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The adults, larvae, and systematics of the Nearctic *Oemopteryx* Klapálek, 1902 (Plecoptera: Taeniopterygidae)

CHRIS J. VERDONE[1,5*], BRONWYN W. WILLIAMS[2,6], STEVEN R. BEATY[1,7], VICTOR B. HOLLAND[1,8], SCOTT A. GRUBBS[3,9] & R. EDWARD DEWALT[4,10]

[1]*North Carolina Department of Environmental Quality, Division of Water Resources, Water Sciences Section, Raleigh, NC, 27607, USA*
[2]*North Carolina Museum of Natural Sciences, Raleigh, NC, 27607, USA*
[3]*Department of Biology and Center for Biodiversity Studies, Western Kentucky University, Bowling Green, Kentucky 42101, USA*
[4] *University of Illinois, Prairie Research Institute, Illinois Natural History Survey, 1816 S Oak St., Champaign, Illinois, 61820, USA*
[5] *chris.verdone@ncdenr.gov; https://orcid.org/0000-0001-8482-0708*
[6] *bronwyn.williams@naturalsciences.org; https://orcid.org/0000-0001-6403-112X*
[7] *steven.beaty@ncdenr.gov; https://orcid.org/0000-0003-2132-1754*
[8] *victor.holland@ncdenr.gov; https://orcid.org/0000-0002-2289-4143*
[9] *scott.grubbs@wku.edu; https://orcid.org/0000-0003-2170-9716*
[10] *dewalt@illinois.edu; https://orcid.org/0000-0001-9985-9250*
**Correspondence author*

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Abstract

The adult and larval life stages of the Nearctic species of *Oemopteryx* Klapálek, 1902 (Plecoptera: Taeniopterygidae) are reviewed using color images, scanning electron microscopy photomicrographs, variation in the barcode region of the mitochondrial DNA cytochrome c oxidase subunit I (COI) gene, and distributional information. Two new species are described from the southeast Nearctic region. Adult and larval keys to *Oemopteryx* species are presented in addition to revised keys to genera for Nearctic Taeniopterygidae.

Key words: Nearctic, Plecoptera, Taeniopterygidae, Brachypterainae, *Oemopteryx*, new species

Introduction

In 2019, a Brachypterainae Zwick, 1973 (Plecoptera: Taeniopterygidae) larva was collected in North Carolina from the Sand Hills Level IV ecoregion (USEPA 2019). Initially it was identified as a *Strophopteryx* Frison, 1929*,* but was later determined as an *Oemopteryx* Klapálek, 1902. The Sand Hills are located in the Coastal Plain Level III ecoregion, an unusual place to find *Oemopteryx*. The only species known from the southeast Nearctic is *O. contorta* (Needham & Claassen, 1925), which is a montane taxon (Kondratieff & Kirchner 1987). This updated determination prompted an investigation and collection of additional specimens of this stonefly. Eventually, additional specimens were found in a historic benthic sample archived among North Carolina Department of Environmental Quality samples at the Raleigh facility. The sample contained an abundance of this uncommon taxon. Subsequently, a comprehensive morphological and molecular analysis was conducted on all Nearctic *Oemopteryx* species, yielding the identification of two novel species.

Oemopteryx is a Holarctic genus presently represented by six species (DeWalt *et al.* 2024), including the single Palearctic member *O. loewii* (Albarda, 1889) that is considered extinct (Zwick 1992, Fochetti & Tierno de Figueroa 2006, Tyufekchieva *et al.* 2019). The five Nearctic species are *O. glacialis* (Barnston, 1848), *O. contorta*, *O. vanduzeea* (Claassen, 1937)*, O. fosketti* (Ricker, 1965) and *O. leei* Baumann & Kondratieff, 2009. In their review of the Brachypterainae, Ricker & Ross (1975) established four species groups for the genus based largely on adult male morphology. The *O. loewii* Group (*O. loewii*) was designated based on their interpretations of adult male genitalia illustrations from Klapálek (1902) and wing venation of the female, presumably from examined material as no illustrations of the female wings were included in Klapálek (1902). The *O. glacialis* Group (*O. glacialis, O. fosketti*) was distinguished by the lack of crossveins in the apical field of the female forewing as compared to *O. loewii* and by the epiproct apex being produced laterally near the apex. The *O. contorta* Group (*O. contorta*) was differentiated by several male characteristics. Specifically, the presence of a vesicle, paired anterior processes on tergum-10, long tapered anterior paraprocts, shelf-like basal cercal processes, an epiproct consisting of two prongs terminating in paired membranous lobes, and the lack of a median strut on the basal plate of tergum-10. The *O. vanduzeea* Group (*O. vanduzeea* plus *O. leei* added by Baumann & Kondratieff (2009a)) was defined by the basal plate being depressed medially, the flat anterior epiproct, an apparently singular internal filament, short club shaped anterior paraprocts, and long anteriorly directed basal cercal processes (not present in *O. leei*). Like many female Plecoptera, differentiating morphology is largely limited to characteristics of the subgenital plate. Detailed larval descriptions are available for *O. contorta* (Nelson 1982), *O. glacialis* (Stewart & Stark 2002) and *O. fosketti* (Dosdall & Lehmkuhl 1979), but larvae of both *O. vanduzeea* and *O. leei* remain undescribed. As a result, a comparative study of *Oemopteryx* larvae is not available.

Herein, we provide new and updated descriptions for adults and larvae of the Nearctic *Oemopteryx* including two new species in the *O. contorta* group supported by color images, scanning electron microscope (SEM) photomicrographs, and maximum likelihood (ML) and pairwise genetic distance analyses based on mitochondrial cytochrome c oxidase subunit I (COI) fragment data. We also present distribution maps for *Oemopteryx* species, updated keys to genus for Nearctic Taeniopterygidae adults and larvae, and species keys for adult and larval *Oemopteryx*.

Materials and Methods

Specimen and data acquisition. Adult stoneflies were collected using beating sheets, aerial nets, and hand-picking from riparian vegetation and substrates. Larvae were collected using a dip-net and kicknet and were immediately preserved in 80–95% ethanol or reared to the adult stage using the methods described by Beaty *et al.* (2017). Teneral adults were preserved in 80–95% ethanol after a day to fully sclerotize in a vented container.

Additional specimens were examined from the Canadian National Collection of Insects, Ottawa (CNCI), C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, Colorado (CSUIC), Illinois Natural History Survey, Champaign, Illinois (INHS), North Carolina Division of Water Resources Biological Assessment Branch Collections (NCDWR), Raleigh, North Carolina, University of Kentucky Insect Collection, Lexington, Kentucky (UKIC), and the S.A. Grubbs Collection, Western Kentucky University, Bowling Green, Kentucky (WKUC). Dr. Bill Stark, Mississippi College, Clinton, Mississippi also provided specimens. Dr. John B. Sandberg provided records for California from his personal collection (JBSC). Location coordinates for museum specimen records were georeferenced from labels using GEOLocate v. 3.22 (Rios & Bart 2010) or AcmeMapper 2.2 (mapper.acme.com) and are indicated by "[]". Coordinates for newly collected material were recorded directly using Topo Maps version 1.16 for iPhone. Plotting of coordinate data and map measurements were accomplished using ArcMap, ArcGIS 10.8.1. Level III/IV eastern Nearctic ecoregion data were obtained from the US Environmental Protection Agency (USEPA 2019) and drainage data were acquired from USGS StreamStats program 4.1.1 (U.S. Geological Survey 2016).

Conservation ranks for species were either obtained from NatureServe (2024) or derived using the rank calculator (NatureServe 2020) if a rank was unavailable. Ranges for the respective taxa were coarsely estimated by calculating the area covering known occurrence locations. Environmental specificity was set to moderate if taxa were known from a wide range of stream sizes or narrow if taxa were known from small streams and springs. Moderate intrinsic vulnerability was selected for *O. leei, O. tuscarora* **sp. nov.** and *O. vanduzeea* due to their occurrence in springs and seasonally intermittent streams, which are no longer protected under the Clean Water Act (Sackett v. EPA, 598 U. S. 2022).

Morphological terms generally follow Ricker & Ross (1975), Stewart & Stark (2002), Béthoux (2005), Sandberg (2011) and Murányi *et al.* (2015). The holotypes and paratypes will be deposited in the National Museum of Natural History, Washington, DC (USNM). Additional paratypes are deposited at CSUIC and NCDWR. Some characters are described using the relative positions "left" and "right". The relative positions are determined by viewing the specimen dorsally, with the head pointing away from the observer.

Images. Specimens were stack-photographed using a Nikon D2900 mounted on a Wild M5-A, a Jenoptik Gryphax mounted on a Leica DM 2000, and a Canon 6D Mark II with a 5X macro-lens mounted on a StackShot Motorized Rail. Composite images were assembled using Zerene Stacker version 1.04 (Zerene Systems LLC, Richland, Washington) and then edited using Adobe Photoshop version 21.0.3. Illustrations were made by tracing stacked images in Adobe Illustrator 2020. Adult male and female terminalia were prepared for SEM via serial dehydration in 90%, 95% and 100% ethanol for 10-minutes each and subsequently critical point dried. Dehydrated terminalia were attached to aluminum stubs with double-stick tape and sputter-coated with gold-palladium. Coated specimens were imaged using a Hitachi SU3900 at the Analytical Instrumentation Facility, North Carolina State University, Raleigh, North Carolina.

DNA extraction, amplification, and sequencing. Total genomic DNA was isolated from full or partial legs using a NucleoSpin 96 Tissue Core Kit (Machery-Nagel Inc., Allentown, PA, USA) following manufacturer protocols. A region of COI was amplified using the primer pairs LCO1490 and HCO2198 (Folmer *et al.* 1994) or mlCOIintF and jgHCO2198 (Leray *et al.* 2013). We conducted amplification in 10μL reactions comprising 25–100 ng template DNA, 5 μL Promega Taq Master Mix, 1.5 μM MgCl2, and 0.16 μM forward and reverse primers. The thermal profile for polymerase chain reaction (PCR) amplification included an initial denaturation at 95°C for 2-minutes, followed by 35 cycles of 95°C for 30 seconds, 30 seconds at the annealing temperature (LCO1490/HC02198: 46°C; mlCOIintF/jgHCO2198: 42°C), and 72°C for 1-minute, with a final extension of 72°C for 7-minutes. Amplified fragments were purified using Affymetrix ExoSAP-IT and were subsequently sequenced and run on an ABI3130 DNA Analyzer (Thermo Fisher Scientific). Additional sequences were obtained from BOLD: The Barcode of Life Data System (https://boldsystems.org) (Ratnasingham & Hebert 2007).

Genetic data analysis. Sequences were reconciled, compiled, and aligned in Geneious Prime® 2024.0.7 using the auto algorithm of MAFFT v7.450 (Katoh *et al.* 2002; Katoh & Standley 2013), and default parameters (gap open

penalty 1.53, offset value 0.123), adjusting for sequence direction. We examined all sequences for the presence of indels and subsequently translated them into amino acids to verify an open reading frame and avoid the inclusion of pseudogenes or NUMTs into analyses. All sequences, including duplicates, were retained in the alignment for downstream analysis. Uncorrected pairwise distance (p-distance) matrices were calculated in MEGA v11.0.13 accounting for transitions and transversions (d) and uniform rates among sites, treating missing data via pairwise deletion (Tamura *et al.* 2021).

We used ModelFinder (Kalyaanamoorthy *et al.* 2017), implemented in IQTREE v2.3.2 (Minh *et al.* 2020; as "-m MFP+MERGE"), to find the best-fit model of evolution for our data using a heuristically optimized search and the Bayesian Information Criterion (Chernomor *et al.* 2016). The optimal model (TPM2u+F+I+G4) was automatically implemented in the subsequent maximum likelihood (ML) phylogenetic tree reconstruction (Nguyen *et al.* 2015), quantifying clade support with 1000 ultrafast phylogenetic bootstraps (Hoang *et al.* 2018). We visualized the resulting majority rule (>50%) consensus tree using FigTree v1.4.4 (Rambaut 2018).

Results

Overall, the present study largely validated the Nearctic Taeniopterygidae keys of Baumann *et al.* (1977), Stewart (2000), Stewart & Stark (2002), Stewart & Oswood (2006) and DeWalt & Kondratieff (2019). Presented below are slightly modified versions. List of examined Brachypterainae excluding *Oemopteryx* are shown in Appendix 1. Morphological abbreviations are summarized in Table 1.

TABLE 1. Morphological abbreviations.

Adult morphology			
AEp	anterior epiproct	**Ep**	epiproct
AP	anterior process	**LS**	lateral strut
APp	anterior paraproct	**MS**	median strut
AS	abdominal sternum	**PEpD**	posterior epiproct dorsal process
AT	abdominal tergum	**PEpV**	posterior epiproct ventral process
BB	basal bulb	**PP**	posterior process
BCP	basal cercal process	**PPp**	posterior paraproct
BP	basal plate	**SGP**	subgenital plate
Ce	cercus	**V**	vesicle
Wing venation			
AA1	first anterior Analis	**M**	Media
AA2	second anterior Analis	**ScP**	posterior Subcosta
ccv	costal cross vein	**ScPcv**	posterior Subcosta cross vein
Co	Costa	**RA**	anterior Radius
CuP	posterior Cubitus	**RP**	posterior Radius
hcv	humeral cross vein		
Larval morphology			
AS	abdominal sternum	**P**	Antennal pedicel
DS	dorsal sensillae	**PS**	maxillary palp setae
Ga	galea	**S**	scape
IC	inner cusp	**SB**	sensilla basiconica
L	lacinia	**SD**	subapical denticles
MA	molar acanthae	**TC**	tibial callus
MP	molar pad	**VA**	ventral acanthae
MxP	maxillary palp	**VSP**	ventro-apical setal patch (dotted line = extent)
OC	outer cusp		

Taeniopterygidae genera adult male key

1 Each coxa with a gill scars (GS in Fig. 1C), cercus composed of one segment (Ce in Fig. 1A) . . . . . *Taeniopteryx* Pictet, 1841

1' Each coxa without gill scars, cercus composed of more than one segment (Ce in Figs 2A–C, 3A–C, 4A–C, 5A–C, 9A, 16A, 22A, 29A, 35A, 41A, 46A) 2

2 Epiproct composed of an anterior and posterior prong (AEp and PEp in Figs 9E, 16E, 22E, 29E, 35E, 41E, 46E). . . . . *Oemopteryx* Klapálek, 1902

2' Epiproct composed of a single prong (Ep in Figs 2A–B, 3A–B, 4A–B, 5A–B) 3

3 Apex of 9th sternal plate twisted, asymmetrical (AS9 in Fig. 2C) . . . . . *Bolotoperla rossi* Ricker & Ross, 1975

3' Apex of 9th sternal plate symmetrical (AS9 in Figs 3C, 4C, 5C) 4

4 Tergum-10 with paired, flattened, posteriorly directed anterior processes that are more than twice as long as their middle width (AP in Fig. 3B) . . . . . *Doddsia occidentalis* Needham & Claassen, 1925

4' Tergum-10 with paired anterior processes less than twice as long as their middle width (AP in Fig. 5B), or without paired anterior processes on tergum-10 and with (PP in Fig. 4A–C) or without paired posterior processes on tergum-9 5

5 Apex of 9th sternal plate sharply upturned medially in lateral and caudal aspects (AS9 in Figs, 4A, C), always lacking paired processes on tergum-10; with (PP in Figs 4A–C) or without paired posterior processes on tergum-9 . . . . . *Strophopteryx* Frison, 1929

5' Apex of 9th sternal plate broadly upturned, scoop shaped (AS9 in Figs 5A–C), usually with paired anterior processes on tergum-10 (AP in Figs 5A–B) (absent in *T. grinnelli* (Banks, 1918)). . . . . *Taenionema* Banks, 1905

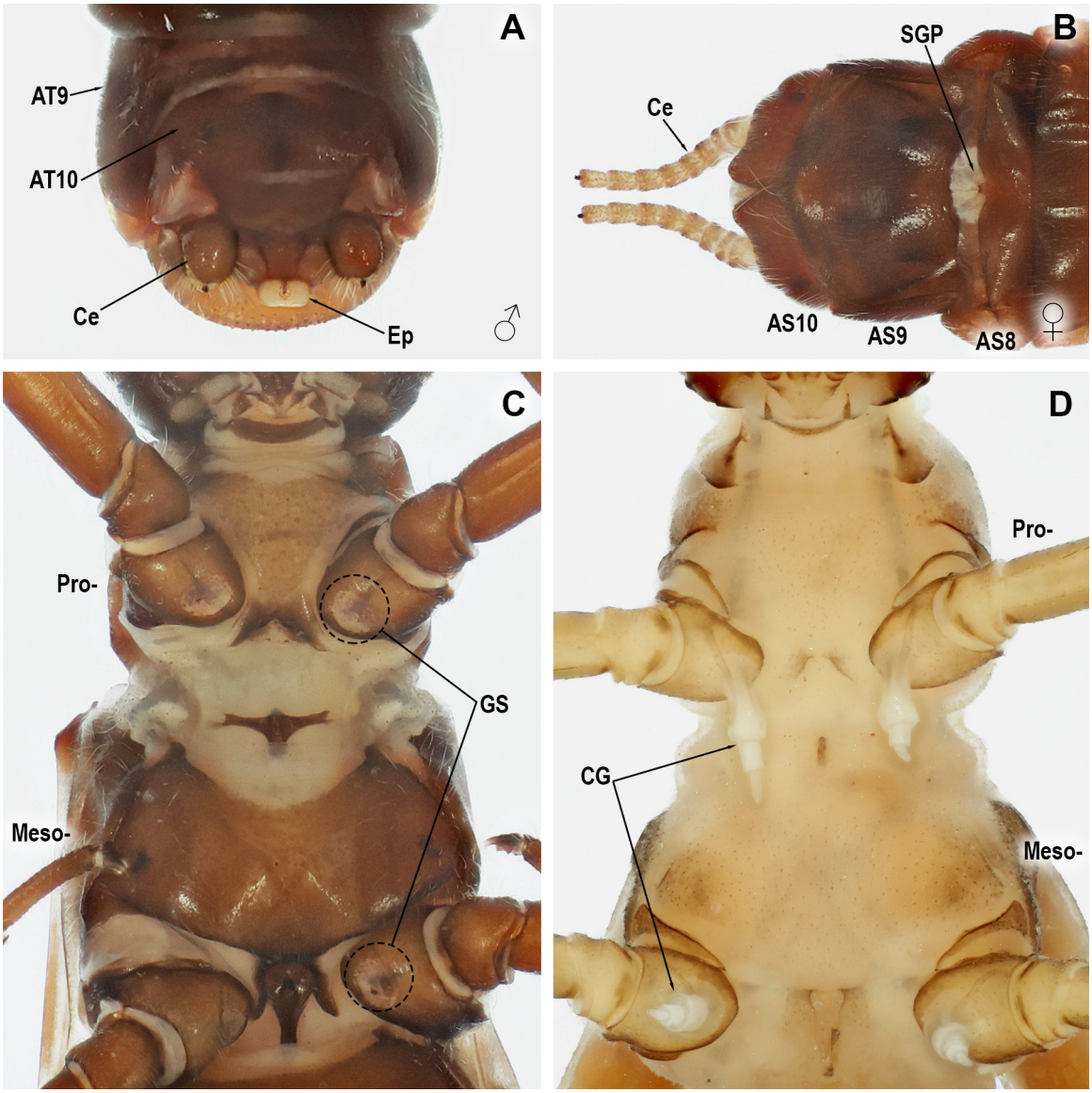

FIGURE 1. *Taeniopteryx* spp. **A–C.** *Taeniopteryx burksi* Ricker & Ross, 1968, Swain Co., North Carolina. **A.** Adult male terminalia, dorsal. **B.** Adult female terminalia, ventral. **C.** Adult thoracic sterna, ventral. **D.** *Taeniopteryx ugola* Ricker & Ross, 1968, Morgan Co., Tennessee, larval thoracic sterna. [morphological abbreviations: see Table 1].

