# *Lopescladius* (Diptera: Chironomidae) from the Nearctic, including keys and new pupal exuviae descriptions

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**Abstract**

Male adults and pupae of the genus *Lopescladius* from the Nearctic are reviewed. The morphologies of adult male and pupal *Lopescladius* (*Cordiella*) *hyporheicus* Coffman and Roback, 1984, are reexamined and compared to the Neotropical *Cordiella*. The pupa of *Lopescladius* (*Lopescladius*) *inermis* Sæther, 1983, is described, along with comments on the adult male. Three additional pupal morphotypes are described. Keys are included for adult males and pupal exuviae from the Nearctic. Large range expansions are reported for several species.

**Introduction**

The genus *Lopescladius* Oliveira was first described from the Neotropics, where much of the known diversity exists (Oliveira 1967, Ashe and O'Connor 2012). The original reference to this genus was proposed by Brundin (1966), as "*Cordites*" *nomen nudum*, but without giving a formal description. Sæther (1983) described three additional species, along with six unassociated pupae. Coffman and Roback (1984) described the subgenus *Cordiella*. An emended diagnosis of *Cordiella*, with additional descriptions, was given by Hagenlund et al. (2010).

There are three species described from the Nearctic: *Lopescladius* (*Cordiella*) *hyporheicus* Coffman & Roback, 1984, *L.* (*L.*) *inermis* Sæther, 1983, and *L.* (*L.*) *verruculosus* Sæther, 1983. All three have broad distributions. A described unassociated larva known as *Lopescladius* sp. 1 (Coffman and Roback 1984) is common in the southeastern U.S., but it's unclear if this represents an undescribed species or is a smaller form of *L.* (*L.*) *hyporheicus* (Epler 2001). The pupal exuviae were described for *L.* (*L.*) *verruculosus* by Sæther (1983) and *L.* (*C.*) *hyporheicus* by Coffman and Roback (1984). Across its range, *Lopescladius* larvae occur in sandy erosional and depositional sediments of rivers and streams (Andersen et al. 2013, Hagenlund et al. 2010, Epler 2001).

**Materials and Methods**

General terminology follows Sæther (1980). Measurements are presented in ranges followed by a mean in parentheses. If only two specimens were measured, the mean was not included.

Pupal exuviae descriptions in this genus usually conflate the term rugulose (fine wrinkling or a striated texture) and granulose (fine granules or a bumpy texture). In most original descriptions, the term rugulose was used for granular structures, although wrinkles may be present in some species at the same locations. For example, in *Lopescladius* the thorax is commonly granular with a rugose prealar area, but rarely is the thorax rugose overall.

In previous descriptions of pupal exuviae in this genus (e.g., Sæther 1983, Coffman and Roback 1984), the term 'spine' is used for large posterior points on abdominal segments. These posterior spines may appear to be on caudal flaps when flipped forward in a slide mount, but *in situ* they do not appear to be on flaps. In general, these features are triangular, and 'thorn' may be a more accurate term, although some of these features, particularly on sternites, are thin and spine-like. Sæther (1980, p. 16) described spines as an "immovable projection of body wall of multicellular origin," differentiated from spinules by size (> 10 µm). Snodgrass (1935) has a similar definition and illustrates both narrow and wide features. For consistency, the word spine will continue to be used.

Slide mounting techniques presumably varied for the specimens examined but were likely similar to those in Wiederholm (1986) and Kranzfelder et al. (2015). Specimens examined are from collections at the University of Minnesota, St. Paul (UMSP, all specimens unless noted), the Academy of Natural Sciences of Drexel University (ANSP), and personal collections (Will Bouchard [RWB], Peter Langton [PHL]).

**Diagnoses**

For generic and subgeneric diagnoses see Sæther (1983), Coffman and Roback (1984), Coffman et al. (1986), and Hagenlund et al. (2010). Specimens fit prior genus and subgenus diagnoses with the following additions and comments for pupae: the

thorax ranges from granulose to rugose to nearly smooth; in many species abdominal reticulation is absent or indistinct; sternite VIII of female often has weak posterior spines laterally; abdominal segment I with 1-2 dorsal and 0-1 ventral taeniate setae; abdominal segments II-VII with taeniate setae at $D_2$ and $D_5$, ($V_4$) and $V_5$, and the single L seta; abdominal segment VIII with 2 dorsal, 1-2 ventral, and 1 lateral taeniate setae; and in some species the genital sheath has an additional small lobe ventrally.

For adult males: wing length 0.5-1.5 mm; hind tibia comb with 8-14 setae; inferior volsella probably always present but may be transparent and obscured by other features; in subgenus *Cordiella*, inferior volsella with two lobes in all described species; gonostylus does not always have a medial bend.

