antenna 5 segmented, segments sequentially decrease in size, blade shorter than flagellum (Figure 76C), A_1 setae L=75.8 µm, Antennal pedestal spur L=11.6 µm, LO on long pedicels, LO L=112.1 µm, AR=2.2. SI brush like (Figure 76D), SII and SIII on pedestals and plumose. Labral lamella well-developed with ~30 branches. Pecten epipharyngis with 3 scale and 5, 4, 5 teeth formation (Figure 76D). Premandible bifid with well-developed brush (Figure 77E). Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, all teeth dark, SSd long reaching the base of apical tooth (Figure 76F), pecten mandibularis with ~20 setae. Mentum with trifid median tooth and 5 pairs of lateral teeth (Figure 76G), median portion of median tooth light, lateral teeth gradually arching, distance between VmPs about 1/3rd of the median tooth, VmP W/mentum W=1.1. Procercus longer than wide, bearing 7 apical and 2 sub-apical setae (Figure 76H). Posterior parapods wider than long, bearing > 50 claws in a horseshoe form. 2 Anal tubules present, L=171.4 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta, Saskatchewan, Quebec, Ontario, and Nunavut). USA (Arizona, Illinois, Main, Maryland, New Mexico, Ohio, Oregon, Pennsylvania, and South Dakota).

Ecology and habitat. Larvae of this species prefer cold low ordered streams with maximum summer temperature of 10-18°C. Larvae may also occur in slow seepage of streams (Oliver and Dillon, 1994). In this study it occurred in abundance in areas outside the oil sand operations.

Remarks. Larva is described by Epler (2001), Oliver and Dillon (1994) and by Webb (1981).

Neostempellina reissi Caldwell, 2000

Larva (n=4)

Figures 77A-F

Macroscopic characters. Larva constructs curved case made from sand grains that has a larger anterior end than posterior (Figure 77A). Body widens anteriorly with small hump on 2nd thoracic segment (Figure 77A). Dorsal and latero-ventral side of head capsule with coarse tubercles, head is semicircular. Eyespots are double and small, attached in parallel line. Strongly sclerotized procercus with multiple spines and projections (Figure 77A).

Description. Larva L=2.1 mm. HL/HW=0.83. Clypeal setae S3 bifid (Figure 77B). Antenna 5 segmented, 4th segment longer than 3rd and 3rd segment longer than 2nd, blade slightly longer than flagellum, LOs on short pedicels located on 2nd segment, LO L=17.5 µm, large antennal spur and multi-toothed projection are present (Figure 77C), antennal spur L=49.5 µm, multi-toothed projection W=70.2 µm, AR=0.78. SI comb-like (Figure 77D), SII plumose, SIII simple. Labral lamella well-developed with 16 branches (Figure 77D). Pecten epipharyngis with 3 apically serrated scales. Premandible bifid, with well-developed brush (Figure 77D). Mandible with 1 light dorsal tooth, 1 dark apical tooth and 2 dark inner teeth, SSd prominent and long, reaching the tip of dorsal tooth (Figure 77C), inner ridge with single spine. Mentum with 3 light median teeth and 5 pairs of darker lateral teeth (Figure 77E), VmP wider than long separated by 1/3rd of mentum's width, VmP W/ mentum W=0.73. Procercus strongly sclerotized with multiple projections and spines (Figure 77F). 2 long anal setae are present, L=87.3 µm. Posterior parapods short bearing 10-12 simple small claws.

Rivers and streams. Athabasca River, Dover River, Ells River, Mackay River, and Steep Bank River.

Nearctic distribution. 1st record for Canada (Alberta). USA (Alabama, Florida, Main, North Carolina, Ohio and South Carolina).

Ecology and habitat. In this study larvae occurred on both gravel and sandy substrates.

Remarks. Larva is described by Epler (2001) as *Stempellina* sp. C. Additional diagnoses are available in Cranston (2010) and Epler *et al.* (2013).

Paratanytarsus sp.

Larva (n=1)

Figures 78A-D

Description. Larva L=2.4 mm. HL/HW=0.87. Antenna 5 segmented, segments sequentially decrease in size, blade shorter than flagellum, LO developed on very short pedicels (not detectable), RO at the base of 1st segment (Figure 78A). SI comb-like (Figure 78B), SII on pedestals and

serrated at the tip, SIII simple. Labral lamella well-developed with 30 branches (Figure 78B). Pecten epipharyngis with 4 subeqaul scales (Figure 78B). Premandible bifid with well-developed brush (Figure 78B). Mandible with all teeth evenly dark (Figure 78C), pecten mandibularis with 10 setae, SSd long reaching the dorsal tooth. Mentum with tripartite median tooth and 5 pairs of lateral teeth, mentum teeth evenly dark and in an even arch, VmPs touching at mid-section of mentum (Figure 78D), VmP W/mentum W=1.2, SSm well posterior to mentum. Procercus wider than long, bearing 8 apical setae. Posterior parapods wider than long, bearing few claws. Anal tubules L=85.2 µm.