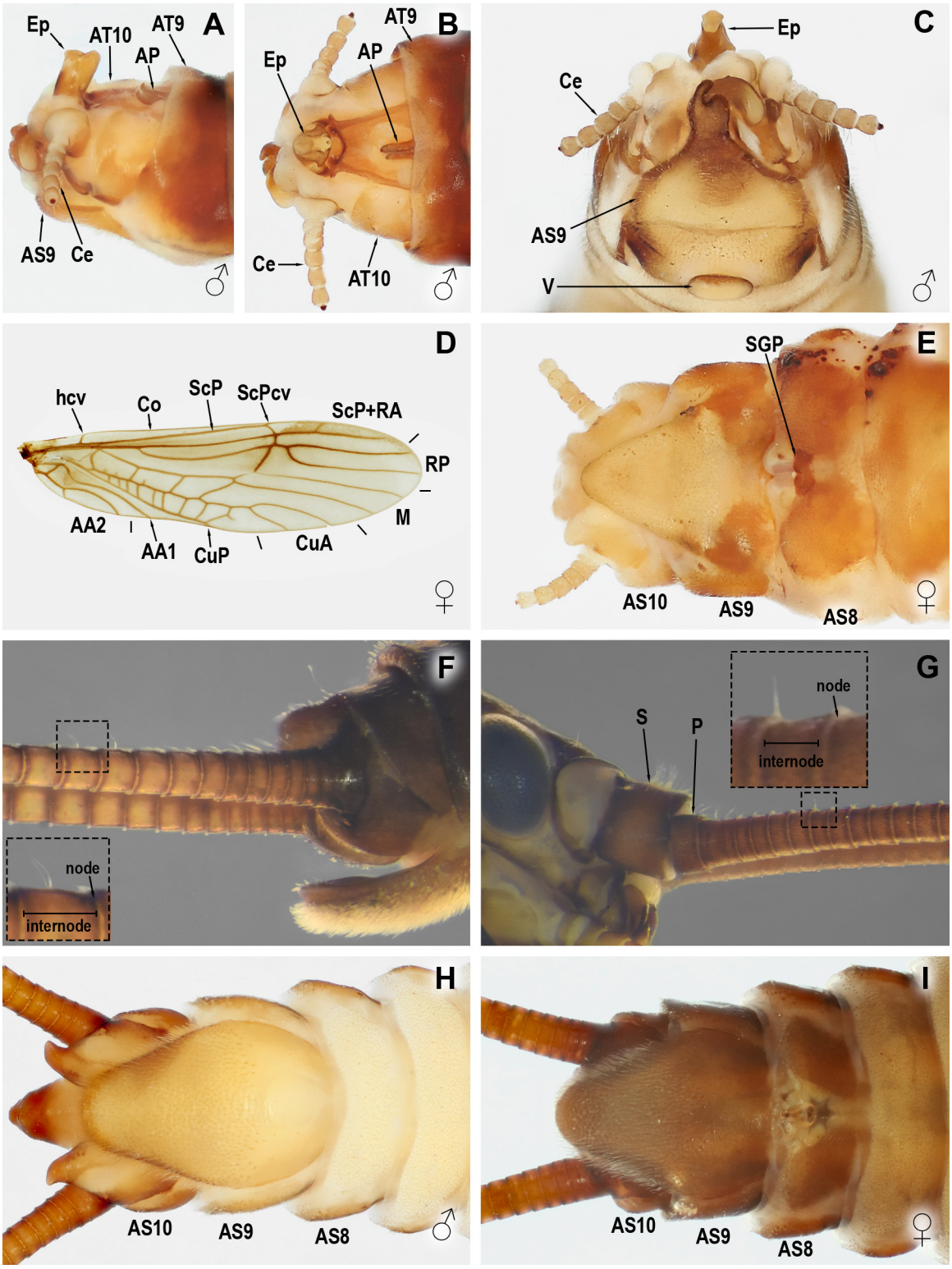

FIGURE 2. *Bolotoperla rossi*. **A–C.** Adult male terminalia, Essex Co., New York. **A.** Lateral. **B.** Dorsal. **C.** Caudal. **D–E.** Adult female, Greenbrier Co., West Virginia. **D.** Forewing. **E.** Terminalia, ventral. **F–G.** Larva, Yancey Co., North Carolina. **F.** Right cercus, lateral. **G.** Right antenna, lateral. **H.** Watauga Co., North Carolina. Larva, male sterna, ventral. **I.** Yancey Co., North Carolina. Larva, female sterna, ventral. [morphological abbreviations: see Table 1].

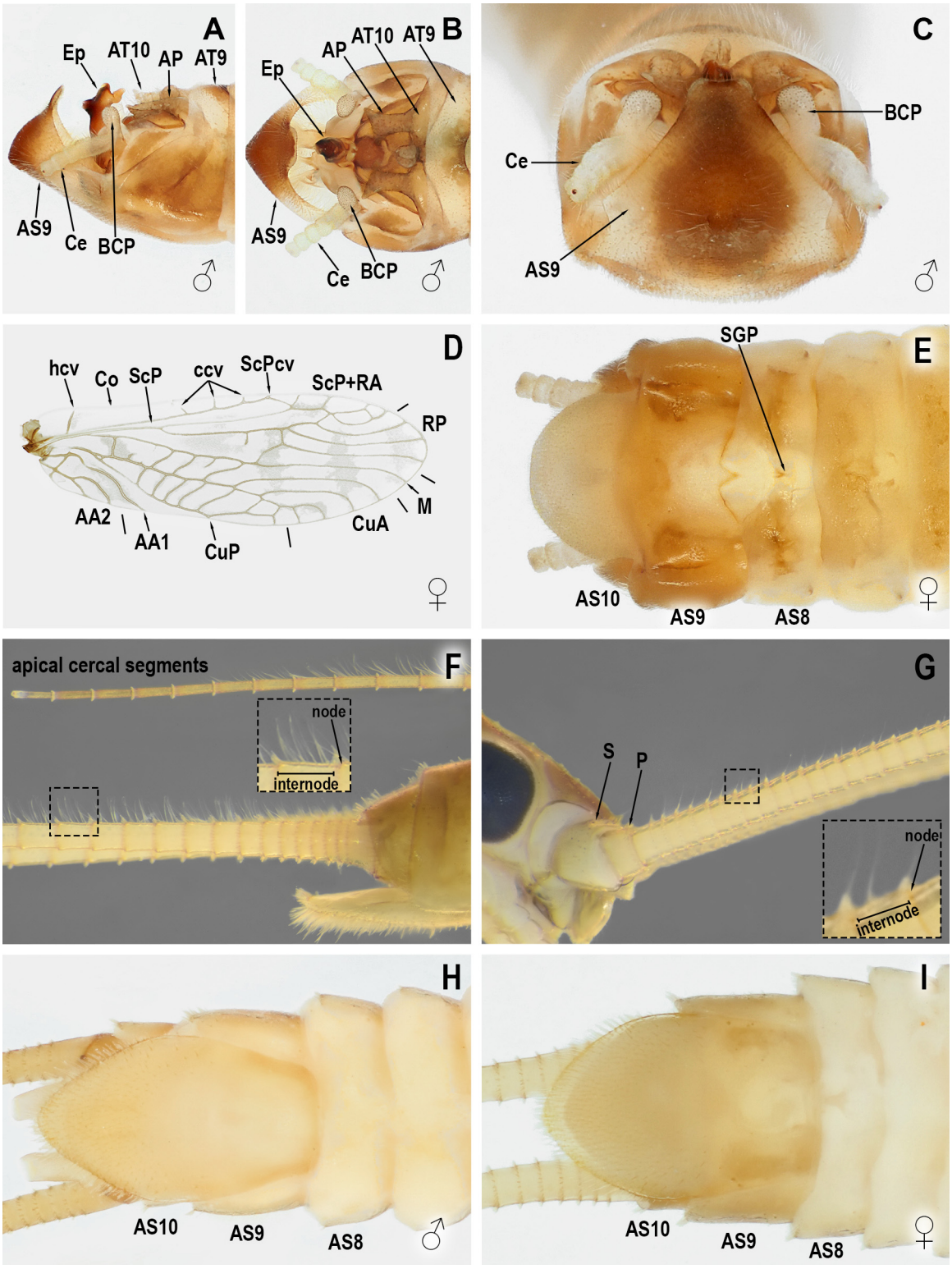

FIGURE 3. *Doddsia occidentalis*, Garfield Co., Colorado. **A–C.** Adult male terminalia. **A.** Lateral. **B.** Dorsal. **C.** Caudal. **D–E.** Adult Female. **D.** Forewing. **E.** Terminalia, ventral. **F–I.** Larva. **F.** Right cercus, lateral. **G.** Right antenna, lateral. **H.** Male sterna, ventral. **I.** Female sterna, ventral. [morphological abbreviations: see Table 1].

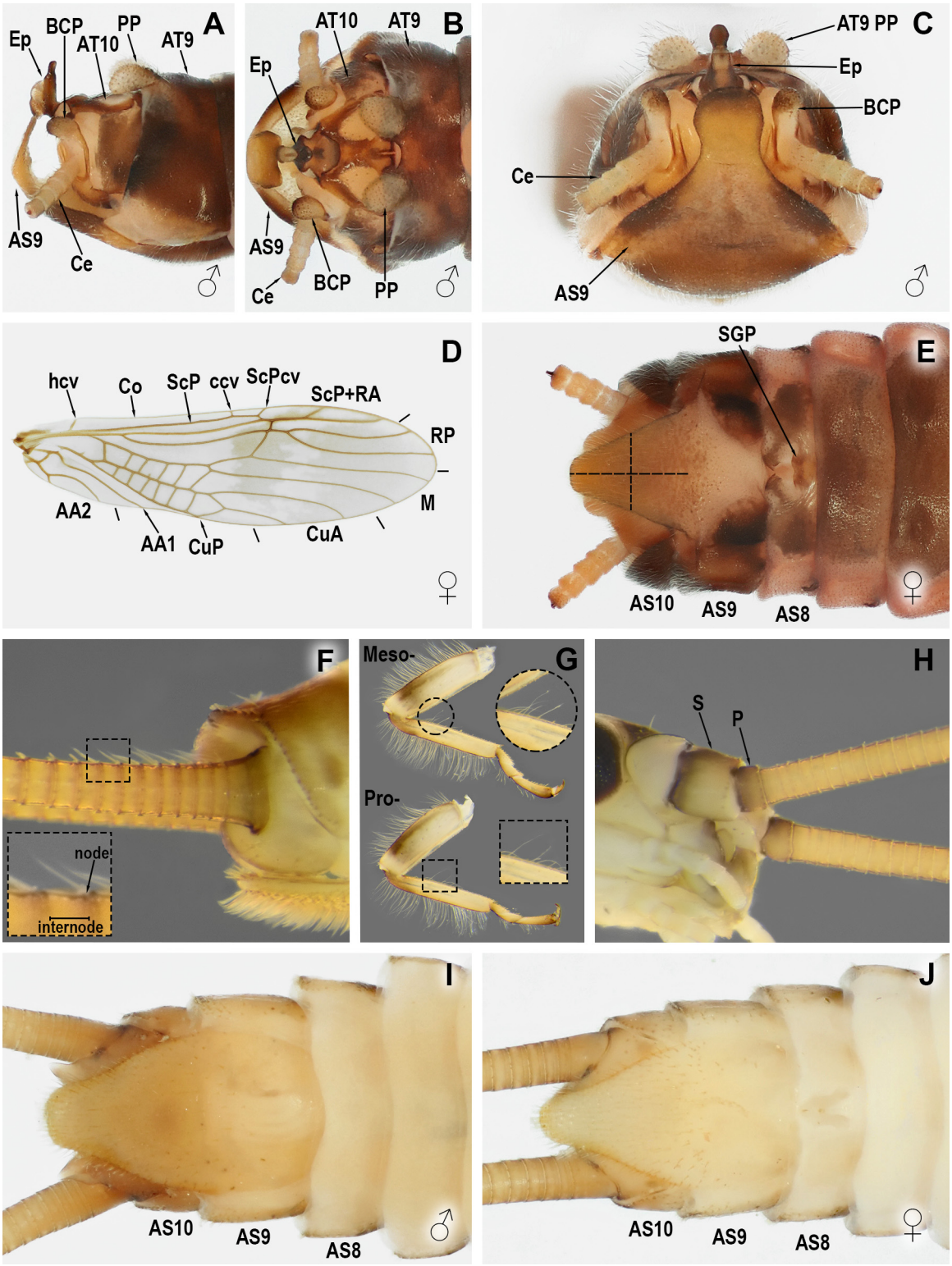

FIGURE 4. *Strophopteryx* spp. **A–E, G, I–J.** *Strophopteryx fasciata* (Burmeister, 1839), Madison Co., North Carolina. **A–C.** Adult male terminalia. **A.** Lateral. **B.** Dorsal. **C.** Caudal. **D–E.** Adult female. **D.** Forewing. **E.** Terminalia, ventral. **F.** *Strophopteryx arkansae* Ricker & Ross, 1975, Durham Co., North Carolina, larva, right cercus, lateral. **G.** Larva, pro- and mesothoracic legs, anterior. **H.** *Strophopteryx arkansae*, larva, right antenna, lateral. **I.** Male sterna, ventral. **J.** Female sterna, ventral. [morphological abbreviations: see Table 1].

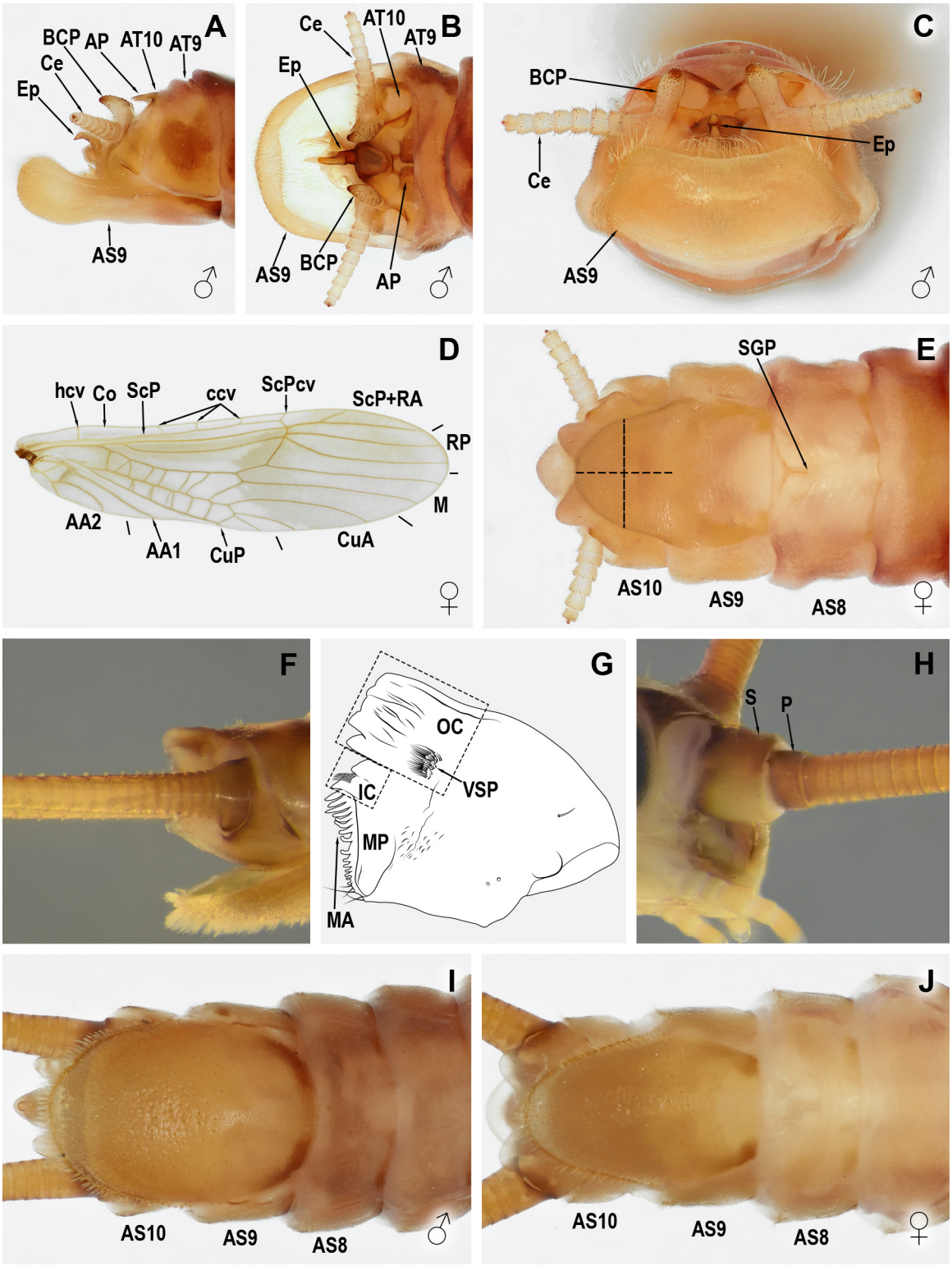

FIGURE 5. *Taenionema atlanticum* Ricker & Ross, 1975, Swain Co., North Carolina **A–C.** Adult male terminalia. **A.** Lateral. **B.** Dorsal. **C.** Caudal. **D–E.** Adult Female. **D.** Forewing. **E.** Terminalia, ventral. **F–J.** Larva. **F.** Right antenna, lateral. **G.** Left mandible, ventral. **H.** Right antenna, lateral. **I.** Male sterna, ventral. **J.** Female sterna, ventral. [morphological abbreviations: see Table 1].

Taeniopterygidae genera adult female key

1 Each coxa with gill scars (GS in Fig. 1C); ninth sternum only extending to base of paraprocts (AS9 in Fig. 1B). . . . . *Taeniopteryx* Pictet, 1841
1' Each coxa without gill scars; ninth sternum extending well beyond base of paraprocts (AS9 in Figs 2E, 3E, 4E, 5E, 8E, 15E, 21E, 28E, 34E, 40E, 45E). 2
2 Forewing without costal crossveins between humeral crossvein and the apical posterior subcostal crossvein (Figs 2D, 8D, 15D, 21D, 28D, 34D, 40D, 45D) 3
2' Forewing with 1–5 costal crossveins between humeral crossvein and the apical posterior subcostal crossvein (ccv in Figs 3D, 4D, 5D). 4
3 Sternum-9 triangular, evenly tapering from base; free portion of sternum-9 usually pale (AS9 in Fig. 2E). . . . . *Bolotoperla rossi* Ricker & Ross, 1975
3' Sternum-9 parabolic; free portion of sternum-9 usually brown (AS9 in Figs 8E, 10A, 15E, 17A, 21E, 23A, 28E, 30A, 34E, 36A, 40E, 42A, 45E, 47A) . . . . . *Oemopteryx* Klapálek, 1902
4 Posterior Radius vein of forewing with 3–4 branches (RP in Fig. 3D) and anterior Cubitus vein with 4–5 branches (CuA in Fig. 3D) . . . . . *Doddsia occidentalis* Needham & Claassen, 1925
4' Posterior Radius vein of forewing wing with 2–4 branches (RP in Figs 4D, 5D) and anterior Cubitus vein with 2–3 branches (CuP in Figs 4D, 5D) 5
5 Length of free portion of sternum-9 at least as long as middle width of free portion (AS9 in Fig. 4E) . . . . . *Strophopteryx* Frison, 1929
5' Length of free portion of sternum-9 less than middle width of free portion (AS9 in Fig. 5E) . . . . . *Taenionema* Banks, 1905

Taeniopterygidae genera larval key

1 Single telescopic segmented gill present on each coxa (CG in Fig. 1D) . . . . . *Taeniopteryx* Pictet, 1841
1' Coxal gills absent 2
2 Cercus with internodal setal fringe (Fig. 3F), or only a single or several setae on internodal surface (Fig. 2F). 3
2' Cercus without internodal setae (Figs 5F, 11B, 18B, 24B, 48B), if setae present, inserted apically only (Figs 5F, 31B, 37B, 43 B) 4
3 Cercus with well-developed internodal setal fringe that extends to last 4–5 apical segments (Fig. 3F); antenna (excluding scape, pedicel and first flagellum) with a single or several internodal setae (Fig. 3G) . . . . . *Doddsia occidentalis* Needham & Claassen, 1925
3' Cercus with a single or several internodal setae on basal and middle flagella (Fig. 2F); basal antennal segments (excluding scape, pedicel and first flagellum) with setae inserted apically only (Fig. 2G) . . . . . *Bolotoperla rossi* Ricker & Ross, 1975
4 Basal antennal segments (excluding scape, pedicel and first flagellum) (Figs 31B, 37B, 43B) and basal cercal segments with apically inserted setae (Figs 31C, 37C, 43C), or both absent (Figs 5F, 5H, 11B–C, 18B–C, 24B–C, 48B–C); lateral margins of 9th sternal plate usually convex at apical 1/3 (AS9 in Figs 5I–J, 11F–G, 18F–G, 24F–G, 43F–G, 48F–G, 31G–H, 37G–H); without an inner tibial fringe on pro- and meso-thoracic legs 5
4' Basal antennal segments without a fringe of apically inserted setae (Fig. 4H); basal cercal segments usually with apically inserted setae (Fig. 4F); lateral margins of 9th sternal plate usually concave at apical 1/3 (AS9 in Figs 4I–J); with (Fig. 4G) or without an inner tibial fringe on pro- and meso-thoracic legs . . . . . *Strophopteryx* Frison, 1929
[NOTE: For couplet-5, the left mandible needs to be slide mounted ventral side up. Left and right are determined by viewing the specimen dorsally, with the head pointing away from the observer.]
5 Ventro-apical patch of setae on left mandible extending proximally to, or past, base of the basal tooth of outer cusp (VSP in Figs 12D, 19D, 25D, 32D, 38D, 44D, 49D). . . . . *Oemopteryx* Klapálek, 1902
5' Ventro-apical patch of setae on left mandible not extending proximally to base of the basal tooth of outer cusp (VSP in Fig. 5G), or patch absent . . . . . *Taenionema* Banks, 1905

Oemopteryx species adult male key

1 Forewing brachypterous (Figs 28A, 34A), vesicle absent (AS9 in Figs 28C, 34C) 2
1' Forewing macropterous (Figs 8D, 15D, 21D, 40D, 45D), vesicle present (AS9/V in Figs 8C, 15C, 21C, 40C, 45C) 3
2 Upturned portion of forewing >1/3 total wing length (Fig. 28A circle inset); medial apical lobe of anterior epiproct >1/3 epiproct width (AEp in Figs 29A–B); apical lobes of posterior epiproct divided by a deep furrow (PEp in Figs 29A–B); free portion of sternum-9 with rounded lateral margins ventrally (AS9 in Fig. 28C). . . . . *Oemopteryx fosketti* (Ricker, 1965) (Canada: AB, SK, MB. USA: CO, UT, MT, ND, WY)
2' Upturned portion of forewing <1/3 total wing length (Fig. 34A circle inset); medial apical lobe of anterior epiproct <1/3 epiproct width (AEp in Figs 35A–B); apical lobes of posterior epiproct not divided by a deep furrow (PEp in Figs 35A–B); free portion of sternum-9 with straight lateral margins ventrally (AS9 in Fig. 34C) . . . . . *Oemopteryx glacialis* (Barnston, 1848) (Canada: NB, NS, ON, QC. USA: CT, MA, MI, MN, NH, NY, VT, WI, WV)