***Lopescladius* (*Cordiella*) *hyporheicus* Coffman & Roback, 1984**

**Material examined**. USA: Pennsylvania: Crawford County, Linesville Creek (1 km north of Linesville), 15-VI-1974, leg. Wartinbee, 6 adult males (holotype and paratypes), ANSP. Colorado: Freemont County, Arkansas River at Canyon City, 19-IX-1985, leg. S. J. Herrmann, 1 adult male. New Mexico: Rio Grande River, Otowi Bridge between Santa Fe and Los Alamos, 16-VII-1976, sweep net, 1 adult male. Taos County, Rio Pueblo above the confluence with the Rio Grande, 21-VIII-1991, 1 adult male. Catron County, Negrito Creek at Reserve, 21-IX-1992, leg. D. James, 1 female of unassociated pupal exuviae. Sierra County, Alamosa Creek 14.4 rd. mi. upstream of Monticello, 10-IX-1997, leg. M. Hatch, 1 female of unassociated pupal exuviae. Vacas (Rio de las Vacas?), 31-V-2018, 3 adult males. Washington: Stevens County, Little Pend Orielle River, 21-VII-2021, 1 adult male. Mason County, east fork Satsop River, Shafer State Park, 16-VII-2024, leg. R. W. Bouchard, Jr., 2 females of unassociated pupal exuviae. Montana: Carbon County, Red Lodge Creek above lowest bridge, 3-VIII-2023, 3 adult males. Minnesota: Chisago County, Sunrise River, 23-V-2003 and 2-IX-2023, leg. L. C. Ferrington, Jr., 1 male and 1 female of unassociated pupal exuviae. Rush Creek and Rock Creek, 6-VI-2003, leg. L. C. Ferrington, Jr., 1 male and 1 female of unassociated pupal exuviae.

Adult males and pupal exuviae generally agree with the original descriptions, with the following morphological additions and comments.

**Male imago**. Thorax and tergites golden to yellowish brown. Unless indicated, n = 1.

*Wing*. Wing length 1.07-1.12 (1.10) mm (n = 4). Wing length/length of profemur 3.41-3.73 (3.61, n = 3). Venarum ratio (VR) 1.30-1.33 (n = 2). Cu length 644 µm. M length 840 µm. False costal extension faint, 88 µm, ending shortly beyond $R_{4+5}$. Brachiolum with one seta 30 µm long, other veins bare. Squama bare.

*Legs*. Fore tibia spur 25-29 µm long (n = 2). Mid tibia spur 28-30 µm long (n = 2). Hind tibia spur 32-35 µm long, and 8-14 setae in comb (n = 2). Width at apex of fore tibia 27 µm; of mid tibia 27 µm; of hind tibia 34 µm.

*Abdomen*. Tergites II-VII have a single strong medial seta, 68-92 µm long (n = 6 measured on one adult). Sternite II-IV with no setae or insertion points; sternites V-VII with a single strong medial seta, 40-48 µm long (n = 3 measured on one adult).

*Hypopygium*. Phallapodeme 41-45 µm long (n = 2); transverse sternapodeme 45 µm long. Gonocoxite 66-96 (81) µm long (n = 4). Inferior volsella bifurcate, basomedial branch 10-14 µm long, 6-7 µm wide at base (n = 2), usually tapers to a rounded apex resembling a canine tooth; main branch 34-41 (40) µm long (n = 4), 7-8 µm wide (n = 2, Fig. 1).

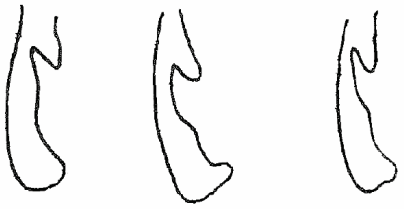

Figure 1. *Lopescladius hyporheicus*, inferior volsella variations.

**Pupal exuviae**. Total length and abdominal spine counts include ranges from Coffman and Roback (1984). For all other measurements n = 8, unless indicated. See Figs 9-12 in Coffman and Roback (1984).

Total length 2.1-2.5 (2.2) mm.

*Cephalothorax*: Thorax granulose overall (not rugulose per Coffman and Roback [1984]); prealar weakly granulose; wing sheath often smooth. Leg sheath sclerotization not distinctive.

*Abdomen*: Largest $D_{1-5}$ setae 70 µm, taeniate. Transverse anterior shagreen 3-5 µm long, arranged in 2-5 irregular rows (Fig. 2 c). Segments VI-VIII may have additional pleurite shagreen. Pleurites with granulation ranging from moderate to weak, sometimes absent. Tergite posterior spine

count (n = 10): I 5-17 (10), II 12-20 (15), III 11-22 (15), IV 10-23 (15), V 12-18 (15), VI 11-16 (13), VII 8-16 (11), VIII 6-14 (10). Sternite posterior spine count (n = 10): I 0, II 7-16 (12), III 13-19 (15), IV 11-15 (13), V 11-15 (13), VI 8-14 (12), VII 7-12 (10), VIII 5-13 (9). Sternites II (male and female) and VIII (female) with small spines widely separated. In lateral view, anal lobe digitiform projections conical, 84-129 (103) µm long, 42-56 (50) µm wide at base ($L/W_{base}$ 1.7-2.3), and lacking ventral lobes on the genital sheath (n = 6).

**Remarks**. The original description and figures of the *L. hyporheicus* male imago (Coffman and Roback 1984) described the inferior volsella as digitiform with a single lobe. Hagenlund et al. (2010) described three Neotropical *Cordiella* with an inferior volsella having a double lobe, including a small anterior branch. A review of specimens from across the Nearctic, including the type material (holotype and five paratype males, Fig. 1) from Pennsylvania, indicate the original description and figures omitted the small, basomedial branch (it can appear to be part of the lateral sternapodeme). Therefore, all *Cordiella* species currently described share a bilobed inferior volsella. The subgenus diagnosis in Hagenlund et al. (2010) otherwise remains correct for *Cordiella*, with only one minor variation: comb of hind leg with 8-14 setae.