Rivers and streams. Athabasca River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. *Paratanytarsus* larvae are eurytopic, occurring in wide range of freshwater environments.

Remarks. Single mounted larva of this species was obtained in this study.

Rheotanytarsus

Note on the genus *Rheotanytarsus*. Usually larvae of this genus are separated from other Tanytarsini by combination of comb-like pecten epipharyngis, bifid premandible and VmP with apparent block-like strial ridge markings. Two distinct larvae were observed in Athabasca and its tributaries that can be partially separated based on the key below.

Ecology and habitat. Larvae of *Rheotanytarsus* usually occur in small rivers and streams. In large rivers occur on potamon and in large lakes where there is wave action. Larvae attach their cases to stones to retrieve suspended particles from water (Epler *et al.,* 2013).

Key to species of *Rheotanytarsus*

1a. LOs on very short pedicels, LOs do not reach the tip of last antennal segment (Figure 79C) .....***Rheotanytarsus* sp. 1**

1b. LOs on long pedicels, LOs reach the tip of last antennal segment (Figure 80C) .....***Rheotanytarsus* sp. 2**

Rheotanytarsus sp. 1

Larva (n=2)

Figures 79A-G

Macroscopic characters. Larval case is made from detritus with arm like extension (Figure 79A). Head is yellow and almost squared (Figure 79B). Antennae are short with small pedestals. Eyesspots are bifid, equal, parallel, and well-separated (Figure 79B), located at anterior 1/4th of the head capsule. Dorsal portion of the 1st three body segment with erect and long setae (Figure 79B).

Description. Larva L=1.7 mm. HL/HW=0.93. Antenna 5 segmented, segments sequentially decrease in size, blade shorter than flagellum, LO developed on very short pedicels, LO L=15.0 µm, RO at of 1st segment (Figure 79C). SI comb-like, SII on pedestals and serrated at the tip, SIII simple. Labral lamella well-developed with 30 branches (Figure 79D). Pecten epipharyngis multi-toothed (Figure 79D). Premandible bifid with well-developed brush (Figure 79E). Mandible with all teeth evenly dark (Figure 79F), pecten mandibularis with 18 setae, SSd long reaching the base of apical tooth. Mentum with tripartite median tooth and 5 pairs of lateral teeth, mentum's teeth evenly dark and in an even arch, VmPs almost touching at mid-section of mentum (Figure 79G), VmP W/mentum W=0.72, SSm well posterior to mentum. Procercus wider than long, bearing 8 apical setae. Posterior parapods wider than long, bearing few claws. 4 anal tubules, L=59.2 µm.

Rivers and streams. Athabasca River, Dover River, Ells River, Firebag River, Jackpine Creek, Mackay River, and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Rheotanytarsus sp. 2

Larva (n=4)

Figures 80A-G

Macroscopic characters. Larvae build cases with organic debris and fine silt with extensions for attachments to hard surface (Figure 80A). Head capsule is yellowish-red, almost squared (Figure 80B). Eyespots are parallel, bifid and well-separated (Figure 80B).

Description. Larva L=3.6 mm. HL/HW=0.78. Antennae 5 segmented, segments sequentially decrease in size, blade shorter than flagellum (Figure 80C), LO on long pedicels, arising from the base of 2nd segment (L=16.4 µm), RO of 1st segment, antennal pedestal L=70.29 µm, AR=2.2. SI comb-like, SII on pedestals with serration, SIII simple. Lebral lamella well-developed and with branches. Pecten epipharyngis comb-like. Premandible with 2 teeth and well-developed brush (Figure 80D). Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, SSd long reaching the base of sub-apical tooth (Figure 80E). Mentum with 3 partite median tooth and 5 pairs of lateral teeth, median teeth stand slightly higher than lateral teeth, (Figure 80F), VmP separated about the 1/20th of mentum W, VmP W/mentum W=0.93. Procercus wider than long, bearing 7 apical and 2 sub-apical setae. 2 anal setae present, L=105.0 µm. Posterior parapods almost as long as wide, bearing simple claws (Figure 80G). 4 conical anal tubules present (Figure 80G), L=121.1.

Rivers and streams. Ells River.

Nearctic distribution. Canada (Alberta).

Remarks. This larva resembles the larva of *Sublettea*. However, pedicels of LOs do not reach beyond the antennal apex.

Stempellina sp.

Larva (n=1)

Figures 81A-G

Macroscopic characters. Head capsule is flat dorsally with fine tubercles, darkening posteromedially, short pedestals in anterior mid-section of the head and antennal pedestals with multi-spined processes are visible (Figure 81A). Eyespots are bifid and attached, located in anterior 1/5th of the head capsule, 1st three body segment with multiple long setae. Procercus are sheath-like (Figure 81B). Posterior papapods are well-reduced.