3 Basal plate of tergum-10 with two prominent hemispherical lobes (BP in Figs 41A–B, 46A, C); anterior prong of epiproct entire (AEp in Figs 41A–E, 46A–B) 4
3’ Basal plate of tergum-10 essentially flat (BP in Figs 9A–B, 16A, 16C, 22A, 22C); anterior prong of epiproct apically divided (AEp in Figs 9A–B, 9E, 16A–B, 16E, 22A–B, 22E) 5
4 Anterior prong of epiproct broadly spatulate with a medial depression in dorsal aspect (AEp in Figs 46A–B); basal cercal process anteriorly directed (BCP in Figs 46A, D) . . . . . *Oemopteryx vanduzeea* (Claassen, 1937) (USA: CA)
4’ Anterior prong of epiproct with a hood-like tip (AEp in Figs 41A–E); basal cercal process dorsally directed with a pointed, posteriorly directed apex (BCP in Figs 41A, 41D) . . . . . *Oemopteryx leei* Baumann & Kondratieff, 2009 (USA: CA, OR)
5 Paired anterior processes on tergum-10 present (AP in Figs 9A, 9C, 16A, 16C) 6
5’ Paired anterior processes on tergum-10 absent (Figs 22A, 22C); abdominal tergum-1 with a U-shaped pale area (AT1 in Fig. 20B) . . . . . *Oemopteryx tuscarora* **sp. nov.** Verdone, Beaty, Holland & Williams (USA: NC; Sand Hills Level IV ecoregion)
6 Abdominal tergum-1 sclerotized with two submedial pale spots anteriorly, which may be contiguous medially (AT1 in Fig. 7B) . . . . . *Oemopteryx bimaculata* **sp. nov.** Verdone, Williams, Beaty & Holland (USA: AL, GA, KY, TN, WV; Central & Southwestern Appalachians Level III ecoregions)
6’ Abdominal tergum-1 pale medially from anterior to posterior margin (AT 1 in Fig. 14B) . . . . . *Oemopteryx contorta* (Needham & Claassen, 1925) (USA: CT, MA, MD, ME, NC, NH, PA, TN, VA, WV)

Oemopteryx species adult female key

1 Subgenital plate moderately produced posteriorly, sometimes emarginated with a concave or truncate margin (SGP in Figs 28E, 30A–B, 34E, 36A–B, 40E, 42A–B, 45E, 47A–B) 2
1’ Subgenital plate not produced posteriorly (SGP in Figs 8E, 10A–B, 15E, 17A–B, 21E, 23A–B) 5
2 Long fine setae ≥1mm extending to base of AA1 vein (Fig. 28F) . . . . . *Oemopteryx fosketti* (Ricker, 1965) (Canada: AB, SK, MB. USA: CO, UT, MT, ND, WY)
2’ AA1 vein of forewing with short fine setae ≤0.5mm (Fig. 40F, 45F), or if long setae present, not extending to base (Fig. 34F) 3
3 Subgenital plate with a narrow U-shaped notch medially (SGP in Figs 40E, 42A–B) . . . . . *Oemopteryx leei* Baumann & Kondratieff, 2009 (USA: CA, OR)
3’ Subgenital plate with a broad, shallow concave posterior margin or nearly entire (SGP in Figs 34E, 36A–B, 45E, 47A–B) 4
4 Subgenital plate moderately sclerotized throughout (SGP in Fig. 45E) . . . . . *Oemopteryx vanduzeea* (Claassen, 1937) (USA: CA)
4’ Subgenital plate with a moderately sclerotized triangular area medially, otherwise lightly sclerotized (SGP in Fig. 34E) . . . . . *Oemopteryx glacialis* (Barnston, 1848) (Canada: NB, NS, ON, QC. USA: CT, MA, MI, MN, NH, NY, VT, WI, WV)
5 Abdominal tergum-1 with a U-shaped pale area (AT1 in Fig. 20C) . . . . . *Oemopteryx tuscarora* **sp. nov.** Verdone, Beaty, Holland & Williams (USA: NC; Sand Hills Level IV ecoregion)
5’ Tergum-1 not as above (AT1 in Figs 7C, 14C) 6
6 Abdominal tergum-1 sclerotized with two submedial pale spots anteriorly (AT1 in Fig. 7C) . . . . . *Oemopteryx bimaculata* **sp. nov.** Verdone, Williams, Beaty & Holland (USA: AL, GA, KY, TN, WV; Central & Southwestern Appalachians Level III ecoregions)
6’ Abdominal tergum-1 pale medially from anterior to posterior margin (AT1 in Fig. 14C) . . . . . *Oemopteryx contorta* (Needham & Claassen, 1925) (USA: CT, MA, MD, ME, NC, NH, PA, TN, VA, WV)

Oemopteryx species larval key

1 Basal segments of cercus (Figs 31B, 37B, 43B) and antenna with a few dorsal apically inserted setae (Figs 31C, 37C, 43C) 2
1’ Basal segments of cercus (Figs 11B, 18B, 24B, 48B) and antenna without dorsal apically inserted setae (Figs 11C, 18C, 24C, 48C) 4
2 Maxillary palp with long hair-like sensillae on distal margins of segments 3–4 (PS in Figs 44A–B circle and square insets) . . . . . *Oemopteryx leei* Baumann & Kondratieff, 2009 (USA: CA, OR)
2’ Maxillary palp without long hair-like sensillae (Figs 32A–B, 38A–B) 3
3 Tarsal segment-3 brown (Fig. 37D), abdominal sterna 7–8 with conspicuous sensillae in lateral aspect (AS8/SB in Fig. 37F circle inset) . . . . . *Oemopteryx glacialis* (Barnston, 1848) (Canada: NB, NS, ON, QC. USA: CT, MA, MI, MN, NH, NY, VT, WI, WV)
3’ Tarsal segment-3 pale (Fig. 31D), abdominal sterna 7–8 lacking conspicuous sensillae (AS7/AS8 in Fig. 31F) . . . . . *Oemopteryx fosketti* (Ricker, 1965) (Canada: AB, SK, MB. USA: CO, UT, MT, ND, WY)
4 Ninth sternum with an acute nipple-like projection at its apex (AS9 in Figs 48F–G) . . . . . *Oemopteryx vanduzeea* (Claassen, 1937) (USA: CA)
4’ Ninth sternum without an acute nipple-like projection at its apex (AS9 in Figs 11F–G, 18F–G, 24F–G) 5

5 Tibial callus pale (TC in Fig. 24D). . . . . *Oemopteryx tuscarora* **sp. nov.** Verdone, Beaty, Holland & Williams (USA: NC; Sand Hills Level IV ecoregion)

5’ Tibial callus darkened (TC in Figs 11D, 18D) 6

6 Abdominal terga usually subtly or distinctly banded (Fig. 11E); occurs in the Southwestern Appalachians and Central Appalachians Level III ecoregions into the Dissected Appalachian Plateau Level IV ecoregion (Fig. 6) . . . . . *Oemopteryx bimaculata* **sp. nov.** Verdone, Williams, Beaty, Holland (USA: AL, GA, KY, TN, WV)

6’ Abdominal terga usually uniformly brown (Fig. 18E); occurs in ecoregions east and north of the Southwestern Appalachians and Central Appalachians Level III ecoregions, if in the Central Appalachians then north or east of the Dissected Appalachian Plateau Level IV ecoregion (Fig. 6) . . . . . *Oemopteryx contorta* (Needham & Claassen, 1925) (USA: CT, MA, MD, ME, NC, NH, PA, TN, VA, WV)

Generic Description

Oemopteryx Klapálek, 1902

(Figs 7–12, 14–25, 28–32, 34–38, 40–49)

Type species: *Taeniopteryx loewii* Albarda, 1889.
Oemopteryx Klapálek, 1902: 179.
Oemopteryx: Klapálek 1909: 59.
Taeniopteryx (*Oemopteryx*): Hanson 1938: 79.
Oemopteryx: Illies 1966: 62.
Oemopteryx: Zwick 1973: 313.
Oemopteryx: Stewart & Stark 2002: 232.
Oemopteryx: Zhiltzova 2003: 131.
Oemopteryx: Fochetti & Tierno de Figueroa 2006: 2363.
Oemopteryx: Baumann & Kondratieff 2009b: 221.

Adult male (Figs 7A, 8A, 15A, 21A, 28A, 34A, 40A, 45A). Brachypterous or macropterous. Length of forewings 1.7–8.8 mm (n = 66). Length of body 6.0–10.4 mm (n = 66). General body color dark-brown.

Head (Figs 7A, 8A, 15A, 21A, 28A, 34A, 40A, 45A). Dorsum of head light-brown to dark-brown. Labrum pale anteriorly, brown posteriorly or with brown spots. Anterior frontoclypeus light-brown to brown. Frons with a dark-brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella light-brown, yellow-brown to dark-brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Rugosities or pale area anterolateral to lateral ocelli and ecdysial suture. Interocellar area light-brown to dark-brown and slightly depressed. Occasionally with a pale stripe spanning area between eyes across lateral ocelli and interocellar space. Occiput with brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Figs 7A, 8A, 15A, 21A, 28A, 34A, 40A, 45A). Pronotum subquadrate, wider than long (length 0.75–0.85X width) with posterior width slightly wider than anterior width; brown overall with brown rugosities or with a pale medial triangular area that widens posteriorly. Anterior and posterior margins of pronotal flange often pale. Disk with irregular brown rugosities; with or without a transverse sinuous furrow at anterior 1/4. Prosternum moderately sclerotized. Meso- and metathorax dark-brown, lightly to heavily sclerotized dorsally and ventrally. Mesonotum with or without a pale anteromedial spot. Thoracic nota and coxae uniformly covered with sparse, short, fine clothing hairs and with or without longer brown setae. Legs with or without contrasting pigment. Femur pale, distal portion of femur with darker pigment, or with an incomplete mottled brown stripe antero- and posterodorsally. Tibia brown, darker brown on proximal and distal portions, or with proximal callus pale; apex of tibiae with 2-stout apical spines. Tarsus pale to dark-brown. Legs uniformly covered with dark, short stout setae. Forewings brachypterous, extending to posterior margin of tergum-1 with apex acutely pointed, or macropterous; hyaline; venation brown; forewing with or without light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked. Hindwing mottling minimally developed or absent, absent in anal region.

Abdomen. First abdominal tergite either uniformly sclerotized or with a pale stripe (Fig. 14A), a U-shaped pale area (Fig. 20A), or paired spots (Fig. 7A). Abdominal segments 1–9 lightly covered with short, fine clothing hairs. Terga 2–6 uniformly brown; terga 6–9 with or without a well-defined posteromedial membranous cleft. Sterna 1–9 or 2–8 with a pair of anterior sublateral oval brown spots. Sternum-9 with (Figs 8C, 15C, 21C, 40C, 45C) or without (Figs 28C, 34C) a lightly sclerotized vesicle. Sterna 7–8 lightly sclerotized. Sternum-9 elongated into a scooped

plate, lateral margins straight (Figs 8C, 15C, 21C, 34C, 40C, 45C) or with rounded lateral margins (Fig. 28C); plate with numerous long setae on dorsal and ventral surfaces; plate covering sternum-10 ventrally and extending beyond.

Terminalia (Figs 9A, 9D, 16A. 16D, 22A, 22D, 29A, 29D, 35A, 35D, 41A, 41D, 46A, 46D). Abdominal segment-10 nested within segment-9. Anterior margin unsclerotized. Tergal sclerite-10 with a subtle medial cleft and with (Figs 9A, 9C, 16A, 16C) or without (Figs 22A. 22C, 29A, 29C, 35A, 35 C, 41A, 41C, 46A, 46C,) paired anterior processes with raised scale-like armature. Cercus 3–7 segmented (Figs 9A, 9D, 16A, 16D, 22A, 22D, 29A, 29D, 35A, 35D, 41A, 41D, 46A, 46D), excluding vestigial apical segment, and with posteriorly or anteriorly directed basalcercal process covered in socketed setae and sensilla basiconica (Figs 9A, 9D, 16A, 16a, 16D, 22A, 22D 29A, 29D 35A, 35D, 41A, 41D, 46A, 46D). Basal plate of tergum-10 relatively flat (Figs 9A, 16A, 22A, 29A, 35A), or produced into paired lobes (Figs 41A–C, 46A, 46C). Lateral struts present (Figs 9A, 9C, 16A, 16C, 22A, 29A, 35A, 35C, 41A, 46A–C), median strut present (Figs 29A, 29C, 35A, 35C, 46A–C), or absent with a small medial point (Figs 9A, 9C, 16A, 16C, 22A). Basal bulb, glabrous (Figs 9A–B, 9E, 16A–B, 22A–B, 22D–E, 41A–B, 41D–E, 46A–C) or covered in minute raised armature (Figs 29A–B, 29E, 35A, 35C), oval, bulbous, moderately sclerotized and with or without an obvious oval inner bulb bearing a small hollow stalk, which terminates at a pore on the anterior face of the anterior epiproct prong. Anterior epiproct prong fused to basal bulb, entire (Figs 29A–B, 29D–E, 35A–B, 35D–E, 41A–B, 41D–E, 46A–B, 46D–E) or divided halfway to base (Figs 9A–B, 9E, 16A–B, 16E, 22A–B, 22E). Posterior epiproct prong subdivided into 2-processes; ventral process lightly sclerotized, entire (Figs 29A–B, 29D–E, 35A–B, 35D–E, 41A–B, 41D–E, 46A–B, 46D–E) or divided near apex into 2-rounded lobes (Figs 9A–B, 9D–E, 16A, 16D–E, 22A–B, 22D–E); dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing 1–3 internal filament(s) (Figs 35B, 35E, 41B, 41E, 46B, 46E); filament(s) sometimes visible on left side of basal bulb. Paraprocts subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical bi-lobed posterior paraprocts. Anterior paraprocts medially directed, minute and lightly sclerotized (Fig. 46D) or subrectangular (Figs 29A, 35A–B) or conical and well-sclerotized (Figs 9A–B, 9D–E, 16A–B, 16D, 22A–B). Posterior paraprocts subdivided, multi-lobed, variable in appearance, fused at base (variously visible in Figs 9A, 16A, 22A, 29A, 41A, 46A; not visible in Figs 35A–E).

Adult female (Figs 8B, 14A, 15B, 20A, 21B, 28B, 34B, 40B, 45B). Macropterous. Length of forewings 7.6–14.7 mm (n = 66). Length of body 5.7–13.2 mm (n = 70). General body color brown. Appearance generally similar to male. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Figs 8D, 15D, 21D, 28D, 34D, 40, 45D). AA1 vein of forewing with long fine setae ≥1.0 mm (Fig. 28F) or short setae (Figs 8F, 15F, 21F, 34F, 40F, 45F). Hindwing mottling reduced or absent (Figs 8D, 15D, 21D, 28D, 34D, 40D, 45D). Abdominal tergites either unmodified and lightly sclerotized or with contrasting pigment patterns on the first abdominal tergum (Figs 7, 14, 20 C); lateral margins of abdomen segments 1–8 unsclerotized. Sternum-8 weakly sclerotized (Figs 8E, 15E, 21E, 28E, 34E, 40E, 45E). Terga 9–10 sclerotized dorsally and laterally. Subgenital plate weakly to moderately sclerotized (Figs 8E, 15E, 21E, 28E, 34E, 40E, 45E), produced posteriorly with a posterior notch (Fig. 40E, 42A–B), without a notch (Figs 30A–B, 36A–B, 42A–B, 47A–B) or not produced posteriorly (Figs 10A–B, 17A–B, 23A–B). Sternum-9 parabolic (Figs 8E, 10A–B, 15E, 17A–B, 21E, 23A–B, 28E, 30A–B, 34E, 36A–B, 40E, 42A–B, 45E, 47 A–B), produced just beyond the apex of abdominal segment-10; length of free portion of sternum-9 0.7–1.0X basal width; uniformly covered with long setae that are longer posteriorly; lateral margins slightly narrowing to a rounded apex. Cercus 4–8 segmented, excluding vestigial apical segment (Figs 8E, 10A, 17A, 15E, 21E, 23A, 28E, 30A, 34E, 36A, 40E, 42A, 45 E, 47A).

Ovum. Unknown.

Mature larva (Figs 11A, 18A, 24A, 31A, 37A, 43A, 48A). Length of male body 6.4–10.9 mm (n = 40), female body 6.8–13.3 mm (n = 51). General color light-brown to brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture with the head touching or approaching the abdomen apex, similar to other Taeniopterygidae.

Head (Figs 11A, 18A, 24A, 31A, 37A, 43A, 48A). Dorsum of head light-brown to brown with darker brown maculations variously developed. Antelabrum pale to brown; anterior margin with a dense brush of golden setae. Postlabrum pale to brown. Anterior frontoclypeus pale to brown. Frons with or without a brown U-shaped marking with posterolateral extensions; often with light-brown subrectangular markings directly anterior to lateral ocelli. Interocellar area diffusely light-brown to brown. Occipital area light-brown to brown and with irregular brown rugosities. Eyes with pigmented ommatidia sometimes reduced, not reaching eye margins. Antennal scape brown (Figs 11C, 18C, 24C, 31C, 37C, 43C, 48C); scape and flagella light-brown to brown; dorsobasal apically inserted

setae present (Figs 31C, 37C, 43C) or absent (Figs 11C, 18C, 24C, 48C); antenna slightly shorter than body (Figs 11A, 18A, 24A, 31A, 37A, 43A, 48A).

Maxilla (Figs 12A–B, 19A–B, 25A–B, 32A–B, 38A–B, 44A–B, 49A–B). Lacinia triangular with a straight, convex or sinuous inner margin. Lacinia with 2-apical, cupped teeth and 1–7 subapical denticle(s) on ventral face (SD in Fig. 12B square inset). Apical teeth subequal in length; relative length of apical teeth to palm length difficult to discern due to wear. Inner palm margin with 10–19 stout socketed marginal setae below apical teeth; first marginal seta robust. Basal 1/3 of palm with a cluster of 6–10 thin dorsal setae. Acutely pointed sensilla basiconica on various locations on palm surface. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 1/4; a thin patch of setae on inner margin below apical setae, which extends about 1/2–2/3 to base. Length of galea, including apical setae 1.1–1.3X length of lacinia; width of galea 0.8–1.3X the lacinia width. Maxillary palp with 5-segments; 1.7–2.2X length of lacinia; palp with sensilla basiconica variously developed.

Mandible. Right mandible (Figs 12C, 19C, 25C, 32C, 38C, 44C, 49C) bicuspid, outer cusp with 2–3 teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of pointed acanthae (length 1.0–2.1X width). Palm dorsum with 1–11 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Figs 12C, 19C, 25C, 32C, 38C, 44C, 49C square inset); proximal basal corner with a marginal patch of 3–5 hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Figs 12C, 19C, 25C, 32C, 38C, 44C, 49C). Left mandible (Figs 12D, 19D, 25D, 32D, 38D, 44D, 49D) bicuspid, outer cusp with 4–5 teeth, inner cusp with 5-tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 2.0–4.5X width). Palm dorsum with 1–12 dorsal sensillae adjacent to molar pad (Figs 12D, 19D, 25D, 32D, 38D, 44D, 49D circle inset); proximal basal corner with a marginal patch of 3–5 hair-like, branched setae. Ventral palm setae extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Figs 12D, 19D, 25D, 32D, 38D, 44D, 49D)

Thorax (Figs 11A, 18A, 24A, 31A, 37A, 43A, 48A). Pronotum wider posteriorly; light-brown with faint rugosities and with or without a pale posteromedial spot. Length of forewing pad 1.0–3.9X width. Length of hindwing pad 1.8–2.0X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with light-brown spicules laterally and a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules dense medially and sporadic distally, or absent. Mesothorax with an oval prefurcasternal pit; light-brown spicules present both anterior and posterior to pit; lateral areas glabrous. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular (length 0.5–1.2 width). Metathoracic basisterna with a medial patch of light-brown spicules and a pair of furcasternal pits. Femur and tibia pale to light-brown (Figs 11D, 18D, 24D, 31D, 37D, 43D, 48D) and with a fringe of silky setae (not shown); length of femoral setae 0.5–1.5X width of the femur; length of tibial setae about 1.0–1.4X tibial width. Anterior and posterior faces of the femur with scattered short stout setae. Tibial callus, an area of thickened integument on the proximal end of the tibia, pale or darkened (Figs 11D, 18D, 24D, 31D, 37D, 43D, 48D). Tarsus with a sparse dorsal fringe of silky setae (not shown); tarsus entirely pale or light-brown and becoming progressively darker distally. Venter of tibia and tarsus with scattered short stout setae.

Abdomen (Figs 11E, 18E, 24E, 31E, 37E, 43E, 48E). Dorsum of abdomen uniformly light-brown to brown. Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of tergum-8 and tergum-9 or terga 8–10 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 1–8 with light-brown spicules. Sternum-9 with an elongate plate (male = length 1.4–1.7X width; female = length 1.5–1.9X width); plate width relative to sternal width (male = 0.7–0.9X; female = 0.7–0.8X). Male plate (Figs 11F, 18F, 24F, 31F, 37F, 43F, 48F) with sides slightly widening towards posterior margin of sternum-9, posterolateral margins convex, evenly rounded towards apex. Female plate (Figs 11G, 18G, 24G, 31G, 37G, 43G, 48G) narrower basally, widest at posterior margin of sternum-9; posterolateral margins linear or convex, evenly narrowing towards apex. Plates of both males and females with stout setae sparse on basal half, becoming denser towards apex. Cercus uniformly light-brown to brown; dorsobasal apically inserted setae absent; cercus about as long as body (Figs 11A, 18A, 24A, 31A, 37A, 43A, 48A).