Within *Cordiella*, imago features for Nearctic *L. hyporheicus* (Coffman and Roback 1984) are similar to Neotropical *L. vibrissatus* Hagenlund, Andersen *et* Mendes, 2010 and *L. morosus* Hagenlund, Andersen *et* Mendes, 2010. The hypopygium of *L. hyporheicus* is most similar to *L. vibrissatus* in Hagenlund et al. (2010), but the basomedial lobe of the inferior volsella is often shaped like a canine tooth, with a broad base that tapers to a rounded apex (Fig. 1). In addition, the wing length/profemur length in *L. hyporheicus* is larger (3.41-3.73) and the hypopygium ratio (length of gonocoxite/length of gonostylus) is lower (1.56-1.89).

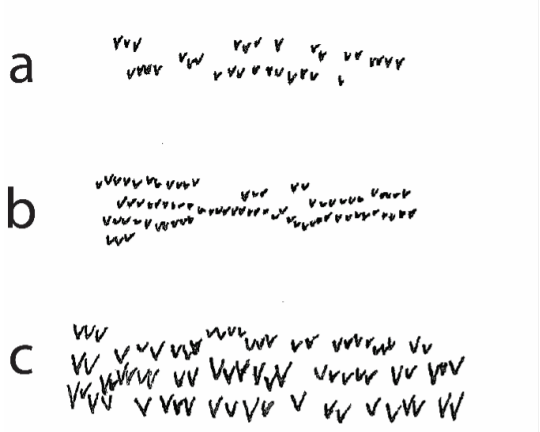


Figure 2. Abdominal shagreen pattern and relative size. a: *Lopescladius* NA3 (2-3 µm); b: *L.* NA2 (1-2 µm); c: *L. hyporheicus* (3-5 µm).

Specimens presented here indicate a broad Nearctic range for *L. hyporheicus*, from Pennsylvania, South Carolina, and Virginia in the east (Ashe and O'Connor 2012), to Minnesota in the Midwest, and Washington, Colorado, Montana, and New Mexico in the west. Larvae have been identified from New Brunswick and Nova Scotia in Canada (Bilyj, pers. comm.).

***Lopescladius* (*Lopescladius*) *inermis* Sæther, 1983**

**Material examined**. USA: New Mexico: Eddy County, Pecos River at bridge on Hwy 82 between Artesia Loco Hills, sweep net, 1-VIII-1976, leg. J. E. Sublette, 6 adult males. Doña Ana County, Rio Grande River below Leasburg Diversion Dam, UV sample, 29-IX-1992, leg. unknown, 2 adult males. Guadalupe County, Pecos River at Puerto de Luna, Malaise trap, 29-IX-1974 and 12-VII-1976, leg. unknown, 2 adult males. Chaves County, Pecos River at NM Hwy 70, 13-IV-1991, leg. M. Hatch, 3 females and 4 males of unassociated pupal exuviae. Wisconsin: Burnett County, St. Croix River upstream of CCC Bridge, 25-VII-2007, St. Croix County, St. Croix River upstream of Marine-on-St. Croix, 27-VIII-2007, leg. B. E. Schuetz, 3 pharate males with associated pupal exuviae. Minnesota: Pine County, St. Croix River, upstream of Hwy 70, 30-V-2007, leg. B. E. Schuetz, 1 female of unassociated pupal exuviae. Chisago County, Sunrise River and Rush Creek, 6-VI-2003, leg. L. C. Ferrington, Jr., 2 females of unassociated pupal exuviae. Texas: Gregg County, Sabine River, Zone 1 Rte. 149 bridge to outfall 001, Zone 4 outfall 004 to Mason Lake discharge, 7-X-2015 and 9-X-2015, leg. R. W. Bouchard Jr. and R. L. Thomas, 1 male and 1 female of unassociated pupal exuviae, RWB collection. Oklahoma: Beaver County, Cimarron River at Mocane, 16-VII-2019, leg. unknown, 7 pharate males with associated pupal exuviae.

In Sæther (1983) only one adult male was examined. Selected features from thirteen additional adult males are included here to revise the description of *L. (L.) inermis*. Measurements include Sæther's (1983) specimen. Specimens from Sæther (2004) were not included but agree with present measurements. See Sæther (2004, Fig. 1) for a revised illustration of the male hypopygium.

**Male imago.** Coloration yellow-brown to brown on thorax and legs, pale brown abdomen. Ultimate flagellomere of antenna 100 – 142 (121) µm long, AR 0.35-0.66 (0.51, n = 11). Phallapodeme 69-99

(86) µm long. Gonocoxite 145-180 (165) µm long (n = 10); distance from base of gonocoxite to base of gonostylus 83-116 (94) µm (n = 10); distance from base of gonostylus to apex of gonocoxite 62-83 (71) µm long (n = 9). Gonostylus 41-57 (51) µm long (n = 13) and 9-12 (10) µm wide (n = 12). Hypopigium ratio 2.79-4.02 (3.19, n = 9). Inferior volsella present (see Fig. 1 in Saether 2004), weak and transparent with a pointed apex, no seta; depending on orientation may not be visible; 8-12 (10) um long (n = 10).

**Pupal exuviae**. Total length 1.27-1.83 (1.67) mm (n = 18), pale yellow to pale brown.

*Cephalothorax*. Figs. 3 a-b. Granularity strong to weak overall including frontal apotome and antennal sheath; posterior thorax may be rugose instead, wing sheath with reduced granules or smooth. Frontal setae and thoracic horn absent. All thoracic setae weak to very weak, usually difficult to find, no prealars observed; antepronotal, precorneal, and dorsocentral setae similar in size, 18-31 (27) µm long (n = 8). All leg sheaths straight and adjacent, foreleg ends near posterior edge of abdominal segment I, midleg ends near apex of wing sheaths, and hindleg ends near the posterior edge of abdominal segment II (see Figure 3C in Saether [1983]).