Description. Larva L=2.1 mm. Head dark brown, HW/HL=0.77. S3 bifid sitting on a short pedestal (Figure 81C), S3 L=63.8 µm. Antennae 5 segmented, segments decrease in size sequentially, blade much longer than flagellum (L=80.6 µm), RO at the base of 1st segment, antennal pedestal with multi-spined processes (Figure 81D), LO arising from the base of 2nd segment (L=25.8 µm). SI serrated, SII on pedestals and simple. Pecten epipharyngis is multi-tooted. Premandible with 3 teeth and well-developed brush. Mandible with 1 dorsal tooth, 1 apical tooth and 2 inner teeth (Figure 81E), SSd long reaching beyond apical tooth (L=83.4 µm). Mentum with trifid median tooth and 5 pairs of lateral teeth (Figure 81F), 1st median tooth wide and dome shaped lighter in color than remaining teeth, VmP rectangular shaped separated by 1.2X the width of median tooth (Figure 81F). Abdominal segment I-II with long simple setae, segment II with multi-branched setae (Figure 81G). Procercus each bearing 8 sheath like apical setae and 2 sub-apical setae, no spines or projections present. 2 long anal setae present, L=93.2 µm. Posterior parapods as long as wide, bearing few small simple claws.

Rivers and streams. Athabasca River, Ells River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae of *Stempellina* construct long, curved, transportable cases of silt and sand. They occur in all freshwater habitats.

Stempellinella sp.

Larva (n=4)

Figures 82A-F

Macroscopic characters. Larvae construct transportable tube cases made from fine sand and silt (Figure 82A). Head capsule is yellow, almost squared. Eyespots are bifid, parallel and well-separated (Figure 82B).

Description. Larva L=2.2 mm. HL/HW=0.87. Clypeal setae S3 is simple and long (L=60.6 µm). Antennae 5 segmented, segments sequentially decrease in size, blade shorter than flagellum (Figure 82C), LO arise at the base and anterior 1/10th of the 2nd segment (L=22.0 µm), RO at the base of 1st segment, antennal pedestal L=35.3 µm, pedestals with blunt spur (L=6.5 µm), AR=0.78. SI comb-like (Figure 82D), SII on pedestals with serration, SIII simple. Lebral lamella well-developed with 21 branches (Figure 82D). Premandible with 3 teeth and well-developed brush (Figure 82D). Mandible with 1 dorsal tooth, 1 apical tooth and 3 inner teeth, SSd long reaching the base of sub-apical tooth (Figure 82E). Mentum with 3 median teeth and 5 pairs of lateral teeth, 1st median tooth slightly lighter than remaining teeth (Figure 82F), VmP separated about 1/2 the mentum W and with weak median projections, VmP W/mentum W=0.80. Procercus wider than long, bearing 4 apical and 2 sub-apical setae. 2 anal setae present, L=143.8 µm. Posterior parapods wider than long and with 10 simple claws. 2 small conical anal tubules present, L=48.5 µm.

Rivers and streams. Athabasca River, Ells River and Steep Bank River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Larvae occur in both lotic and lentic environment.

Tanytarsus chinyensis group

Larva (n=3)

Figures 83A-G

Macroscopic characters. Larvae construct cases similar to those of *Micropsectra* species. Head capsule more or less are squared shaped (Figure 83A). Antennae arise from a well-developed tubercle (Figure 83A), antennae are long. Eyespots located in the mid-section of head capsule (Figure 83A), upper eyespot slightly larger than lower eyespot. Several erect hair-like setae on body segments 1-3 (more prominent in 1st segment).

Description. Larva L=3.0 mm. HL/HW=0.93, Clypeus setae simple and long, L=71.6 µm. AHR=0.08. Antennae 5 segmented, segmented sequentially decrease in size (Figure 83B), AAR=0.17, LOR=4.20, antennal pedestals with long conical spur (L=16.1 µm; Figure 83C), AR=1.5. SI serrated and long (Figure 83D), SII with serration at the tip and on pedestals, SIII simple. Labral Lamellae well-developed with 28 teeth (Figure 83D), Pecten epipharyngis with 3 scales and 7, 6, 4 numbers of teeth (Figure 83D). Premandible with 3 teeth and well-developed brush (Figure 83E). Mandibles with 1 dorsal tooth, 1 apical tooth and 3 inner teeth (Figure 84F), SSd long reaching the middle of apical tooth (L=40.3 µm), pecten mandibularis with around 14 setae, seta interna with 3 main branch each with several serrated branches. Mentum with 1 apparently trifid median tooth and 5 pairs of lateral teeth (Figure 83G), 1st median tooth lighter in color than remaining teeth, MW/ML=0.55, VmP nearly meet in the middle, MVR=3.5. Posterior parapods with large group of claws ~35. Procercus sclerotized at the tip each bearing 7 long apical setae and 2 sub-apical setae. Anal tubules shorter than posterior parapods.

Rivers and streams. Athabasca River and Ells River.

Nearctic distribution. Canada (Alberta).

Ecology and habitat. Chernovskii (1949) reported the larvae of *chinyensis* group in both streams and lakes.

Remarks. According to Hoffman (1971) *Tanyrasus* larva with long antennal spur belong to *chinyensis* group.

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