Diagnosis. The genus *Oemopteryx* is defined in the adult male by the epiproct being composed of two prongs. Females are distinguished by their parabolic 9th sternum and the forewing lacking costal crossveins between the humeral crossvein and the apical crossvein of the posterior Subcosta. The larvae are differentiated by having both basal cercal and antennal segments with apically inserted setae, or having both absent; the lateral margins of the 9th

sternal plate usually convex at the apical 1/3; the lack of an inner tibial fringe on pro- and meso-thoracic legs and the ventro-apical patch of setae on the left mandible extends proximally to, or past the base of the basal tooth of the outer cusp.

Biological notes. Nearctic *Oemopteryx* larvae are found in small upland streams in the Appalachians, Sierra Nevada, and Cascades, as well as larger rivers across Canada's Atlantic, Central, and Prairie provinces, and the U.S. Northeast, Upper Midwest, and Rocky Mountain plateaus. A univoltine life cycle and larval diapause has been hypothesized for four species based on life history studies (Dosdall & Lehmkuhl 1979, Nelson 1982, Harper *et al.* 1991). Larvae are usually present from October through April and are most commonly found in gravel riffles. Mouthpart morphology and wear suggests *Oemopteryx* larvae are scrappers. Adults can be active from mid-January to mid-June depending on elevation and latitude.

Nearctic *Oemopteryx* morphological species groups

The *Oemopteryx contorta* Group

The *Oemopteryx contorta* Group includes *O. bimaculata* **sp. nov.**, *O. contorta,* and *O. tuscarora* **sp. nov.** Species of this group have larvae without dorsobasal apically inserted setae on the antenna and cercus (Figs 11B–C, 18B–C, 24B–C) and lack maxillary palp setae (Figs 12A–B, 19A–B, 25A–B). Adult males have a broadly circular vesicle on sternum-9 (Figs 8C, 15C, 21C) that is attached to sternum-9 from beneath the vesicle; an anterior epiproct prong that is divided apically (Figs 9A–B, 9E, 16A–B, 16E, 22A–B, 22E) and a basal plate of tergum-10 that lacks lobes and a median strut (Figs 9A, 9C, 16A, 16C, 22A). Additionally, males have low, rounded, posteriorly directed basal cercal processes (Figs 9A, 9D, 16A, 16D, 22A, 22D). The subgenital plate of the females is not produced posteriorly (Figs 10A–B, 17A–B, 23A–B).

The *Oemopteryx glacialis* Group

The *Oemopteryx glacialis* Group includes *O. fosketti* and *O. glacialis.* Species of this group have larvae with dorsobasal apically inserted setae on the cercus and antenna (Figs 31B–C, 37B–C), but lack maxillary palp setae (Figs 32A–B, 38A–B). Adult males have short, upturned forewings (Figs 28A, 34A), an anterior epiproct prong with a trilobed apex (Figs 29A–B, 35A–B), a basal plate of tergum-10 with weakly developed lobes and a median strut (Figs 29A, 29C, 35A, 35C). Additionally, males have simple, posteriorly directed, finger-like basal cercal processes (Figs 29A, 29D–E, 35A, 35D–E) and lack a vesicle on sternum-9 (Figs 28C, 34C). The subgenital plate of the females is moderately produced posteriorly (Figs 28E, 30A–B, 34E, 36A–B). The description of *O. loewii* is strikingly similar to the species of the *O. glacialis* Group suggesting it could be placed in the same species group. However, because *O. loewii* is presumably extinct, only pinned females are available for study and the scope of the current project is limited to the Nearctic species, no revision to the *O. loewii* Group is proposed at this time.

The *Oemopteryx leei* Group

The *Oemopteryx leei* Group is represented only by *O. leei.* The larvae of this group have dorsobasal apically inserted setae on the cercus and antenna (Figs 43B–C) and hair-like sensillae on the maxillary palps (Figs 44A–B). The adult male has a tab-like vesicle on sternum-9 (Fig. 40C), an anterior epiproct prong that is hooded at its apex (Figs 41A–E), a basal plate of tergum-10 with well-developed lobes and a weak median strut (Figs 41A–E). Additionally, the male has dorsally directed basal cercal processes (Figs 41A, D). The subgenital plate of the female is moderately produced posteriorly (Figs 40E; 42A–B).

The *Oemopteryx vanduzeea* Group

The *Oemopteryx vanduzeea* Group is represented only by *O. vanduzeea.* The larvae of this group have an acute nipple-like projection on the apex of sternum-9 (Figs 48F–G) and lack setae on the cercus (Fig. 48B), antenna (Fig. 48C) and maxillary palp (Figs 49A–B). The adult male has a tab-like vesicle on sternum-9 (Fig. 45C), an anterior epiproct prong that is flat and undivided (Figs 46A–B, 46D–E), a basal plate of tergum-10 with well-developed lobes and a weak median strut (Figs 46A–C). Additionally, the male has long, anteriorly directed basal cercal processes that are bent at mid-length (Figs 46A–B, 46D–E) and the apex of sternum-9 is acute anterodorsally. The subgenital plate of the female is moderately produced posteriorly (Figs 45E, 47A–B) and sternum-9 has an acute medial projection (Figs 45E, 47A).

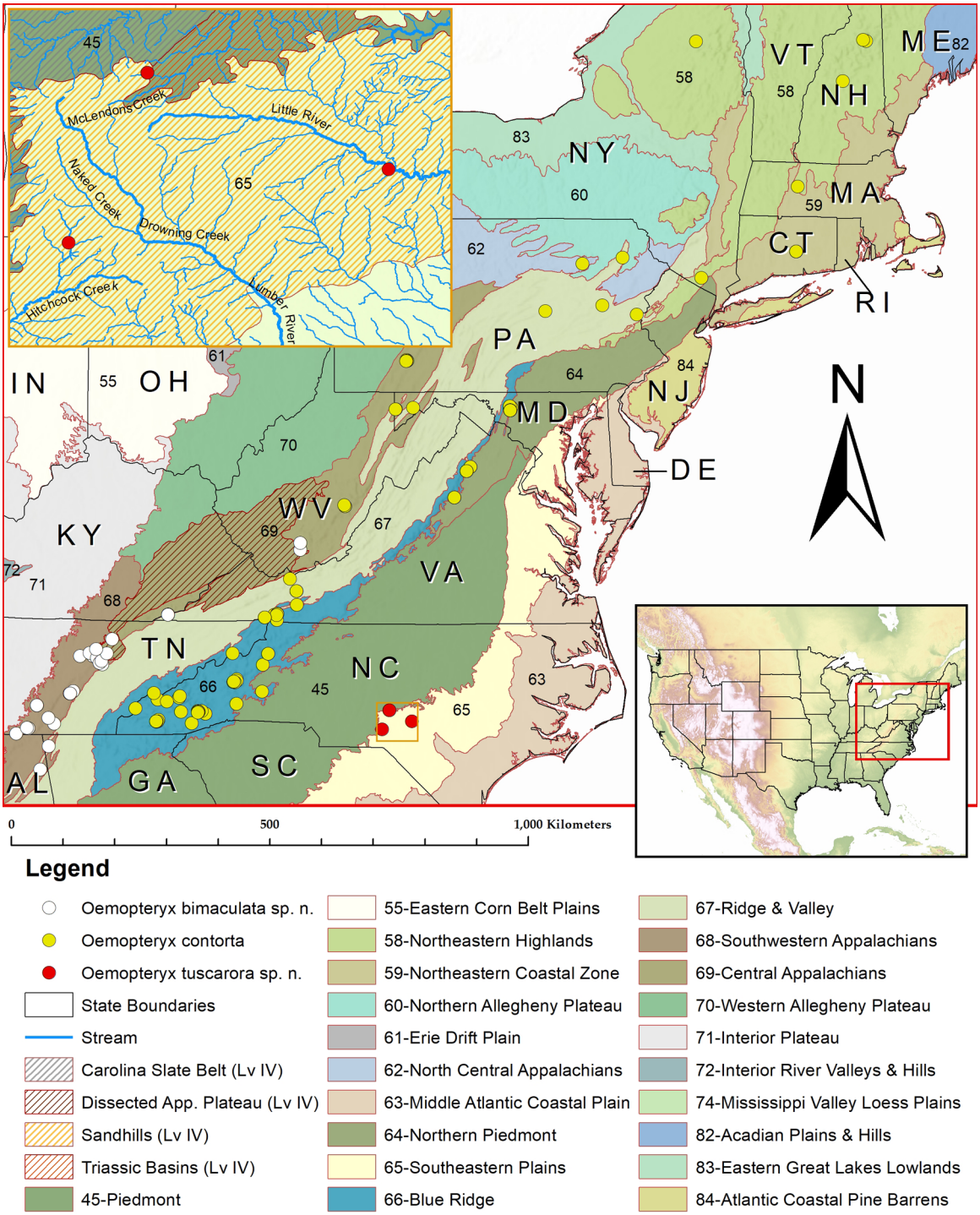

FIGURE 6. Distribution map of the *Oemopteryx contorta* Group species. Records include examined material, BOLD records included in genetic analysis and unpublished data from the CNCI.

The *O. contorta* Group

Oemopteryx bimaculata sp. nov. Verdone, Williams, Beaty & Holland

(Figs 7–12)

Two-spotted Willowfly

Oemopteryx contorta: Stewart 2000:59. (in part)
Oemopteryx contorta: Grubbs 2006: 42.

Oemopteryx contorta: Verdone, Kondratieff, DeWalt & South 2017: 39.

Etymology. This species is named for the pair of pale spots on tergum-1 present on both the adult male and female. The name combines the Latin prefix *bi-* meaning "two" and the Latin adjective *macula* and the past participle *-ta* meaning "spotted". The name is used as an adjective of feminine gender. The common name "Two-spotted Willowfly" is proposed for this species.

Distribution. USA.—AL, GA, KY, TN, WV (Fig. 6).

Material examined. *Holotype* M: **USA.—Tennessee: Morgan Co.,** Hall Branch, Camp Austin Rd., 36.03188, -84.56940, 15 February 2024, C. Verdone, L. Everett (USNM). *Paratypes*: **USA.—Georgia: Dade Co.,** Daniel Creek, Cloudland State Park, 34.82457, -85.49074, 8 February 2017, C. Verdone, B. Kondratieff, 2M, 4F, 4L (CSUIC). **Tennessee: Bledsoe Co.,** Henderson Creek, 4 mi NE Summer City, [TN 235], [35.60689, -85.061514], 24 February 1999, B. Kondratieff, R. Kirchner, 3M, 1F, 19L (CSUIC); Polebridge Creek, off TN 30, Summer City, [35.57793, -85.11890], 24 February 1999, B. Kondratieff, R. Kirchner, 1M (CSUIC). **Cumberland Co.,** Clear [Creek], [Ridge Rd.], Lilly Bridge, [36.10204, -84.71717], 22 February 2007, C.R. Parker, 2F (CSUIC); North Fork Elmore Creek, TN 298, [36.10314, -84.94161], 9 February 1998, B. Kondratieff, R. Kirchner, 1M (CSUIC); Obed River, [no location], [unable to approximate coordinates], 20 February 1976, B. Kondratieff, 1M, 6L (CSUIC). **Morgan Co.,** Green Branch of White Creek, Barnett Bridge Rd., [36.14807, -84.77806], 9 February 1998, B. Kondratieff, R. Kirchner, 14M, 8L (CSUIC); same location, 15 February 2024, C. Verdone, L. Everett, 1M, 26L (NCDWR); same data, emerged 29 February 2024, 1M, 1E (NCDWR); Hall Branch, Camp Austin Rd., 36.03188, -84.56940, 15 February 2024, C. Verdone, L. Everett, 1M, 1F (NCDWR); Mud Lick Creek, TN 299, Oakdale City Park, [35.98646, -84.55544], 9 February 1998, B. Kondratieff, R. Kirchner, 9M, 4F (CSUIC); Smith Branch, Twin Bridge Rd., 36.00640, -84.60735, 15 February 2024, C. Verdone, L. Everett, 1M, 1L (NCDWR).

Additional material: **Kentucky: Harlan Co.,** Left Fork Martins Fork, Martins Fork WMA, 36.68261, -83.41538, 14 April 2016, S.A. Grubbs, 1F (WKUC); same data, 36.68423, -83.41434, 1F (WKUC); same data, 36.68306, -83.41496, 3F (WKUC). **Tennessee: Bledsoe Co.,** [no waterbody], Summer City, [35.57417, -85.11611], 12 March 1964, H.B Cunningham, 3M, 1F (INHS: Plecoptera 6257). **Cumberland Co.,** [no waterbody], 2 miles south of Crossville, [unable to approximate coordinates], 12 March 1964, H.B Cunningham, 1M (INHS: Plecoptera 6258); [no waterbody], 8 miles south of Crossville, [unable to approximate coordinates], 12 March 1964, H.B Cunningham, 2F (INHS: Plecoptera 6259); **Grundy Co.,** [no waterbody], Cumberland Heights, [35.40556, -85.69667], 13 March 1964, H.B Cunningham**,** 1F (INHS: Plecoptera 6254); same data, 1M (INHS: Plecoptera 6255); same data, 1M (INHS: Plecoptera 6256). **Franklin Co.,** UT Little Coon Creek, off TN 16, Bear Hollow Mtn., 35.00451, -86.05228, 10 March 2024, S.A. Grubbs, 1M, 2F (WKUC). **Hamilton Co.,** [no waterbody], 4 miles NW of Chattanooga, [35.22753, -85.49190], 13 March 1964, H.B. Cunningham, 1M, 2F (CNCI). **Marion Co.,** North Prong Flat Fork, Frozen Head State Park, 36.13860, -84.48042, 27 February 2007, A.L. Sheldon, 2M, 1F (WKUC); UT Cross Creek, 17 km NW South Pittsburg, Franklin-Marion State Forest, 35.08700, -85.86721, 12 February 2007, S.A. Grubbs, 2M, 1F (WKUC); UT South Suck Creek, Rte 27, 5.2 km WNW Signal Mountain, Prentice Cooper State Forest, 35.14740, -85.39260, 31 January 2015, S.A. Grubbs, 2M (WKUC); UT Sweeten Creek, 15 km NW South Pittsburg, Franklin-Marion State Forest, 35.08270, -85.83910, 12 February 2007, S.A. Grubbs, 2F (WKUC). [no waterbody], 7 miles north of Whitwell, [unable to approximate coordinates], [no date], H.B Cunningham, 1F (INHS: Plecoptera 6253). **Morgan Co.,** Rock Creek, at Pilot Mountain, Hwy 27, [36.19849, -84.66061], 3 March 1977, K.E. Fullington, 1M (INHS: Insect Collection 795636). **Scott Co.,** UT New River, at Norma Rd. 2.8 air mi due S. of TN 63, [36.33986, -84.38591], 25 January 1997, B.A. Moody, 4L (INHS: Insect Collection 795555). **West Virginia: Mercer Co.,** [no waterbody], Flat Top, at Turnpike, [37.58119, -81.11834], 10 March 1959, H.H. Ross, C.A. Ross, 2F (CNCI). **Raleigh Co.,** Cherry Creek, at I-77, [37.67823 -81.11936], 18 February 1990, K.W. Stewart, 1M, 1F (INHS: Insect Collection 795560).

Adult male (Figs 7A, 8A). Macropterous. Length of forewings 7.6–8.4 mm (n = 10). Length of body 7.2–8.4 mm (n = 10). General body color dark-brown.

Head (Figs 7A, 8A). Dorsum of head mostly dark-brown. Labrum pale anteriorly, brown posteriorly. Anterior frontoclypeus brown. Frons with a dark-brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella dark brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Rugosities anterolateral to lateral ocelli and ecdysial suture. Interocellar area uniformly dark-brown and slightly depressed. Occasionally with a pale stripe spanning area between eyes across lateral ocelli and interocellar space. Occiput with brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Figs 7A, 8A). Pronotum subquadrate, wider than long (length 0.8X width) with posterior width slightly wider than anterior width; brown overall with brown rugosities. Anterior and posterior margins of pronotal flange often pale. Disk with irregular brown rugosities; a transverse sinuous furrow at anterior 1/4. Prosternum moderately sclerotized. Meso- and metathorax dark-brown, heavily sclerotized dorsally and ventrally. Thoracic nota and coxae uniformly covered with sparse, short, fine clothing hairs. Legs with contrasting pigment. Femur pale, distal portion of femur dark brown. Tibia brown, dark brown on proximal and distal portions; apex of tibiae with 2-stout apical spines. Tarsus dark-brown. Legs uniformly covered with dark, short stout setae. Wings hyaline; venation brown. Forewing with light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked. Hindwing mottling less developed, absent in anal region.

Abdomen. First abdominal tergite sclerotized with 2-submedial pale spots anteriorly, which may be contiguous medially and a thin pale posterior margin (Fig. 7B). Abdominal segments 1–9 lightly covered with short, fine clothing hairs. Terga 2–6 uniformly brown; terga 7–9 with a well-defined posteromedial membranous cleft; Sterna 2–8 with a pair of anterior sublateral oval brown spots. Sternum-9 with a lightly sclerotized broadly circular vesicle (Fig. 8C) that is attached to sternum-9 from directly beneath the vesicle. Sterna 7–8 lightly sclerotized. Sternum-9 elongated into a scooped plate (Fig. 9D), width subequal from base to apex; apex square with rounded lateral margins (Fig. 8C); plate with numerous long setae on dorsal and ventral surfaces (Figs 9A, 9D); plate covering sternum-10 ventrally and extending beyond.

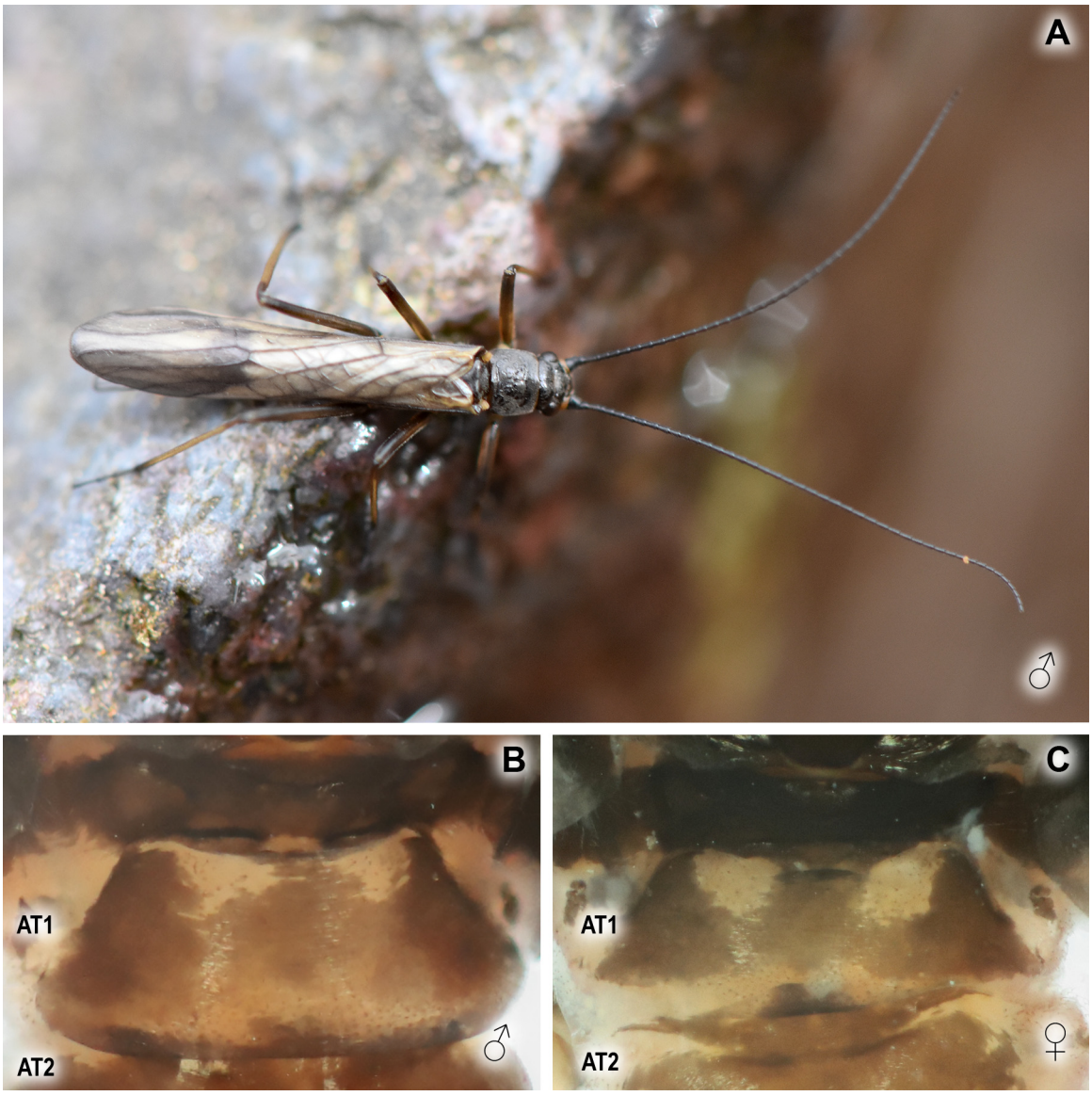

FIGURE 7. *Oemopteryx bimaculata* **sp. nov.**, Hall Creek, Morgan Co., Tennessee, adults. **A.** Live male. **B.** Male tergum one, dorsal. **C.** Female tergum one, dorsal. [morphological abbreviations: see Table 1].