*Abdomen*. Figs. 3 c-d. Lateral setae on segments I-VII weak or absent, narrow taeniate or hairlike, 20-41 (30) µm long (n = 14). No lateral setae observed on segment VIII. Dorsal and ventral setae taeniate, $D_2 + D_5$ and $V_3 + V_5$ lanceolate with wider base and elongate narrow apex; smaller setae on anterior segments, larger setae on posterior segments and in posterior spine rows. Dorsal setae on segments I-II are 28-51 (35) µm long and 2-4 µm wide, segments III-VI are 31-75 (53) µm long and 3-7 µm wide, segments VII-VIII are 34-79 (60) µm long and 3-7 µm wide. Ventral setae on segment I ab-

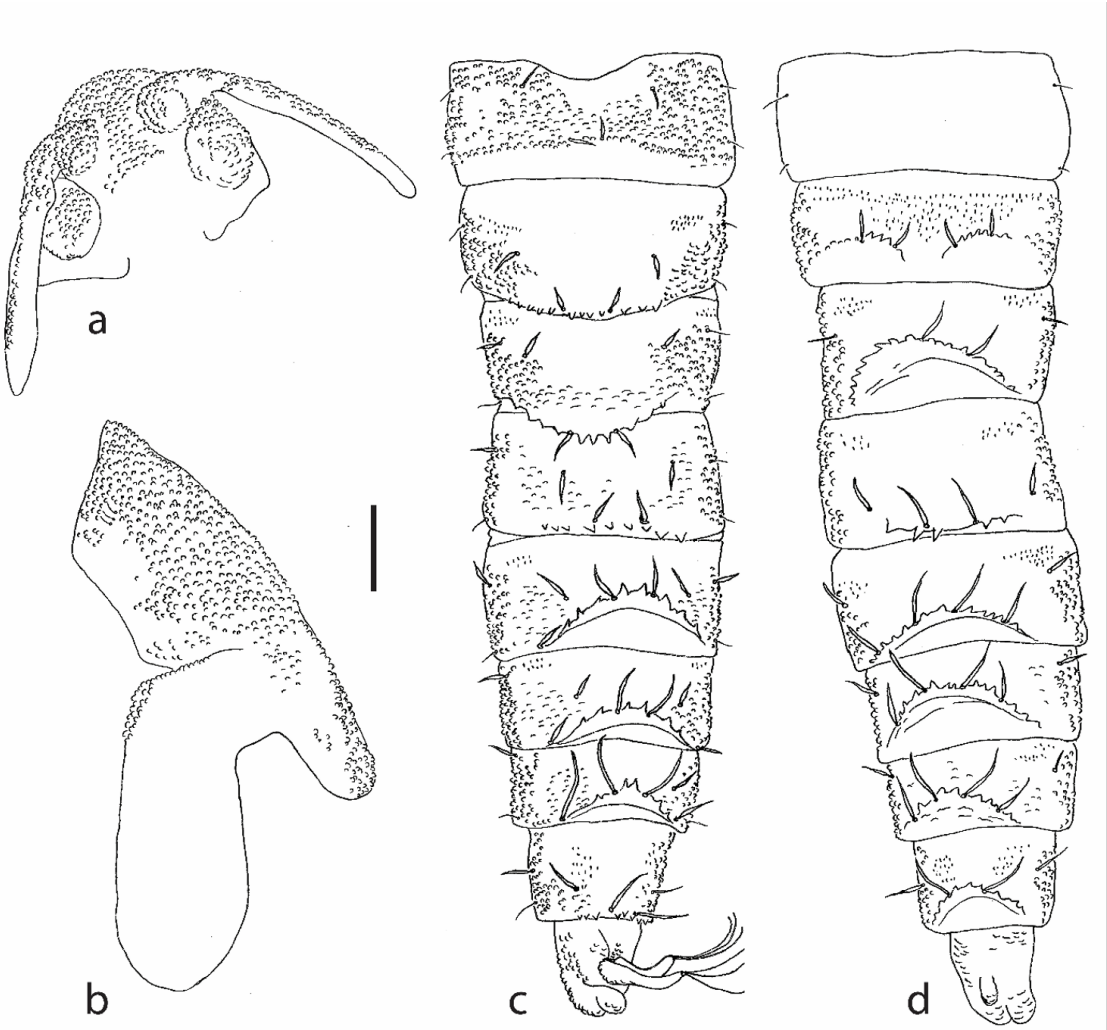


Figure 3. *Lopescladius inermis*, male pupa. a: Frontal apotome and antennal sheaths; b: Thorax; c: Dorsal abdomen; d: Ventral abdomen. Scale bar = 100 µm.

sent, segment II 31-58 (39) µm long and 2-4 µm wide, segments III-VIII 44-82 (62) µm long and 4-8 µm wide. Shagreen variable but never in transverse rows around segments, usually all segments bare; segment II can have sparse anterolateral shagreen on tergite and anterior shagreen on sternite; segment III can be similar to II; segments III-VII may have sparse and light shagreen anterolaterally or above the lateral rugose patches; VIII may have sparse, small tergite or sternite shagreen; anal lobe (IX) bare to wrinkled or sparse shagreen. Lateral edge of abdominal segments usually with rugosity, ranging from strong to weak, occasionally bare; rugosity on anterior segments may extend to tergites, particularly along the spine rows. Caudal spines triangular, usually with pointed apex but may be rounded; on tergite I rugosity often strong along the posterior edge but spines absent. Spines on sternite II have a medial gap between short lateral patches. Spines on sternite VIII absent or present in females, when present there is a wide gap as on sternite II, there are also two posterior medial lobes facing inward.