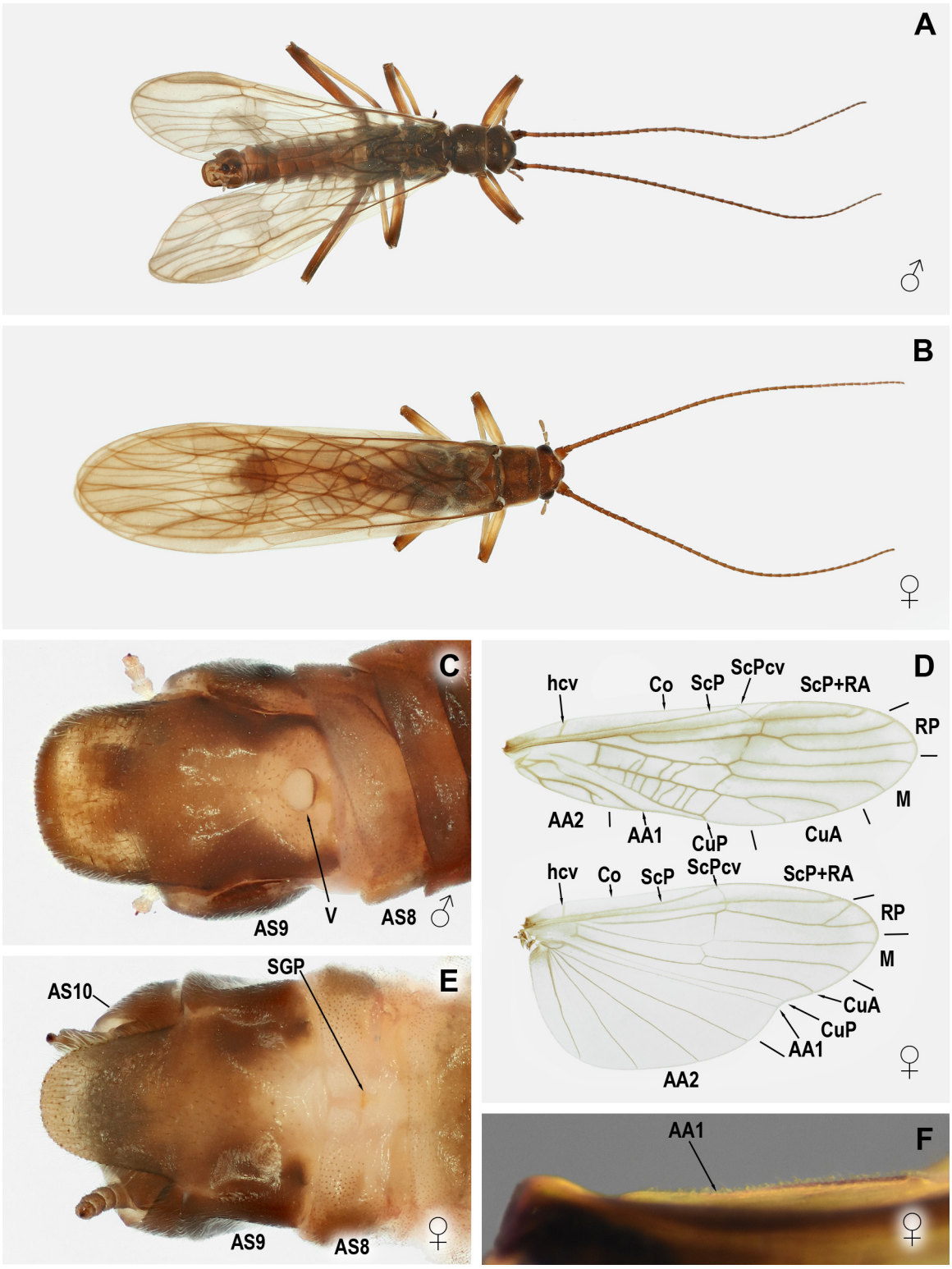

FIGURE 8. *Oemopteryx bimaculata* **sp. nov.** adults., **A–C.** Hall Creek, Morgan Co., Tennessee. **A.** Male habitus, dorsal. **B.** Female habitus, dorsal. **C.** Male sterna, ventral. **D.** Daniel Creek, Dade Co., Georgia, female wings. **E–F.** Hall Creek, Morgan Co., Tennessee. **E.** Female sterna, ventral. **F.** Female forewing, lateral. [morphological abbreviations: see Table 1].

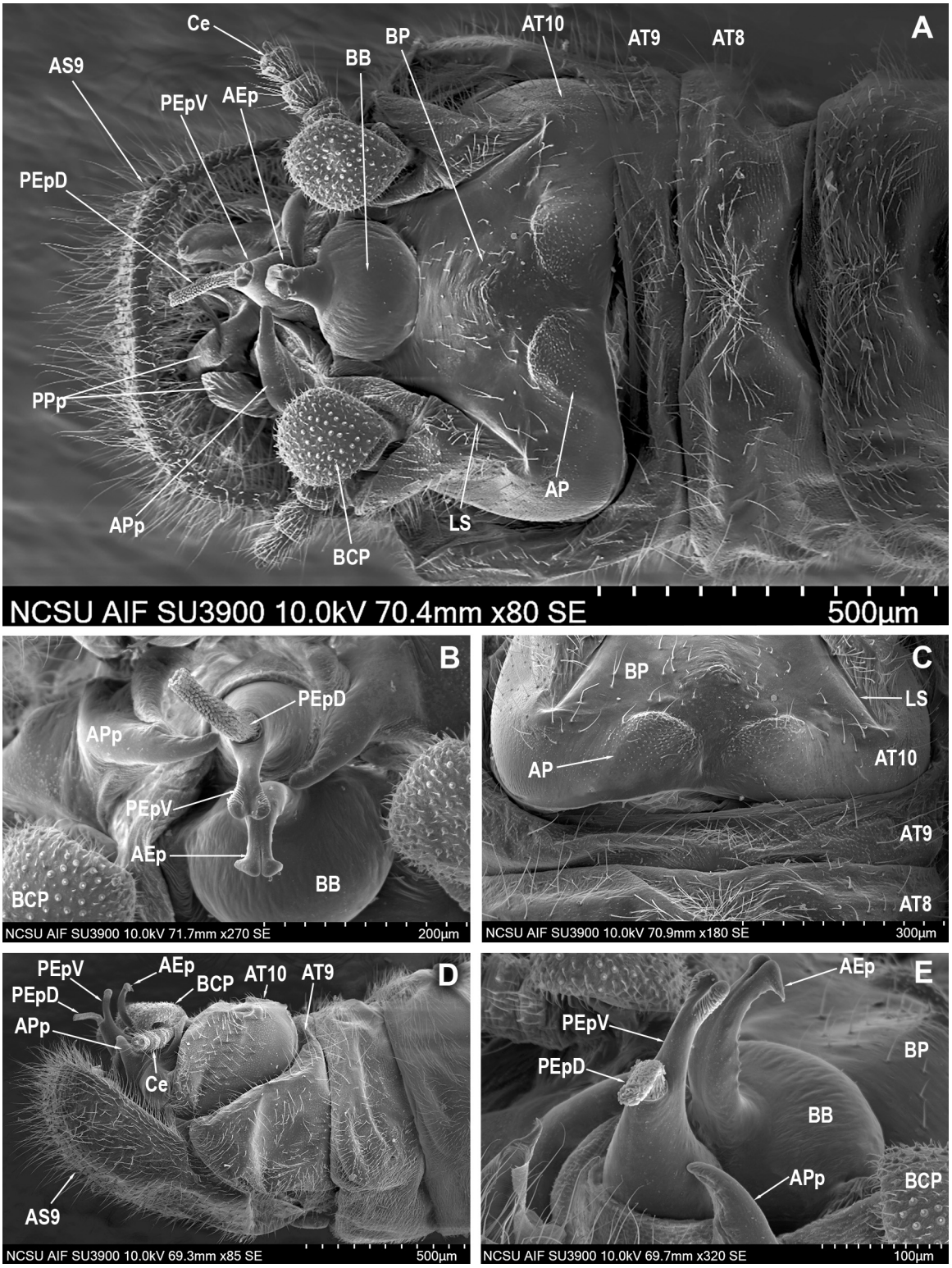

FIGURE 9. *Oemopteryx bimaculata* **sp. nov.**, Green Branch, Morgan Co., Tennessee, adult male. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** Abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

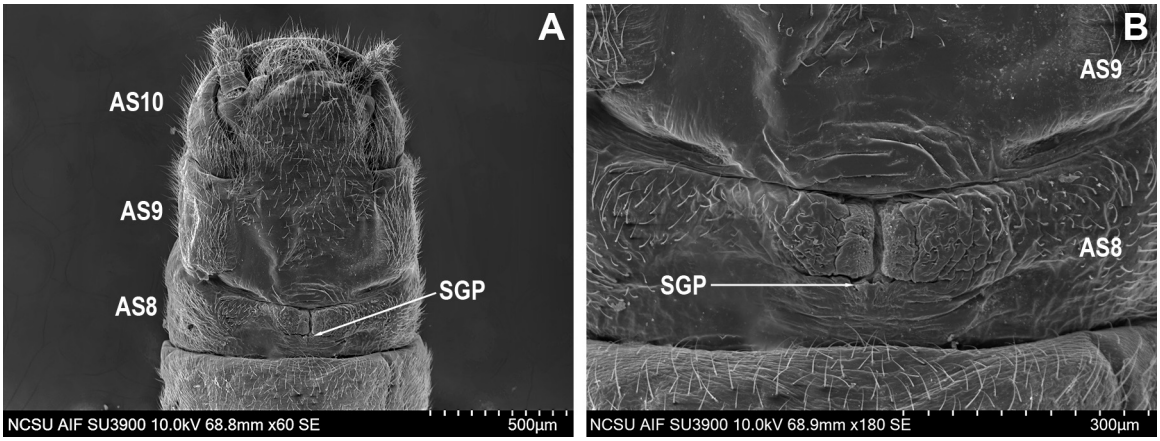

FIGURE 10. *Oemopteryx bimaculata* **sp. nov.**, Daniel Creek, Dade Co., Georgia, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

Terminalia (Figs 9A–E). Abdominal segment-10 nested within segment-9. Anterior margin unsclerotized. Tergal sclerite-10 with a subtle medial cleft and paired submedial flattened anterior processes with raised scale-like armature (Figs 9A, 9C). Cercus 3–4 segmented, excluding vestigial apical segment (Figs 9A, 9D) and with a low, rounded, posteriorly directed basalcercal process covered in socketed setae and sensilla basiconica (Figs 9A–B, 9D–E). Basal plate of tergum-10 relatively flat, sclerotized with a wrinkled texture (Figs 9A, 9C). Lateral struts present, median strut absent, but with a small medial point (Figs 9A, 9C). Basal bulb (Figs 9A–B, 9E), glabrous, oval, bulbous, moderately sclerotized and with an oval inner bulb bearing a small hollow stalk, which terminates at a pore on the anterior face near the junction of the 2-anterior epiproct processes. Anterior epiproct prong fused to basal bulb, divided halfway to base, each arm terminating a distal facing sclerotized foot-shaped process that it pointed at its apex and slightly recurved ventrally (Figs 9A–B, 9D–E). Posterior epiproct prong subdivided into 2-processes. Ventral process lightly sclerotized, divided near apex into 2-glabrous, rounded lobes (Figs 9A–B, 9D–E). Dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing 2–3 internal filaments that are not eversible (Figs 9A–B, 9D–E); filaments sometimes visible on left side of basal bulb. Paraprocts subdivided into two parts, symmetrical anterior paraprocts and asymmetrical bi-lobed posterior paraprocts. Anterior paraproct, conical, medially directed, evenly tapering to a point (Figs 9A–B). Posterior paraprocts (Fig. 9A) subdivided, fused at base. Left outer prong short, flattened and lightly sclerotized. Left inner prong long, flattened, twisted and striated, terminating with an acute sclerotized spine. Right outer prong flattened and moderately sclerotized. Right inner prong tubular, twisted and striated, tapering to apex.

Adult female (Fig. 8B). Macropterous. Length of forewings 9.6–9.7 mm (n = 10). Length of body 8.4–8.7 mm (n = 10). General body color brown. Overall appearance similar to male. Forewing with light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 8D). AA1 vein of forewing with short fine setae ≤0.5mm (Fig. 8F). Hindwing mottling less developed, absent in anal region. (Fig. 8D). First abdominal tergite sclerotized with 2-submedial pale spots anteriorly, which may be contiguous medially and a thin pale posterior margin (Fig. 7C); terga 2–8 uniformly brown dorsomedially; terga 9–10 sclerotized dorsally and laterally. Lateral margins of abdomen segments 1–8 unsclerotized. Sternum-8 weakly sclerotized (Fig. 8E). Subgenital plate weakly sclerotized (Fig. 8E) with a U-shaped notch and a lightly sclerotized medial tab, which may be enfolded (Fig. 10B). Sternum-9 parabolic, produced just beyond the apex of abdominal segment-10 (Figs 8E; 10A); length of free portion of sternum-9 0.8X basal width; uniformly covered with long setae that become longer posteriorly; lateral margins slightly narrowing to a broadly rounded apex (Fig. 8E). Cercus 5–6 segmented, excluding vestigial apical segment (Figs 8E, 9A).

Ovum. Unknown.

Mature larva (Fig. 11A). Length of male body 6.7–7.0 mm (n = 10), female body 7.2–8.0 mm (n = 10). General color light-brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture with the head touching or approaching the abdomen apex, similar to other Taeniopterygidae.

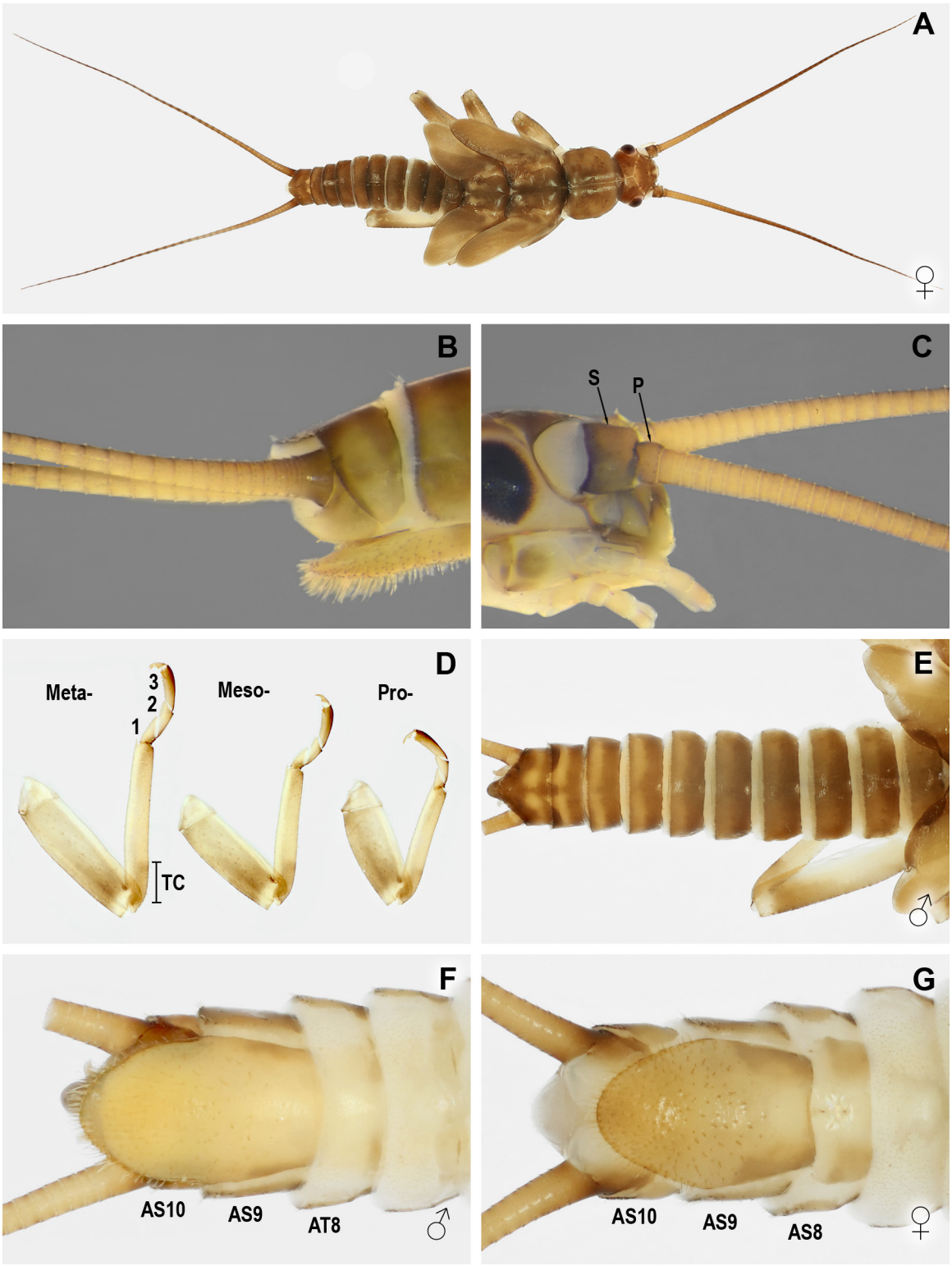

FIGURE 11. *Oemopteryx bimaculata* **sp. nov.**, Green Branch, Morgan Co., Tennessee, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, ventral. **G.** Female sterna, ventral. [morphological abbreviations: see Table 1].

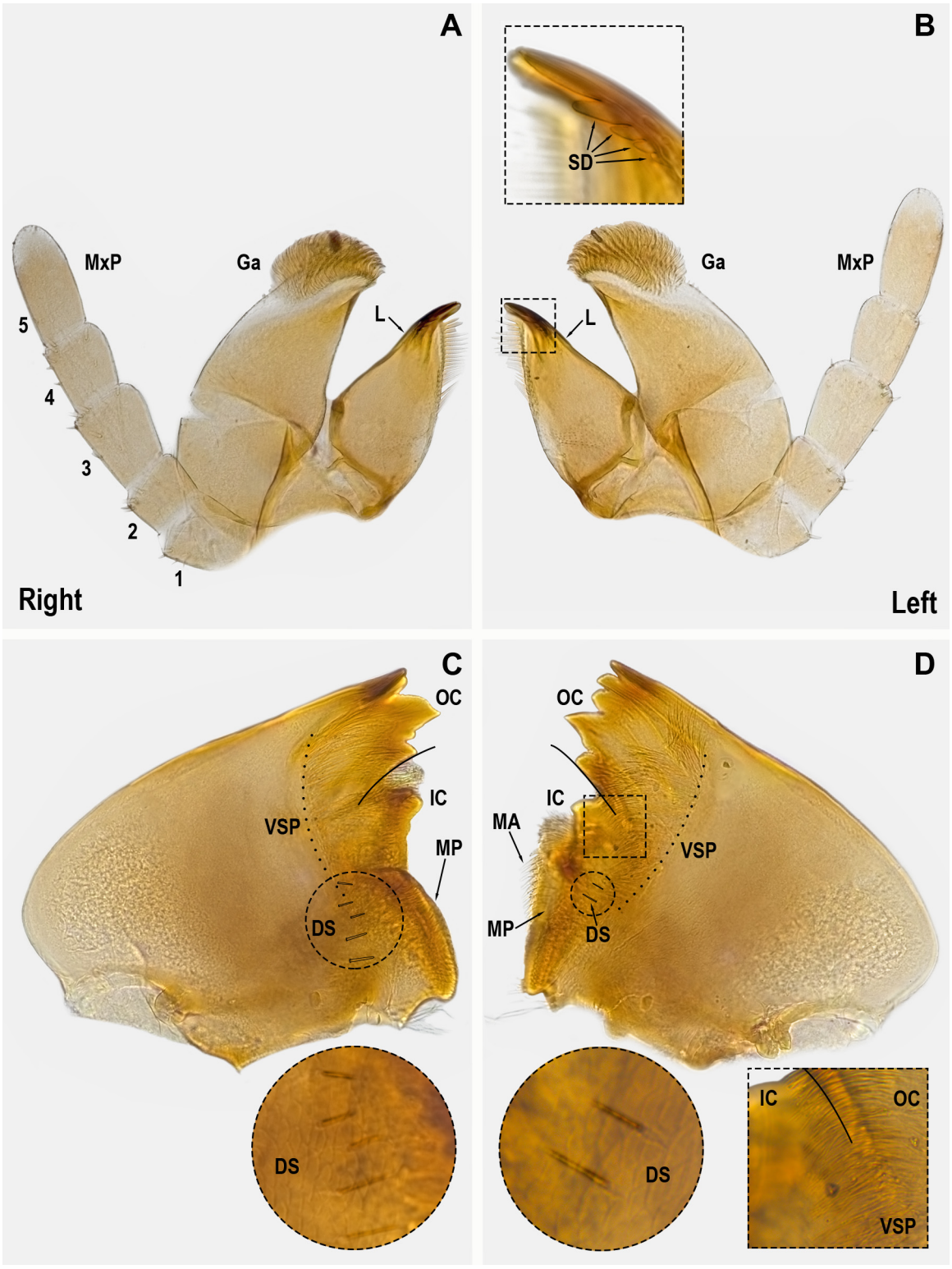

FIGURE 12. *Oemopteryx bimaculata* **sp. nov.**, Henderson Creek, Bledsoe Co., Tennessee, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp; subapical denticles (square inset). **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventro-apical setal patch (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

Head (Fig. 11A). Dorsum of head light-brown with darker brown maculations variously developed. Antelabrum light-brown; anterior margin with a dense brush of golden setae. Postlabrum light-brown. Anterior frontoclypeus pale to light-brown. Frons with a brown U-shaped marking with posterolateral extensions; light-brown subrectangular markings directly anterior to lateral ocelli. Interocellar area diffusely light-brown, pale at junction of ecdysial suture. Occipital area diffusely light-brown and with irregular brown rugosities. Eyes with pigmented ommatidia reduced, not reaching eye margins. Antennal scape, pedicel and flagella brown; dorsobasal apically inserted setae absent (Fig. 11C); antenna slightly shorter than body (Fig. 11A).