Tergite posterior spine count (n = 13): I 0, II 5-12 (9), III 7-11 (9), IV 6-11 (9), V 7-11 (9), VI 6-9 (8), VII 6-8 (7), VIII 2-7 (4). Sternite posterior spine count (n = 13): I 0, II 3-8 (7), III 7-13 (10), IV 7-12 (10), V 7-13 (9), VI 5-11 (7), VII 4-7 (6), VIII 2-7 (6) for males, 0-6 for females.In lateral view, anal lobe with cylindrical digitiform projections, 84-112 (95) µm long, 28-34 (29) µm wide at base (L/$W_{base}$ 3.0-3.4), 17-20 (17) µm wide medially; three curving terminal macrosetae 89 (72-103) µm long (n = 6). Genital sheaths wrinkled to lightly rugose, curved dorsally in male, with a small ventral lobe in male and female.

**Remarks**. New pupal exuviae description. *L. inermis* is easily separated from other Nearctic pupal exuviae by the lack of anterior transverse spinule rows on abdominal segments and abdominal setae that are typically short and lanceolate. Caudal spines appear to be on flaps when the posterior tergite edge is flipped forward, but when not flipped forward there is no flap-like structure.

**Distribution and ecology**. *L. inermis* was previously known from Kansas and Wisconsin. The range is extended to Minnesota, Texas, Oklahoma, and New Mexico. A specimen in the Sublette collection from 27-VII-1971 was collected in the Wabash River, but the state is not identified on the locality label; it is likely that both Illinois and Indiana are in the range of *L. inermis*.

***Lopescladius* (*Lopescladius*) *verruculosus* Sæther, 1983**

Sæther (1983) described this species from an adult male and paratypes of pupal exuviae in Michoacán, southwest Mexico. A single pupa was also noted from the Mississippi River near Cordova, Illinois. Helping to bridge the geographical gap are two specimens of *L. verruculosus* from the PHL collection from sites in the Rio Grande River at Las Cruces, New Mexico, leg. R. Jacobsen, and Rock Springs Creek at Wakita Springs, Florida, leg. W. P. Coffman (Langton, pers. comm.).

***Lopescladius* NA1 Langton**

Langton (2023 and pers. comm.) describes NA1 as being relatively large at 2.7-3.1 mm long (n = 8); thorax nearly smooth to having shallow granulations anterodorsally; lanceolate abdominal setae; tergite I with small posterior spines; sternite II armament with anterior and posterior bands that are joined medially; distinct, continuous transverse anterior shagreen bands encircling segments; weak lateral abdominal rugosity; anal lobe digitiform projections conical, 88-92 µm long, 40-54 µm wide at base ($LxW_{base}$ is 1.7-2.2), 26-30 µm wide medially, and lacking a ventral lobe on the genital sheath (n = 2).

**Remarks and diagnostic characters**. *Lopescladius* NA1 is separated from other *Lopescladius* by the weakly rugose anterodorsal thorax and shagreen on sternite II in two transverse rows joined medially. While it is possibly a pale variant of *L. hyporheicus* with reduced granulation, the sternite II shagreen and larger proportions are unique. In contrast to placement in Langton (2023), *L.* NA1 likely belongs in the subgenus *Cordiella* based on caudal tergite I spines, L/W of the anal lobe projection, and lack of a ventral lobe on the genital sheath. *L.* NA1 is known from collections made at Linesville Creek, Pennsylvania (Langton, pers. comm.).

***Lopescladius* NA2**

**Material examined**. USA, Wisconsin: Burnett County, St. Croix River, CCC Bridge 25-VII-2007 and Riverside Landing 31-V-2007, leg. B. E. Schuetz, 3 males and 1 female of unassociated pupal exuviae.

**Pupal exuviae (n = 4).** Total length 2.2-2.7 (2.4) mm, golden brown.

*Cephalothorax*. Figs. 4 a-b. Strongly granulose thorax and frontal apotome, weak posterior granularity, wing sheaths and prealar mostly bare. Frontal setae and thoracic horn absent. All thoracic

setae weak, no prealars observed. Two median antepronotals, about 30 µm long (n = 2). Three precorneals in a short line, longest is 41 µm long, the others 20 µm long (n = 2). Dorsocentrals 1-2 together, both about 34 µm long; Dc3-4 together, both about 35 µm long; two groups 180 µm apart (n = 2). All leg sheaths straight; foreleg ends before wing apex, midleg ends at apex, and hindleg ends past wing sheath apex.

*Abdomen*. Figs. 4 c-d. Lateral seta on segment I weak, 37 µm long (n = 2). Lateral setae on II-VIII 38-55 µm long, narrow taeniate, 2-3 µm wide (n = 4). Dorsal and ventral setae taeniate, 55-86 µm long, 3-7 µm wide (n = 4). Shagreen absent on segment I; anterior transverse rows of very weak 1-2 µm spinules circle segments II-VIII (Fig. 2 b); sternite II with weak medial shagreen, sternite III without additional medial shagreen; segment IX and genital sheath with weak shagreen. Lateral edge with granulose to rugose patch on anterior segments, usually smooth on posterior segments. Posterior medial lobes on segment VIII of female, absent on male. Caudal spines small, 14-20 µm for tallest, triangular with pointed apex or low and rounded. Spines on sternites II with a medial gap, and sternite VIII with (♀) or without (♂) a gap. Tergite I either bare or with caudal rugose knobs, but never spine shaped. Tergite posterior spine count (n = 4): I 0, II 8-10 (9), III 10-13 (11), IV 8-12 (10), V 9-12 (11), VI 9-11 (10), VII 5-8 (7), VIII 4-6 (6). Sternite posterior spine count (n = 4): I 0, II 9-11 (10), III 10-12 (11), IV 8-12 (10), V 8-11 (10), VI 8-9 (8), VII 5-8 (6), VIII 0-8 (4).