Maxilla (Figs 12A–B). Lacinia triangular with a straight or slightly convex inner margin. Lacinia with 2-apical, cupped teeth and 2–5 subapical denticles on ventral face (Fig. 12B square inset). Apical teeth subequal in length; relative length of apical teeth to palm length difficult to discern due to wear. Inner palm margin with 19-stout socketed marginal setae below apical teeth; first marginal seta robust. Basal 1/3 of palm with a cluster of >10 thin dorsal setae. A single acutely pointed sensilla basiconica on palm surface near the basal 1/5. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 1/4; a thin patch of setae on inner margin below apical setae, which extends about halfway to base. Length of galea, including apical setae, 1.1X length of lacinia; width of galea 1.1X the lacinia width. Maxillary palp with 5-segments; 1.9X length of lacinia; palp with sensilla basiconica sparsely scattered over entire surface.

Mandible. Right mandible (Fig. 12C) bicuspid, outer cusp with 3-teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of pointed acanthae (length 2.1X width). Palm dorsum with 1–9 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 12C circle inset); the proximal basal corner with a marginal patch of 3-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 12C). Left mandible (Fig. 12D) bicuspid, outer cusp with 5-teeth, inner cusp with 1-broad concave tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 4.0X width). Palm dorsum with 1–7 sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 12D circle inset); the proximal basal corner with a marginal patch of 5-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 12D, square inset).

Thorax (Fig. 11A). Pronotum wider posteriorly; light-brown with faint rugosities and a pale posteromedial spot. Length of forewing pad 3.3X width. Length of hindwing pad 1.8X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with light-brown spicules laterally and a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules dense medially and sporadic distally. Mesothorax with an oval prefurcasternal pit; light-brown spicules present both anterior and posterior to pit; lateral areas glabrous. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, as long as wide (length 1.0X width). Metathoracic basisterna with a medial patch of light-brown spicules and a pair of furcasternal pits. Anterior face of femur generally pale with some darker pigment on the distal and dorsal margins (Fig. 11D). Femur and tibia with a dorsal fringe of silky setae (not shown); length of femoral setae less than 1/2 the width of the femur; length of tibial setae about equal to tibial width. Anterior and posterior faces of the femur with scattered short stout setae. Tibia pale; tibial callus and tibia apex darkened (Fig. 11D). Tarsus with a sparse dorsal fringe of silky setae (not shown); tarsus light-brown and becoming progressively darker distally. Venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen usually with contrasting pigmentation, dark anteriorly and lighter posteriorly, most pronounced on terga 6–10 (Fig. 11E). Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of tergum-8 and tergum-9 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 1–8 with light-brown spicules. Sternum-9 with an elongate plate (male = length 1.5X width; female = length 1.5X width); plate width relative to sternal width (male = 0.9X; female = 0.8X). Male plate (Fig. 11F) with sides slightly widening towards posterior margin of sternum-9, posterolateral margins convex, evenly rounded towards apex. Female plate (Fig. 11G) narrower basally, widest at posterior margin of sternum-9; posterolateral margins convex, evenly narrowing towards apex. Plates of both males and females with stout setae sparse on basal half, becoming denser towards apex. Cercus uniformly brown (Fig. 11A); dorsobasal apically inserted setae absent (Fig. 11B); cercus about as long as body (Fig. 11A).

Diagnosis. *Oemopteryx bimaculata* **sp. nov.** is defined in the adult male by the paired anterior processes on tergum-10 in combination with two pale spots on the dorsum of abdominal tergum-1, which the female also possesses. The larvae are usually separable from *O. contorta* by the distinctly banded abdominal terga. The larvae differ from *O. tuscarora* **sp. nov.** by their darkened tibial callus, a character that is shared by *O. contorta.*

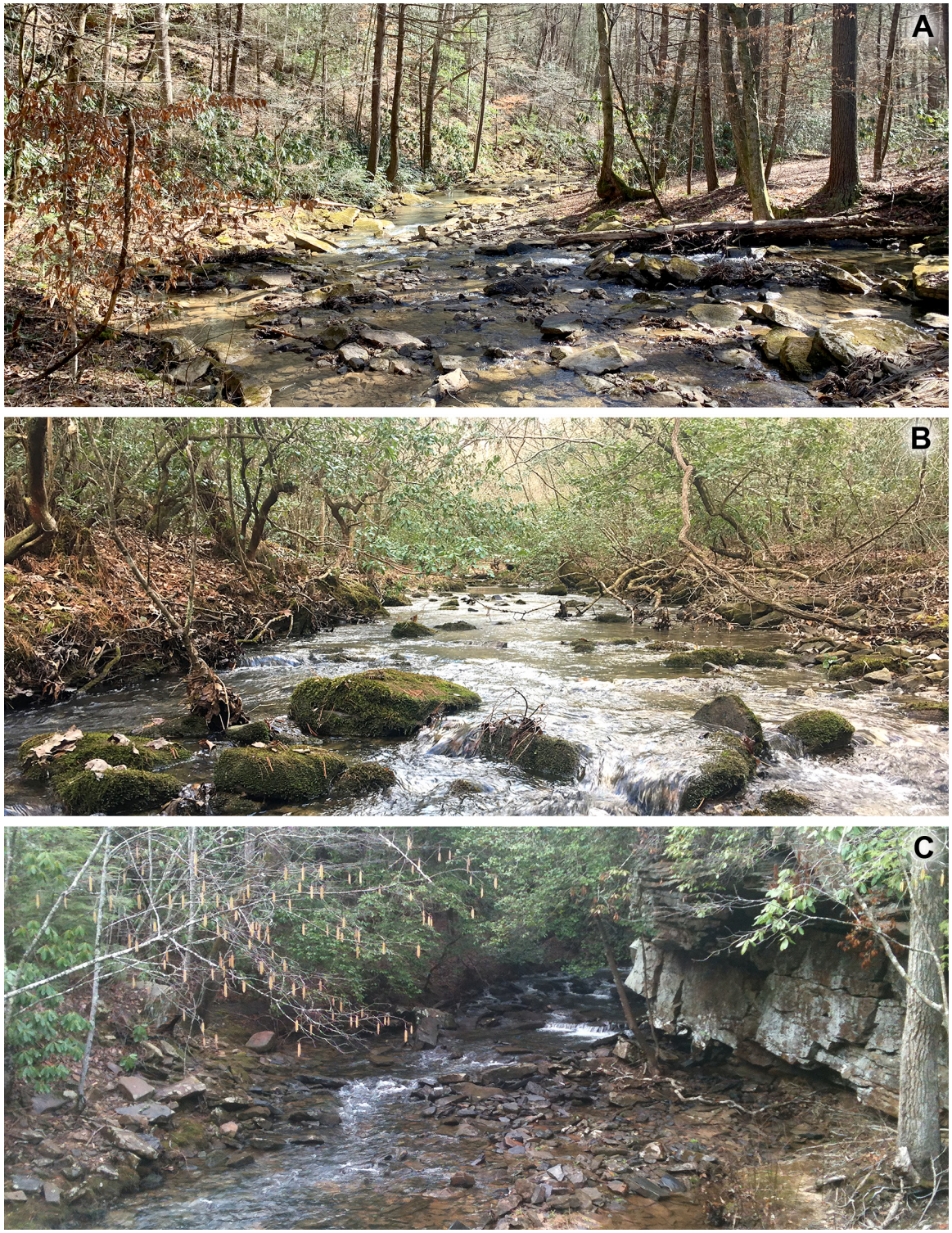

FIGURE 13. *Oemopteryx bimaculata* **sp. nov.**, site photos. **A.** Type locality, Hall Creek, Morgan Co., Tennessee. (Photo credit: Larry Everett). **B.** Paratype locality, Green Branch, Morgan Co., TN. **C.** Paratype locality, Daniel Creek, Dade Co., Georgia.

Type locality (Fig. 13A). Located in the Southwestern Appalachians Level III ecoregion in Morgan County, Tennessee, Hall Branch drains the west side of Lone Mountain (771 m) and is a tributary to the Emory River. The collection site is 304 m ASL and has a drainage area of 6.42 km^2. Substrate consists primarily of flat boulders and cobbles. The stream is well forested with much of the watershed residing in Lone Mountain State Forest. Water quality at the type locality has not been assessed.

Biological notes. *Oemopteryx bimaculata* **sp. nov.** is apparently endemic to the Appalachians with records known from the Southwestern Appalachians and Central Appalachians Level III ecoregions ranging from northeastern Alabama to southern West Virginia. Its most northeasterly records are within the Dissected Appalachian Plateau Level IV ecoregion, a potential basis for to delineate the ranges of the new species and *O. contorta.* The two species are apparently allopatric and although *O. contorta* is also found in the Central Appalachians, it occurs north and east of Dissected Appalachian Plateau Level IV ecoregion. Elevations of collection locations range between 238 m to 667 m ASL. Larvae have been collected from streams with drainage areas ranging from 3.9 km^2 to 16.8 km^2. Available records suggest adults are active from late January to mid-April. A conservation rank of G3 was calculated for this species indicating a moderate risk of extinction or collapse due to a somewhat restricted range, relatively few populations, or other factors (NatureServe 2020).

Oemopteryx contorta (Needham & Claassen, 1925)

(Figs 14–19)
Dark Willowfly

Taeniopteryx contorta Needham & Claassen, 1925: 242. Holotype male (CUIC), Jaffrey, Cheshire Co., New Hampshire, USA.
Brachyptera contorta: Frison 1942: 353.
Oemopteryx contorta: Illies 1966: 63.
Oemopteryx contorta: Zwick 1973: 313.
Brachyptera (*Oemopteryx*) *contorta*: Hitchcock 1974: 125.
Oemopteryx contorta: Ricker & Ross 1975: 141.
Oemopteryx contorta: Nelson 1982: 11.
Oemopteryx contorta: Stewart 2000: 59.

Distribution. USA.—CT, MA, MD, ME, NC, NH, PA, TN, VA, WV (DeWalt *et al.* 2024) (Fig. 6).

Material examined. Connecticut: Middlesex Co., Lyman's Brook, East Hampton, [41.57583, -72.50310], 24 March 1937, H.H. Ross, 1M (INHS: Plecoptera 6237); same data, 3L (INHS: Plecoptera 6238); same data, 4L (INHS: Plecoptera 6239); same data, 4L (INHS: Plecoptera 6240); same data, 2L (INHS: Plecoptera 6241). **Maryland: Frederick Co.,** Fishing Creek, W of Lewiston, [39.53230, -77.47451], 2 March 1958, P.H. Freytag, A.H. Mason, 1M (UKIC); Fishing Creek, Mountaindale, [39.51938, -77.45117], 2 March 1958, P.H. Freytag, A.H. Mason, 3L (UKIC); Fishing Creek, abv. reservoir, Mountaindale, [39.53230, -77.47451], 2 March 1958, P.H. Freytag, 1M (UKIC); [Little] Tuscarora Creek**,** west (northwest) of Yellow Springs, [39.48533, -77.46820], 20 February 1958, P.H. Freytag, A.H. Mason, 27L (UKIC); UT Tuscarora Creek, Hamburg Rd., Frederick Municipal Forest, 39.49710, -77.47465, 9 March 2020, P.N. Hogan**,** 3F (WKUC); UT Tuscarora Creek, W of Yellow Springs, [39.47951, -77.47121], 26 January 1958, P.H. Freytag, 5L (UKIC); same location, 20 February 1958, P.H. Freytag, A.H. Mason, 10M, 4F (UKIC); same location, 23 February 1958, P.H. Freytag, 4M (UKIC); same location, 29 March 1958, P.H. Freytag, 4F (UKIC); same location, 13 April 1958, P.H. Freytag, A.H. Mason, 5F (UKIC). **Garrett Co.,** Bull Glade Run Snaggy Mountain Rd., Garrett State Forest, 39.49162, -79.45862, 25 February 1996, S.A. Grubbs, 5L (WKUC); Middle Fork Crabtree Creek, north bank, 150 feet from spring, Savage River State Forest, 39.51461, -79.15975, 20 March 2020, P.N. Hogan, 1F (WKUC); UT Murley Run, Garrett State Forest, 39.49568, -79.46557, 18 March 2020, P.N. Hogan, 1F (WKUC). **Massachusetts: Franklin Co.,** Dean Branch, Pratt Corner, Cuchman Rd., Amherst Watershed, 42.41863. -72.47600, 18 February 2023, emerged 22 February 2023, R.E. DeWalt, R. Smith, 1M, 1E (INHS: Insect Collection 1505820); same data, emerged 28 February 2023, 1F (INHS Insect Collection 1505841); same data, emerged 14 March 2023, 1F (INHS Insect Collection 1505841). **New Hampshire: Coos Co.,** UT Cutler River, John Shelburne Ski Trail, White Mountains National Forest, 44.25960, -71.28637, 16 June 2021, S.A. Grubbs, L. Myers, 3F (WKUC). **Grafton Co.,** [no waterbody], Plymouth, [43.75694, -71.68860], 26 April 1969, [no collector], 1F (INHS: Insect Collection 795559). **North Carolina: Burke Co.,** Hall Creek, SR 1969, South Mountain State Park, 35.60501, -81.78294, 17 January 2019, C. Verdone, S. Beaty, V. Holland, B. Kondratieff, 1F (NCDWR). **Caldwell Co.,** Wilson Creek, Brown Mountain Beech Rd., 35.97978, -81.76504, 18 January 2019, emerged, 31 January 2019, C. Verdone, S. Beaty, V. Holland, B. Kondratieff, 2F, 1E (NCDWR). **Graham Co.,** Wolf Laurel Creek, FS 81F, Nantahala National Forest, 35.36318, -83.98268, 2 March 2008, A.L. Sheldon, 1F (WKUC). **Haywood Co.,** Dark Prong, Pisgah National Forest, 35.32713, -82.83004, 14 April 2006, J.L. Robinson, 1F (WKUC); Flat Laurel Creek, off Flat Laurel Creek Trail, 35.31837, -82.88342, 20

March 2013, A.L. Sheldon, 1M (WKUC); same data, 35.32434, -82.89617, 5M, 4F (WKUC); same data, 35.31754, -82.88237, 12 April 2014, 1F (WKUC); UT Flat Laurel Creek, Big Sam Trail, 35.32311, -82.89297, 12 April 2014, A.L. Sheldon, 1F (WKUC); UT Flat Laurel Creek, Little Sam Trail, 35.31664, -82.89178 12 April 2014, A.L. Sheldon, 2F (WKUC); UT Flat Laurel Creek, off Flat Laurel Creek Trail, 35.32142, -82.89275, 20 March 2013, A.L. Sheldon, 3F (WKUC). **Jackson Co.,** Big Witch Creek, Dobson Rd., 35.51611, -83.22500, 21 March 2022, R. Tetreault, 1F (NCDWR); Cullowhee Creek, Picnic Grounds Rd. 35.31387, -83.18734, 23 January 2024, C. Verdone, V. Holland, D. Harwood, 4L (NCDWR). **Macon Co.,** Bearpen Branch, FS 711H, Nantahala National Forest, 35.18183, -83.62044, 17 March 2013, A.L. Sheldon, 3F (WKUC); same data; 35.18194, -83.62048 24 February 2014, 2F (WKUC); Bearpen Creek, FSR 711, [35.18579, -83.61411], 5 April 2014, S. Beaty, V. Holland, E. Fleek, 2F (NCDWR); Middle Creek, 11 [km] SW Highlands, Rt. 106, [35.01325, -83.31506], 31 January 1963, W.S. Brooks, L.J. Stannard, 1M (INHS: Plecoptera 6252); White Oak Creek, FS 711, Nantahala National Forest, 35.20191, -83.58354, 29 February 2008, A.L. Sheldon, 1F (WKUC); Wine Spring Creek, FS 711F, Nantahala National Forest, 35.17949, -83.59764, 23 February 2014, A.L. Sheldon, 1M, 1F (WKUC); Wine Spring Creek, FS 711H, Nantahala National Forest, 35.17964, -83.61994, 10 April 2014, A.L. Sheldon, 1F (WKUC); Wine Spring Creek, horse camp nr. FS 711, Nantahala National Forest, 35.17740, -83.61368, 24 February 2014, A.L. Sheldon, 2F (WKUC). **Rutherford Co.,** Pool Creek, Bottomless Pool Rd., 35.42897, -82.22901, emerged 28 January 2019, C. Verdone, S. Beaty, V. Holland, B. Kondratieff, 1M, 1F, 1L, 2E (NCDWR). **Swain Co.,** Bear Creek, 140 m above campsite 75, Great Smoky Mountains National Park, [35.48709, -83.59321], 9 March 2003, D. Etnier, 1F (NCDWR); Bunches Creek, Bunches Creek Rd., 35.53649, -83.20885, 1 March 2022, C. Verdone, S. Beaty, V. Holland, R. Tetreault, 1M (NCDWR); Deep Creek, Deep Creek Campground, N Bryson City, [35.46122, -83.43612], 26 February 2001, B. Kondratieff, R. Zuellig. R. Kirchner, 1F (CSUIC). **Transylvania Co.,** Coontree Creek, NC 276, 35.28967, -82.76324, 29 January 2019, C. Verdone, V. Holland, 1M, 1F (NCDWR); Davidson River, NC 276, 35.28810, -82.76286, C. Verdone, V. Holland, 1M (NCDWR); UT to Greenland Creek, FS trail 488, 35.15451. -82.00331, C. Verdone, S. Beaty, V. Holland, 1M (NCDWR); small seep, E. Devils Courthouse Overlook parking lot, 35.30460, -82.89965, 4 April 2006, J.L. Robinson, M. Geraghty, J. Robinson, 1M (WKUC). **Watauga Co.,** [no waterbody], Blowing Rock, [36.13513, -81.67760], 23 March 1940, T.H. Frison, C.O. Mohr, A.W. Hawkins, 1F, 2E (INHS: Plecoptera 6242). **Yancey Co.,** Rock Creek, end FS 5521, Pisgah National Forest, 35.77315, -82.21896, 2 March 2017, A.L. Sheldon, 1F (WKUC); seeps, Buncombe Trail, Pisgah National Forest, 35.74279, -82.27468, 27 April 2019, M.L. Metzger, 1M, 1F (WKUC); Setrock Creek, Mitchell Trail, 35.75561, -82.24325, 26 February 2014, A.L. Sheldon, 1F (WKUC); South Fork Upper Creek, Buncombe Trail, Pisgah National Forest, 35.73634, -82.27946, 27 April 2019, M.L. Metzger, 1F (WKUC); South Toe River, Pisgah National Forest, 35.75176, -82.22039, 2 March 2017, A.L. Sheldon, 4F (WKUC); Upper Creek, Pisgah National Forest, 35.73162, -82.25181, 4 March 2017, A.L. Sheldon, 2F (WKUC). **New York: Franklin Co.,** Dutton Brook, Rt. 3, nr. [Middle] Saranac Lake, [44.25175, -74.23864], 15 March 2006, L. Myers, R. Younghanz, 1F (CSUIC). **Orange Co.,** unnamed tributary to Lake Stahehe, CR 106, E. Lake Stahehe, Palisades Interstate Park, 41.23630, -74.15080, 9 March 2009, emerged 20 March 2009, L. Myers, 3M, 2F, 4L, 2E (CSUIC). **Pennsylvania: Carbon Co.,** Broad Run, upstream of reservoir, 40.871183, -75.871289, 2 March 2011, T. Daley, 10L (NCDWR). **Lackawanna Co.,** White Oak Run, 40 ft above falls, 41.497078, -75.514229, 4 march 2011, T. Daley, 10L (NCDWR). **Snyder Co.,** Penns Creek, 40.79885, -76.85794, 16 April 2014, no collector data, 1M, 5F (WKUC). **Westmoreland Co.,** Maul Spring, Powdermill Nature Reserve, 40.13921, -79.25883, 17 April 1994, S.A. Grubbs, 1M (WKUC); Powdermill Run, Powdermill Nature Reserve, 40.15171, -79.27028, 7 April 1993, S.A. Grubbs, 1F (WKUC); UT Laurel Run, Powdermill Nature Reserve, 40.13406, -79.27769, 15 April 1997, S.A. Grubbs, 1M (WKUC); UT Powdermill Run, Powdermill Nature Reserve, 40.14108, -79.26786, 29 April 1993, S.A. Grubbs, 1F (WKUC); same data, 17 March 1994, 1M (WKUC); same data, 8 April 1994, S.A. Grubbs, 2F, 2L (WKUC); same data, 3 May 1994, 1F (WKUC). **Wyoming Co.,** South Brook, 50 m upstream Opossum Brook, 41.41998, -76.21470, 22 March 2011, T. Daley, 5L (NCDWR). **Tennessee: Sevier Co.,** Starkey Creek, 0.25 mi above Sams Branch, Great Smoky Mountains National Park, [35.58029, -83.66040] February 1987, D. Etnier, 3M (CSUIC). **Unicoi Co.,** Red Fork, FS 230, 36.13904, -82.29004, 11 April 2014, A.L. Sheldon, 2F (WKUC). **Virginia: Greene Co.,** [no waterbody], Stanardsville, [38.2974, -78.44010], 21 March 1940, T.H. Frison, C.O. Mohr, A.W. Hawkins, 5F (INHS: Plecoptera 6249); same data, 1F (INHS: Plecoptera 6248; same data, 1M (INHS: Plecoptera 6250). **Grayson Co.,** Cabin Creek, US 58, 36.607284, -81.521194, 16 February 2024, C. Verdone, 1M (NCDWR); Lewis Fork, Jefferson National Forest, 36.68908, -81.51917, 3 March 2007, A.L. Sheldon, 2F (WKUC); same data, 36.69414, -81.51462, 1M (WKUC); same data, 36.67407, -81.52554, 1M, 1F, 1L (WKUC); Lewis Fork, at VA-603