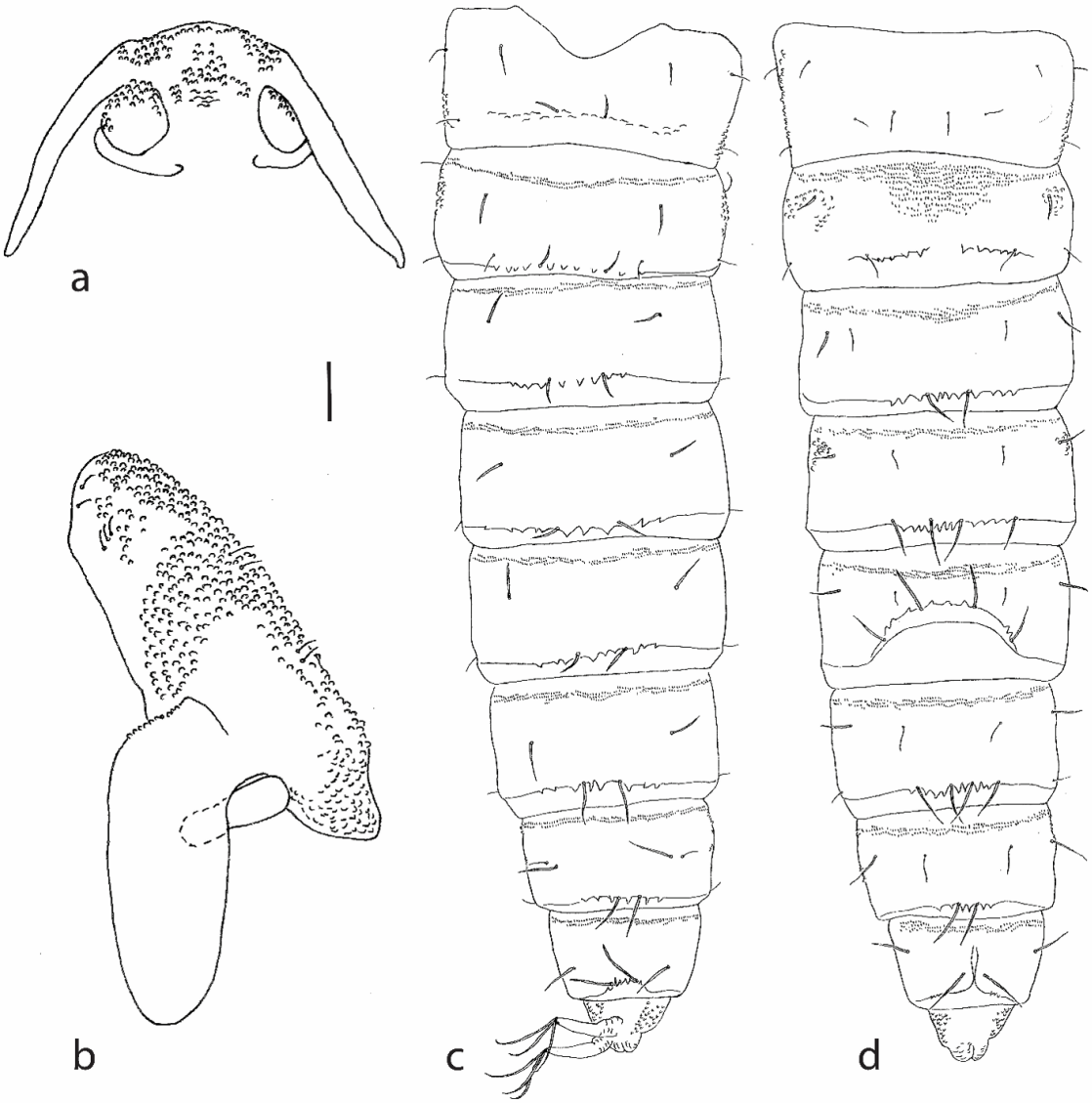


Figure 4. *Lopescladius* NA2, female pupa. a: Frontal apotome and antennal sheaths; b: thorax; c: dorsal abdomen; d: ventral abdomen. Scale bar = 100 µm.

In lateral view, anal lobe projections variable in shape, elongate conical, wrinkled; 118-129 (124) µm long, 40-62 (49) µm wide at base ($L/W_{base}$ 2.0-3.3, n = 6). Small ventral lobes variable, absent to weak. Three curving terminal macrosetae 113-120 µm long (n = 6). Male genital sheaths curve dorsally.

**Remarks**. To follow nomenclature from Langton (2023), the designation *L.* NA2 is used for this morphotype. Placement of *L.* NA2 in the subgenus *Lopescladius* is tentative because of variable features, including anal lobe projections and secondary ventral lobes. However, the lack of caudal spines on tergite I appears to be an important feature separating subgenera. Overall, *L.* NA2 is similar to *L. hyporheicus* but several features suggest a unique morphology. Anterior transverse shagreen rows are comprised of very small points in compact and elongated rows, compared to larger points in irregular rows for *L. hyporheicus* (Fig. 2). Sternite III is unarmed medially in *L.* NA2. Tergite I spines are absent (or at most a few indicated knobs) in *L.* NA2; low counts and weak spines can occur in *L. hyporheicus* but this appears to be atypical. This morphotype is also similar to *L. verruculosus*, but medial sternite II shagreen (absent in *L. verruculosus*, Langton, pers. comm., n = 12) and larger size of *L.* NA2 will separate these.

***Lopescladius* NA3**

**Material examined**. USA, Wisconsin: Burnett County, St. Croix River upstream of Riverside boat launch, 31-V-2007, leg. B. E. Schuetz, 1 male of unassociated pupal exuviae. Minnesota: Chisago County, St. Croix River upstream of Sunrise River, 26-VII-2007, leg. B. E. Schuetz, 1 female of unassociated pupal exuviae.

**Pupal exuviae (n = 2)**. Total length 1.82-1.96 mm, pale yellow.

*Cephalothorax*. Figs 5 a-b. Strongly granulose anterior thorax, weak granulation with bare areas posteriorly; bare to weakly granulose frontal apotome and prefrons; wing sheaths mostly bare. Frontal setae and thoracic horn absent. All thoracic setae weak, no prealars observed. Two median antepronotals, 41 µm long. Three precorneals in a short line, longest is 40 µm long, the others 24 µm long. Dorsocentrals 1-2 paired, both 41 µm long; Dc 3-4 paired, also weak; two groups 120 µm apart. All leg sheaths straight; foreleg ends before wing apex, midleg and hindleg end past wing sheath apex.

*Abdomen*. Figs. 5 c-d. Lateral seta on segment I weak, 38 µm long (n = 1). Lateral setae on II-VIII 62-70 µm long, 2 µm wide. Dorsal and ventral setae hairlike or narrow taeniate, 34-69 µm long, 2-3 µm wide. Shagreen absent on segment I; anterior transverse rows of weak 2-3 µm spinules circle segments II-VIII; sternite II with widespread weak shagreen, sternite III similar but less widespread; segment IX and genital sheath with weak shagreen. Lateral edge of segment II with light anterior rugosity, all other segments smooth. Posterior medial lobes on segment VIII of female, absent on male. Caudal spines robust, triangular with a pointed apex. Spines on sternites II and VIII have a wide medial gap between short lateral patches. Tergite posterior spine count: I 11-12, II 11-11, III 10-12, IV 7-9, V 8-11, VI 9-10, VII 7-8, VIII 6-7. Sternite posterior spine count: I 0, II 9-11, III 9-11, IV 9, V 7-10, VI 9-10, VII 5-7, VIII 5-8. In lateral view, anal lobe projections conical, wrinkled to lightly granulose; 73-90 (81) µm long, 34-39 (36) µm wide at base ($L/W_{base}$ 2.1-2.3, n = 4). Three curving terminal macrosetae 72-79 µm long (n = 4). Due to mount orientations, uncertain if male genital sheaths curve dorsally. Small ventral lobes on genital sheath absent in both specimens.

**Remarks**. To match the nomenclature from Langton (2023), the designation *L.* NA3 is used for this morphotype. Many features are similar to *L. hyporheicus*, in particular the strong spines on tergite I, but several features diverge: small size (< 2 mm), pale pigmentation, weaker abdominal setae, very weak circumferential shagreen (2-3 µm), and no lateral rugose abdominal patches. *L.* NA3 likely belongs in the subgenus *Cordiella* based on caudal tergite I spines, L/W of the anal lobe projection, and lack of a ventral lobe on the genital sheath.

The following are Nearctic revisions to keys in Sæther (1983).

**Key to known Nearctic male adults of *Lopescladius***

1. Gonocoxite without a caudal extension (Coffman and Roback 1984, Fig. 7); inferior volsella bifurcate with long digitiform lobe and short basomedial branch (Fig. 1) ……..... *Lopescladius* (*Cordiella*) *hyporheicus* Coffman and Roback

- Gonocoxite with an elongate caudal extension; inferior volsella simple, small spiniform or triangular (Sæther 2004, Fig. 1) ….....…..... ..... *Lopescladius* (*Lopescladius*) 2

2. Antennal ratio (AR) about 0.75; gonocoxite caudal extension tapers to a point, with a conspicuous terminal spine-like seta (Sæther 1983, Fig. 2E) ..... *Lopescladius* (*s.str.*) *verruculosus* Sæther