[near Grindstone Gap], Mt. Rogers National Recreation Area, [36.69408, -81.51479] 18 February 1990, R.F. Kirchner, K.W. Stewart, 1M (INHS: Insect Collection 795556); Lewis Fork, Rte 603, 36.69455, -81.51460, 16 February 2024, C. Verdone, 1M (NCDWR). **Montgomery Co.,** [no waterbody], Brush Mountain, 2 mi W of Blacksburg, [unable to approximate coordinates], 5 March 1961, R.L. Hoffman, 1M (INHS Plecoptera 6251). **Smyth Co.,** Big Laurel Creek, Rte 603, 36.68190, -81.56527, 16 February 2024, C. Verdone, 1M, 1F (NCDWR). **Rappahannock Co.,** Thornton River, along US-211 at picnic area, Shenandoah National Park, [38.71333, -78.15972], 28 February 1975, R.W. Baumann, 2M, 2F (INHS Insect Collection 795561); [no waterbody], Sperryville, [38.65694, -78.22639], 17 March 1940, T.H. Frison, C.O. Mohr, A.W. Hawkins, 2F (INHS Plecoptera 6244); same data, 1F, (INHS Plecoptera 6245); same data, 3M (INHS Plecoptera 6246); same data, 2L (INHS Plecoptera 6247). **Tazewell Co.,** Cove Creek, Rt. 662, 37.17837, -81.29900, 14 February 2024, C. Verdone, 9M, 14F (NCDWR). **Washington Co.,** Straight Branch, at US-58, Jefferson National Forest, [36.64579, -81.73445], 18 February1990, K.W. Stewart, R.F. Kirchner, 1M, 4F, 7L (INHS: Insect Collection 795562). **Wythe Co.,** Cripple Creek, Speedwell, [36.81834, -81.17447], 22 May 1940, T.H. Frison, C.O. Mohr, A.W. Hawkins, 1F (INHS: Plecoptera 6243); East Fork of Reed Creek, 5 mi N Wytheville at Hwy 717, George Washington and Jefferson National Forest, [37.01016, -81.18438], 17 February 1990, K.W. Stewart, R.F. Kirchner, 5F (INHS: Insect Collection 795572); East Fork Stony Creek, Rt. 717, 6 mi NW Wytheville, [37.00932, -81.18248], 3 March 1979, R. Kirchner, 10M, 2F, 15L (CSUIC). East Fork Stony Fork [US Stony Fork Campground] along VA-717, Jefferson National Forest, [37.00932, -81.18246], 28 March 1978, R.F. Kirchner, G.T. Voreh, 3M, 10F, 3L (INHS: Insect Collection 795558). **West Virginia: Pocahontas Co.,** Hills Creek, off Hwy 39, Falls of Hills Creek Scenic Area, [38.17764, -80.33669], 16 February1990, K.W. Stewart, R.F. Kirchner, 1F, 1L (INHS: Insect Collection 795557); North Fork Cherry River, 14 mi W [E] Richwood at WV-39, [38.19262, -80.35379], 16 February1990, K.W. Stewart, R.F. Kirchner, 26L, INHS Insect Collection 877509). **Randolph Co.,** Trout Run, near Czar, 38.72510, -80.19430, 24 March 1992, S.M. Clark, 1F (WKUC).

Adult male (Fig. 15A). Macropterous. Length of forewings 7.9–8.8 mm (n = 10). Length of body 6.1–9.2 mm (n = 10). General body color dark-brown.

Head (Fig. 15A). Dorsum of head mostly dark-brown. Labrum pale anteriorly, brown posteriorly. Anterior frontoclypeus brown. Frons with a dark-brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella dark brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Rugosities anterolateral to lateral ocelli and ecdysial suture. Interocellar area uniformly dark-brown and slightly depressed. Occasionally with a pale stripe spanning area between eyes across lateral ocelli and interocellar space. Occiput with brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Fig. 15A). Pronotum subquadrate, wider than long (length 0.8X width) with posterior width slightly wider than anterior width; brown overall with brown rugosities. Anterior and posterior margins of pronotal flange often pale. Disk with irregular brown rugosities; a transverse sinuous furrow at anterior 1/4. Prosternum moderately sclerotized. Meso- and metathorax dark-brown, heavily sclerotized dorsally and ventrally. Thoracic nota and coxae uniformly covered with sparse, short, fine clothing hairs. Legs with contrasting pigment. Femur pale, distal portion of femur with darker pigment. Tibia brown, darker brown on proximal and distal portions; apex of tibiae with 2-stout apical spines. Tarsus dark-brown. Legs uniformly covered with dark, short stout setae. Wings hyaline; venation brown. Forewing with light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked. Hindwing mottling less developed, absent in anal region.

Abdomen. First abdominal tergite with a broad pale stripe medially (Fig. 14B); terga 2–7 uniformly brown; terga 8–9 with a posteromedial membranous cleft. Sterna 2–8 with a pair of anterior sublateral oval brown spots. Abdominal segments 1–9 lightly covered with short, fine clothing hairs. Sternum-9 with a lightly sclerotized broadly circular vesicle (Fig. 15C) that is attached to sternum-9 from directly beneath the vesicle. Sterna 7–8 lightly sclerotized. Sternum-9 elongated into a scooped plate (Fig. 16D), width subequal from base to apex; apex square with rounded lateral margins (Fig. 15C); plate with numerous long setae on dorsal and ventral surfaces (Figs 16A, 16D); plate covering sternum-10 ventrally and extending beyond.

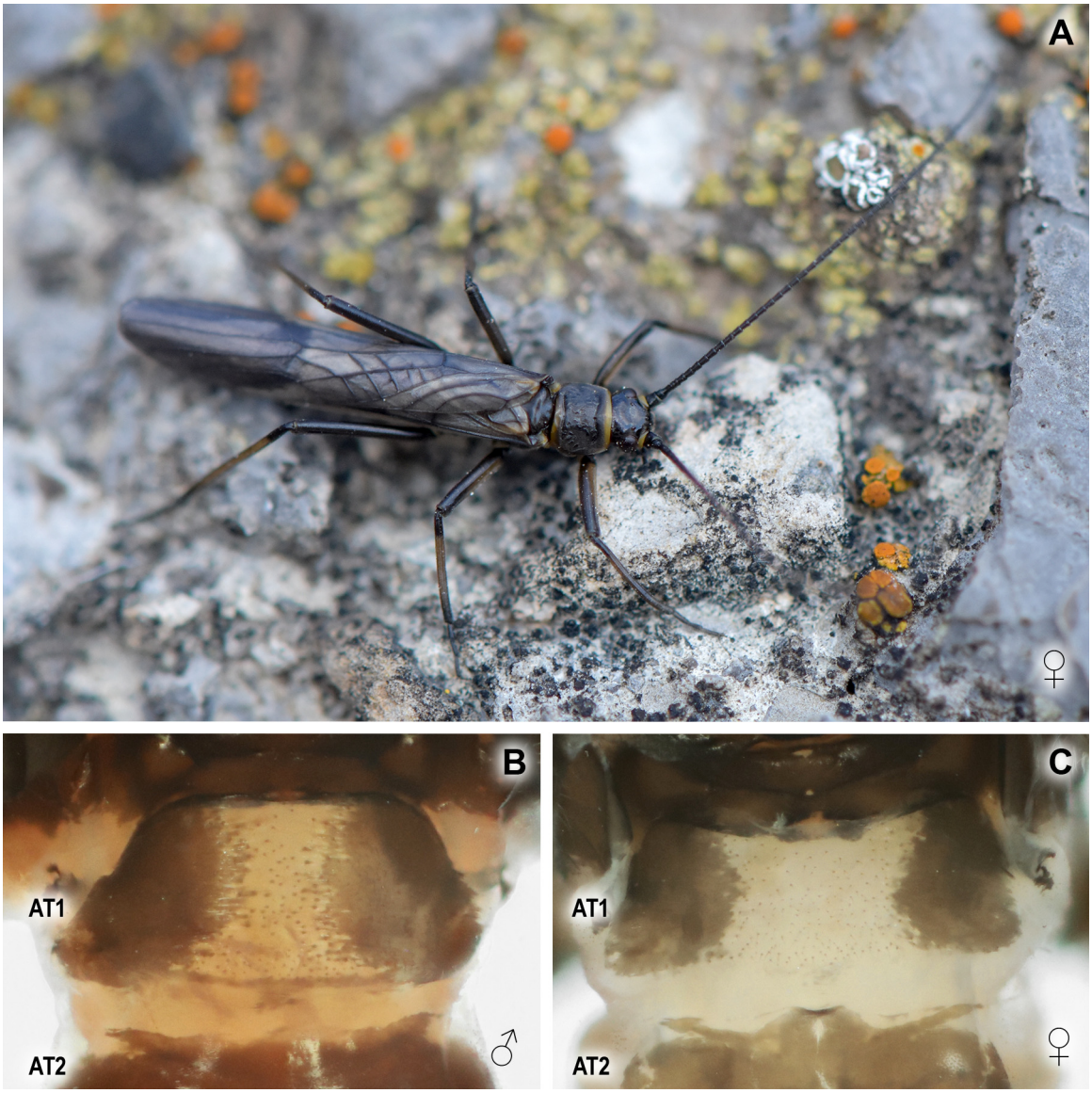

FIGURE 14. *Oemopteryx contorta,* Cove Creek, Tazewell Co., Virginia, adults. **A.** Live female. **B.** Male tergum one, dorsal. **C.** Female tergum one, dorsal. [morphological abbreviations: see Table 1].

Terminalia (Figs 16A–E). Abdominal segment-10 nested within segment-9. Anterior margin unsclerotized. Tergal sclerite-10 with a subtle medial cleft and paired submedial flattened anterior processes with raised scale-like armature (Figs 16A, 16C). Cercus 4-segmented, excluding vestigial apical segment (Figs 16A, 16D), and with a low, rounded, posteriorly directed basalcercal process covered in socketed setae and sensilla basiconica (Figs 16A, 16D). Basal plate of tergum-10 relatively flat, sclerotized with a wrinkled texture (Figs 16A, 16C). Lateral struts present, median strut absent; basal plate with a small medial point (Figs 16A, 16C). Basal bulb (Fig. 16A), glabrous, oval, bulbous, moderately sclerotized and with an oval inner bulb bearing a small hollow stalk, which terminates at a pore on the anterior face near the junction of the 2-processes of the anterior epiproct. Anterior epiproct prong fused to basal bulb, divided halfway to base, each arm terminating a distal facing, lightly-sclerotized foot-shaped process that is pointed at its apex and slightly recurved ventrally (Figs 16A–B, 16D–E). Posterior epiproct prong subdivided into 2-processes. Ventral process lightly sclerotized, divided near apex into 2-glabrous, rounded lobes (Figs 16A, 16E). Dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing 2–3 internal filaments that are not eversible; filaments sometimes visible on left side of basal bulb. Paraprocts subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical bi-lobed posterior paraprocts. Anterior paraproct, conical, medially directed, tapering to a point (Figs 16A, 16E); apical 1/4 subequal in width. Posterior

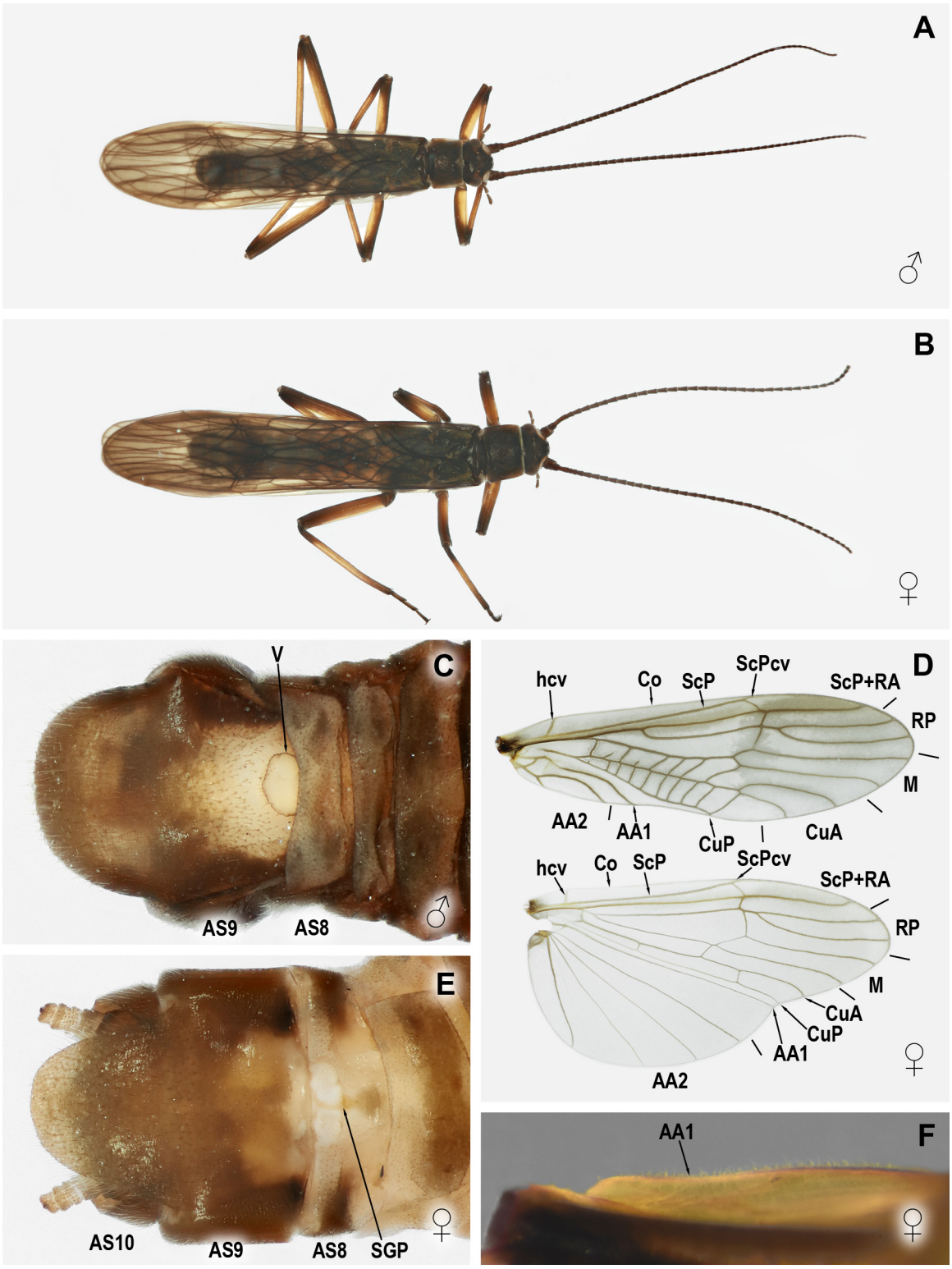

FIGURE 15. *Oemopteryx contorta,* Cove Creek, Tazewell Co., Virginia, adults. **A.** Male habitus, dorsal. **B.** Female habitus, dorsal. **C.** Male sterna, ventral. **D.** Female wings. **E.** Female sterna, ventral. **F.** Female forewing, lateral. [morphological abbreviations: see Table 1].

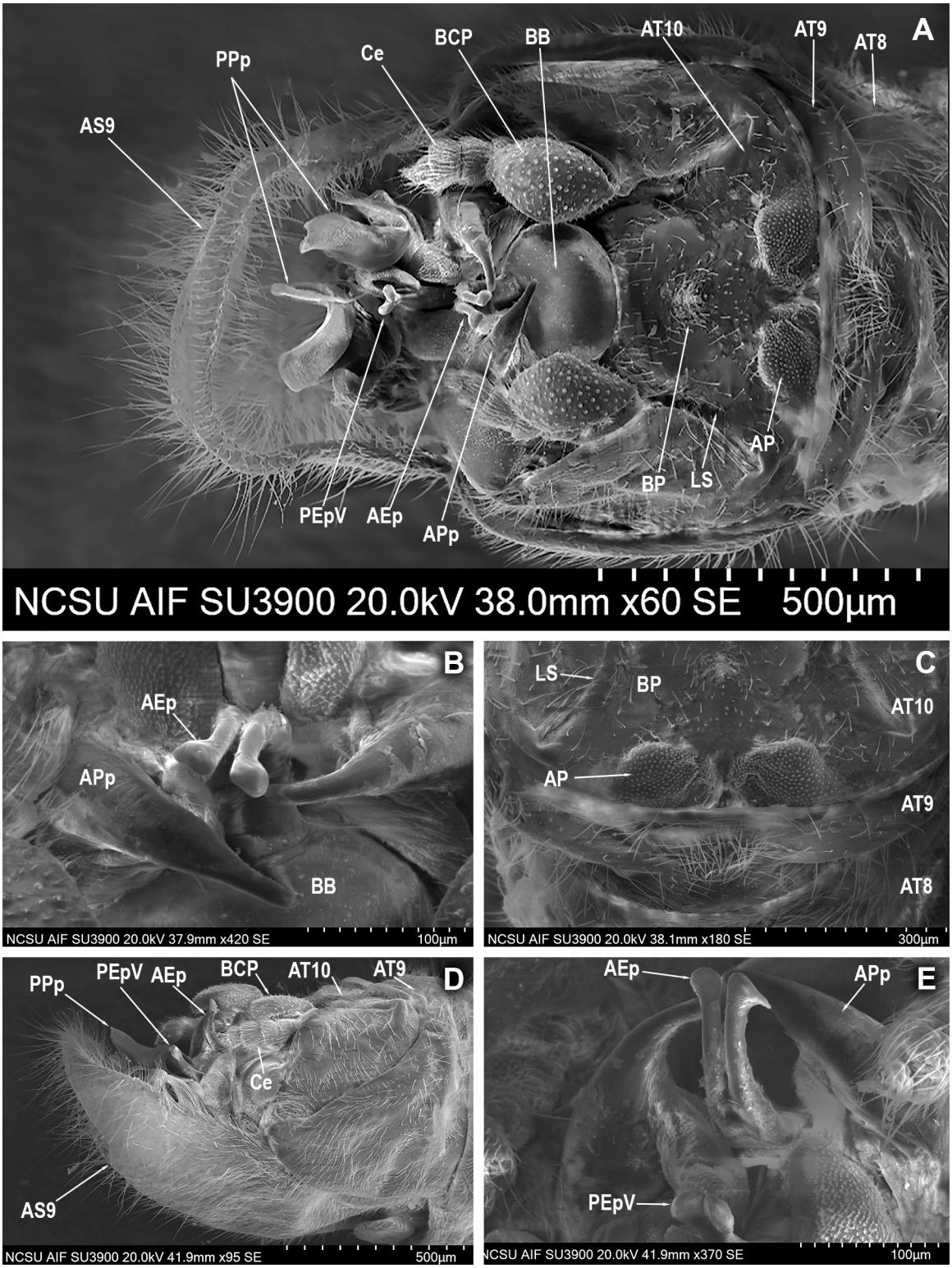

FIGURE 16. *Oemopteryx contorta,* Pool Creek, Rutherford Co., North Carolina, adult male. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** Abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

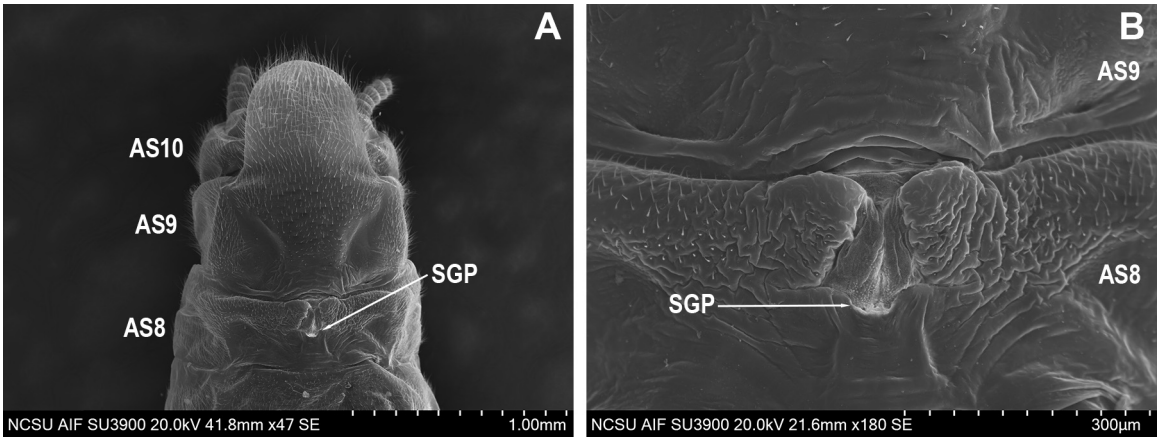

FIGURE 17. *Oemopteryx contorta,* Hall Creek, Burke Co., North Carolina, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

paraprocts (Figs 16A, 16D) subdivided, fused at base; left outer prong short, flattened and lightly sclerotized; left inner prong long, flattened, twisted and striated, terminating with an acute sclerotized spine; right outer prong flattened and moderately sclerotized. Right inner prong tubular, twisted and striated, tapering to apex.