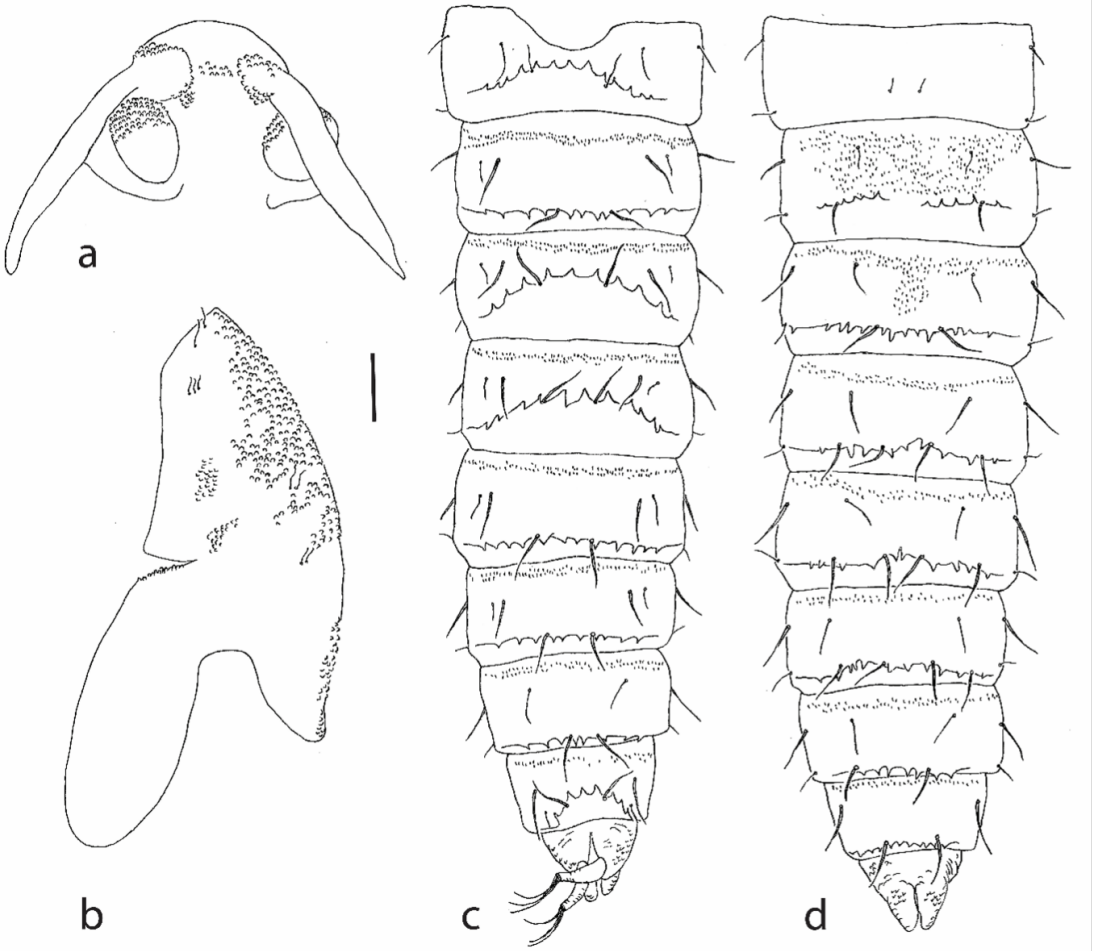


Figure 5. *Lopescladius* NA3, male pupa. a: Frontal apotome and antennal sheaths; b: thorax; c: dorsal abdomen; d: ventral abdomen. Scale bar = 100 µm.

- Antennal ratio 0.5-0.6; gonocoxite caudal extension tubular with a rounded apex, without spine-like terminal seta (Sæther 1983, Fig. 5D) ….....… *Lopescladius* (*s.str*.) *inermis* Sæther

**Key to known Nearctic pupal exuviae of *Lopescladius***

1. Tergite I with a caudal spine row; in lateral view, anal lobe projections conical; small ventral tubercle on genital sheaths always absent ……..... subgenus *Cordiella* 2

- Tergite I without a caudal spine row, though may be rugose or with small granulation; in lateral view, anal lobe projections tubular or weakly conical; small ventral tubercle on genital sheaths present or absent ……..…… subgenus *Lopescladius* 4

2. Total length < 2 mm; pale brown; transverse shagreen very weak, 2-3 µm (Fig. 2a); abdomen smooth laterally …….. *Lopescladius* NA3

- Total length > 2 mm; pale to golden brown; transverse shagreen stronger (Fig. 2c); abdomen usually granular or rugose laterally, at least on some segments ……..…… 3

3. Thoracic granulation strong; sternite II with widespread shagreen but no separate posterior band ……..……. *Lopescladius* (*Cordiella*) *hyporheicus*, Coffman and Roback

- Thoracic granulation weak to nearly smooth; sternite II with a broad anterior and narrow posterior band of shagreen joined medially ….……..….....……..... *Lopescladius* NA1

4. Abdominal segments bare or with sparse shagreen, never forming transverse rows; abdominal setae lanceolate (Fig. 3 c-d); total length < 2 mm .....…….. *Lopescladius* (*s.str*.) *inermis* Sæther

- Anterior shagreen on abdominal segments II-VIII form transverse rows encircling the segment; abdominal setae taeniate, rarely lanceolate ……. 5

5. Total length > 2 mm; sternite II with shagreen expanded medially (Fig. 4d) ……. *Lopescladius* NA2

- Total length < 2 mm; sternite II shagreen without medial expansion …..... ..... *Lopescladius* (*s.str*.) *verruculosus* Sæther

**Discussion**

Although the first mention of this genus was by Brundin (1966), he did not formally describe it. He did note its unique morphology, including straight leg sheaths of the pupa and cordiform fourth tarsal segments of adults. In the Nearctic, he mentions a record from Vancouver Island. Without description this cannot be ascribed to a species. But the locality and his illustration (Brundin 1966; Fig. 622) suggests this could have been *L. hyporheicus*, which is the most widespread species in the Nearctic. With three associated pupal exuviae and three distinct pupal morphotypes, it appears that only half of the Nearctic diversity are described as adults.

Description of the inferior volsella shape between Nearctic and Neotropical species confirms separation of subgenera, with the subgenus *Cordiella* having a bilobed inferior volsella and the subgenus *Lopescladius* having a spiniform shape (although transparency and small size can make it difficult to observe), which was described as absent in *L. inermis* (Sæther 1983:293). For pupal exuviae, caudal spines on tergite I are probably the most useful feature for separating subgenera, with anal lobe projection shape and ventral tubercle presence on the genital sheaths as valuable secondary traits. Without associated adult males, the three morphotypes have been separated using pupal exuviae.

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