Adult female (Figs 14A, 15B). Macropterous. Length of forewings 9.1–9.6 mm (n = 10). Length of body 7.7–9.1 mm (n = 10). General body color brown. Overall appearance similar to male. Wings hyaline; venation brown; Forewing with light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 15D). AA1 vein of forewing with short fine setae ≤0.5mm (Fig. 15F). Hindwing mottling less developed, absent in anal region (Fig. 15D). First abdominal tergite with a broad pale stripe medially (Fig. 14C); terga 2–8 uniformly brown dorsomedially; terga 9–10 sclerotized dorsally and laterally. Lateral margins of abdomen segments 1–8 unsclerotized. Sternum-8 weakly sclerotized. Subgenital plate weakly sclerotized (Fig. 15E) with a U-shaped notch and a lightly sclerotized medial tab, which may be enfolded (Figs 17A–B). Sternum-9 parabolic, produced just beyond the apex of abdominal segment-10 (Figs 15E, 17A); length of free portion of sternum 0.8X basal width; uniformly covered with long setae that become longer posteriorly; lateral margins slightly narrowing to a broadly rounded apex. Cercus 5–6 segmented, excluding vestigial apical segment (Figs 15E, 17A).

Ovum. Unknown.

Mature larva (Fig. 18A). Length of male body 7.0–8.4 mm (n = 10), female body 7.5–8.7 mm (n = 10). General color light-brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture with the head touching or approaching the abdomen apex, similar to other Taeniopterygidae.

Head (Fig. 18A). Dorsum of head light-brown with dark brown maculations variously developed. Antelabrum light-brown; anterior margin with a dense brush of golden setae. Postlabrum light-brown; anterior frontoclypeus pale to light-brown. Frons with a brown U-shaped marking with posterolateral extensions; light-brown subrectangular markings directly anterior to lateral ocelli. Interocellar area diffusely light-brown, pale at junction of ecdysial suture. Occipital area diffusely light-brown and with irregular brown rugosities. Eyes with pigmented ommatidia reduced, not reaching eye margins. Antennal scape, pedicel and flagella brown; dorsobasal apically inserted setae absent (Fig. 18C); antenna slightly shorter than body (Fig. 18A).

Maxilla (Figs 19A–B). Lacinia triangular with a straight inner margin. Lacinia with 2-apical, cupped teeth and 2–5 subapical denticles on ventral face. Apical teeth subequal in length; relative length of apical teeth to palm length difficult to discern due to wear. Inner palm margin19 stout socketed marginal setae below apical teeth; first marginal seta robust. Basal 1/3 of palm with a cluster of >10 thin dorsal setae. A single acutely pointed sensilla basiconica on palm surface near the basal 1/5. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 1/4; a thin patch of setae on inner margin below apical setae, which extends about halfway to base. Length of galea, including apical setae, 1.1X length of lacinia; width of galea 1.1X the lacinia width. Maxillary palp with 5-segments; 2X length of lacinia; palp with sensilla basiconica sparsely scattered over entire surface.

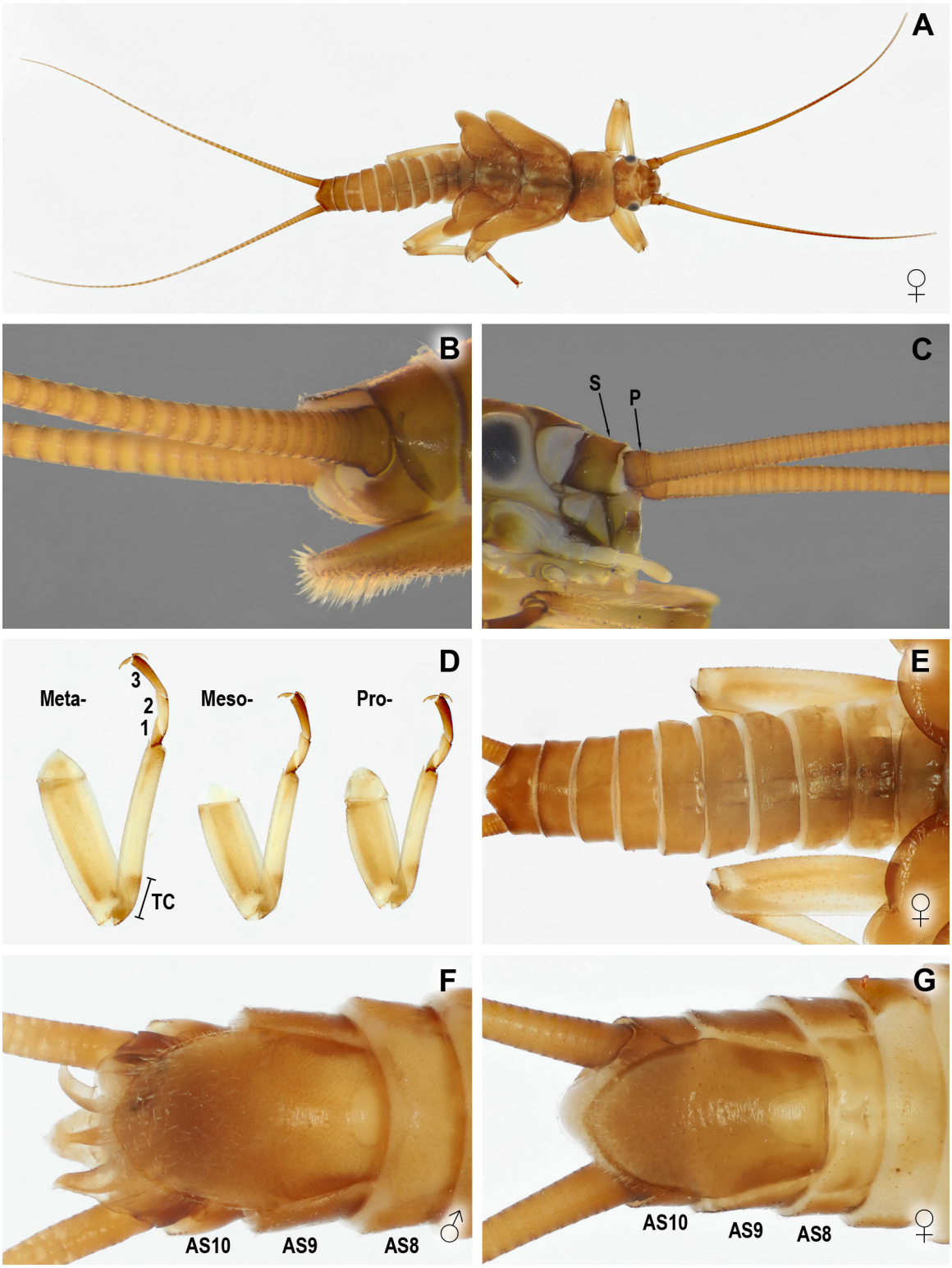

FIGURE 18. *Oemopteryx contorta,* South Brook, Wyoming Co., Pennsylvania, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, ventral. **G.** Female sterna, ventral. [morphological abbreviations: see Table 1].

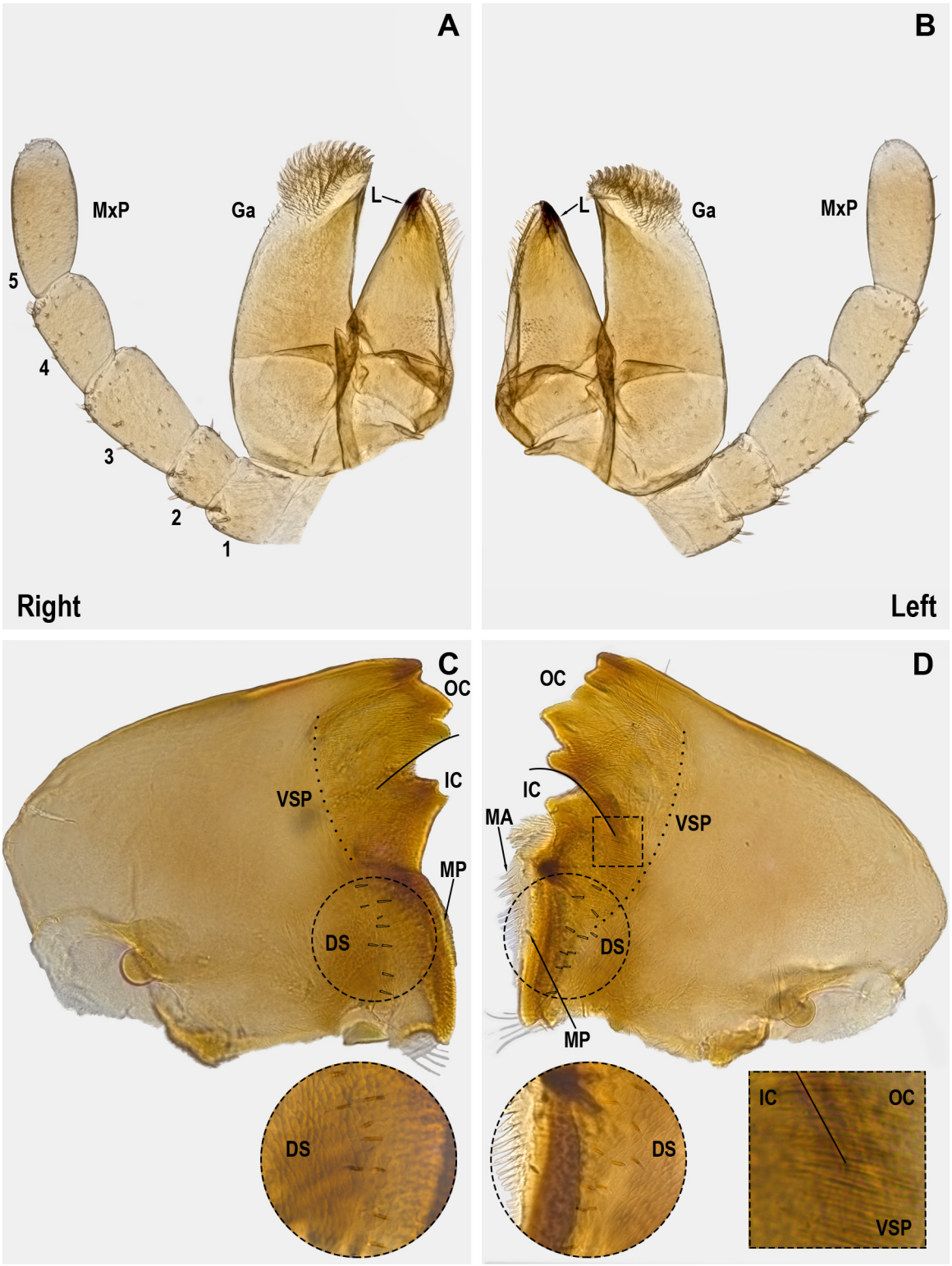

FIGURE 19. *Oemopteryx contorta,* UT Lake Stahehe, Franklin Co., New York, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp. **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventro-apical setal patch (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

Mandible. Right mandible (Fig. 19C) bicuspid, outer cusp with 3-teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of pointed acanthae (length 2.1X width). Palm dorsum with 9–11 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 19C circle inset); the proximal basal corner with a marginal patch of 3-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 19C). Left mandible (Fig. 19D) bicuspid, outer cusp with 5-teeth, inner cusp with 1-broad concave tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 4.0X width). Palm dorsum with 1–12 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 19D circle inset); the proximal basal corner with a marginal patch of 5-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 19D, square inset).

Thorax (Fig. 18A). Pronotum wider posteriorly; light-brown with faint rugosities and a pale posteromedial spot. Length of forewing pad 3.3X width. Length of hindwing pad 1.8X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with light-brown spicules laterally and a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules dense medially and sporadic distally. Mesothorax with an oval prefurcasternal pit; light-brown spicules present both anterior and posterior to pit; lateral areas glabrous. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, as long as wide (length 1.0X width). Metathoracic basisterna with a medial patch of light-brown spicules and a pair of furcasternal pits. Anterior face of femur usually pale, darker distally; dorsum pale (Fig. 18D). Femur and tibia with a dorsal fringe of silky setae (not shown); length of femoral setae less than 1/2 the width of the femur; length of tibial setae about equal to tibial width. Anterior and posterior faces of the femur with scattered short stout setae. Tibial callus darkened (Fig. 18D). Tarsus with a sparse dorsal fringe of silky setae (not shown); tarsus light-brown and becoming progressively darker distally. Venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen usually uniformly light-brown; sometimes darker anteriorly and lighter posteriorly on posterior segments (Fig. 18E). Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of tergum-8 and tergum-9 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 1–8 with light-brown spicules. Sternum-9 with an elongate plate (male = length 1.5X width; female = length 1.5X width); plate width relative to sternal width (male = 0.9X; female = 0.8X). Male plate (Fig. 18F) with sides slightly widening towards posterior margin of sternum-9, posterolateral margins convex, evenly rounded towards apex. Female plate (Fig. 18G) narrower basally, widest at posterior margin of sternum-9; posterolateral margins convex, evenly narrowing towards apex. Plates of both males and females with stout setae sparse on basal half, becoming denser towards apex. Cercus uniformly brown; dorsobasal apically inserted setae absent (Fig. 18B); cercus about as long as body (Fig. 18A).

Diagnosis. *Oemopteryx contorta* is defined in the adult male by the anterior processes on tergum-10 and by the presence of a distinctive broad pale strip on tergum-1, which the female also possesses. The larvae are usually separable from *O. bimaculata* **sp. nov.** by the concolorous abdominal terga. *Oemopteryx contorta* also differs from *O. tuscarora* **sp. nov.** by its darkened tibial callus, a character it shares with *O. bimaculata* **sp. nov.**

Biological notes. *Oemopteryx contorta* is endemic to the Appalachian Mountains with records known from at least five EPA Level III ecoregions (Blue Ridge, Ridge and Valley, Central and North Central Appalachians and the Northeast Highlands), in at least ten states ranging from Tennessee north to Maine. Verdone *et al.* (2017) reported *O. contorta* from Georgia, but this record now pertains to *O. bimaculata* **sp. nov.** as described above. *Oemopteryx contorta* is expected to occur in the Blue Ridge EPA Level III ecoregion in Georgia, but no specimens are currently known. Additionally, records of *O. contorta* from Alabama reported by Grubbs (2006) are considered dubious given their location in the Southwestern Appalachians Level III ecoregion. These specimens could not be located to confirm their identity. Elevations of collection locations range between 135 m to 1720 m ASL. Larvae have been collected from streams with drainage areas ranging from 0.8 km^2 to 104.7 km^2. Nelson (1982) first described the larva of *O. contorta* and reported a univoltine life cycle for this taxon.

Based on known records, *O. contorta* appears to be allopatric with *O. bimaculata* and *O. tuscarora* **sp. nov.** Both *O. contorta* and *O. bimaculata* **sp. nov.** occur in the Central Appalachians; however, *O. contorta* appears to be distributed north and east of the Dissected Appalachian Plateau Level IV ecoregion, which may be a basis for which to delineate the ranges of the two species. Available records indicate adults are typically active from mid-January to late April; however, females have been collected as late as mid-June at higher elevations and northern latitudes.

The North Carolina Biological Assessment Branch has just one larval record of *O. contorta* and consequently, a pollution tolerance value is currently unknown for this taxon. NatureServe (2024) has assigned this species a conservation rank of G4, defined as a low risk of extinction due to its extensive range and numerous populations, but with possible cause for some concern as a result of threats to habitat, or other factors.

***Oemopteryx tuscarora* sp. nov. Verdone, Beaty, Holland & Williams**
(Figs 20–25)
Sand Hills Willowfly

Etymology. This species is named in honor of the Tuscarora Nation of North Carolina that lived throughout much of eastern North Carolina and was considered the most powerful and developed tribe in the region (Parramore 2006). The name is used as a noun of feminine gender. The common name "Sand Hills Willowfly" is proposed for this species.

Distribution. USA.—NC (Fig. 6).

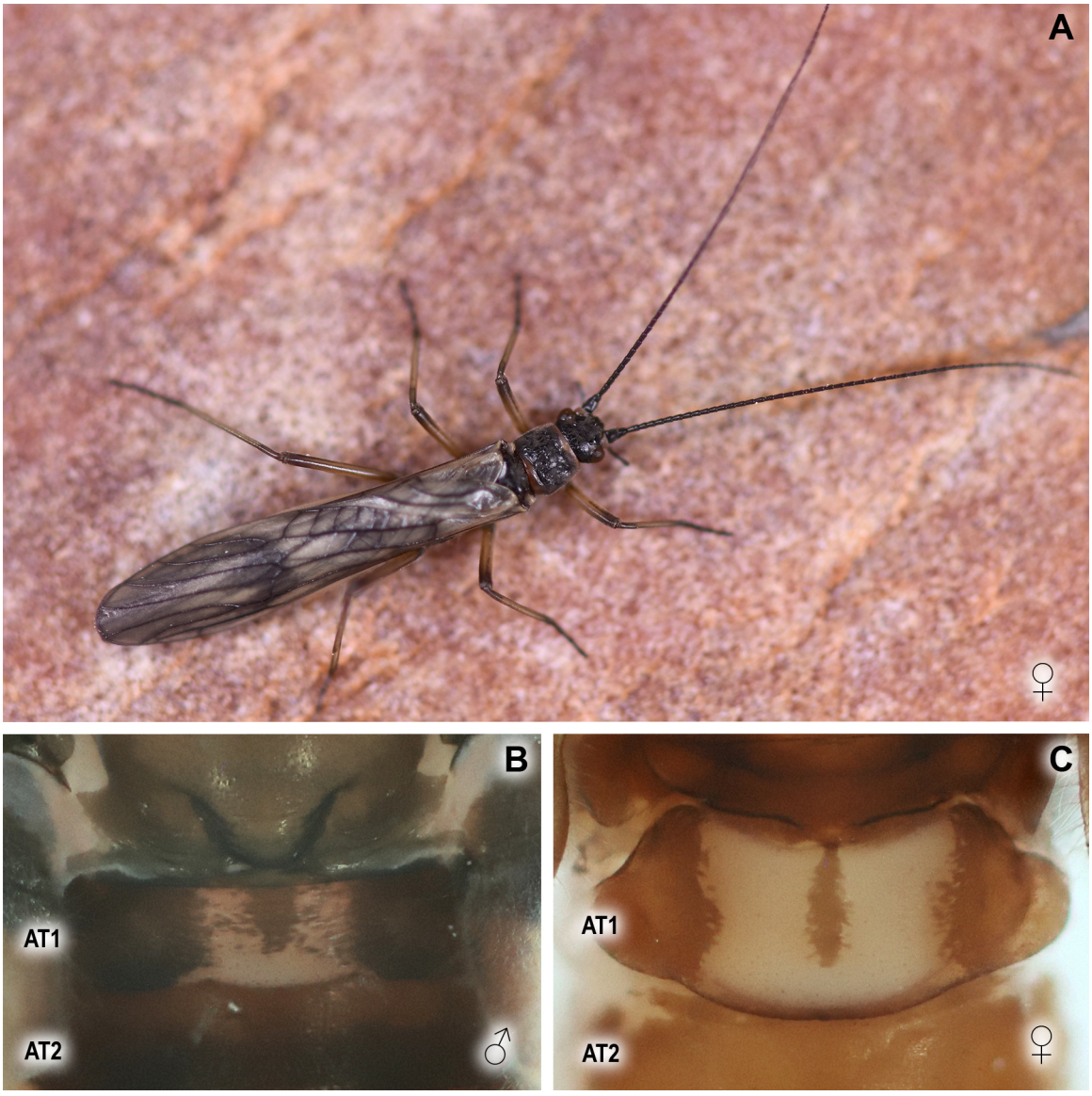

FIGURE 20. *Oemopteryx tuscarora* **sp. nov.**, Haystack Creek, Moore Co., North Carolina, adults. **A.** Live female. **B.** Male tergum one, dorsal. **C.** Female tergum one, dorsal. [morphological abbreviations: see Table 1].

Material examined. *Holotype* M: **USA.—North Carolina: Moore Co.,** Haystack Creek, Camp Reeves, 35.33889, -79.56610, 4 March 2021, C. Verdone, S. Beaty, V. Holland, J. DeBerardinis (USNM). *Paratypes*: **North Carolina: Hoke Co.,** Flat Creek, Manchester Rd., 35.18274, -79.17723, 9 January 2019, C. Verdone. S. Beaty, D. Donahoe, 1L (NCDWR); same location, 13 February 2019, C. Verdone, S. Beaty, E. Fleek, 1L (NCDWR). **Moore Co.,** Haystack Creek, nr. Mouth, Camp Reeves, 35.33889, -79.56610, 6 March 1986, T. McPherson, 10L (NCDWR); Haystack Creek, Camp Reeves, 35.33889, -79.56610, 23 February 2021, emerged 24 February 2021, C. Verdone, S. Beaty 1F, 1E (NCDWR); same location, 25 February 2021, C. Verdone, S. Beaty, V. Holland, J. DeBerardinis, 28L (NCDWR); same data, emerged 26 February 2021, 1M, 1E (NCDWR); same data, emerged 28 February 2021, 1M, 1E (NCDWR); same data, emerged 1 March 2021, 1M, 1E (NCDWR); same data, emerged 1 March 2021, 1F, 1E (NCDWR); same data, emerged 2 March 2021, 2F, 2E (NCDWR); same location, 4 March 2021, emerged 5 March 2021, C. Verdone, S. Beaty, V. Holland, 1F, 1E (NCDWR); same data, emerged 8 March 2021, 1F, 1E (NCDWR); same data, emerged 9 March 2021, 1M, 1E, (NCDWR); same data, emerged 10 March 2021, 1F, 1E, (NCDWR); same data, emerged 10 March 2021, 1F, 1E, (NCDWR); same data, emerged 12 March 2021, 1M, 1E, (NCDWR); same data, emerged 13 March 2021, 1F, 1E, (NCDWR); same data, 1L (NCDWR); same location, 1 April 2021, 1L (NCDWR); same location, 18 February 2022, C. Verdone, B. Williams, 10L (NCDWR); same data, emerged 19 February 2022 1F, 1E; same data, emerged 21 February 2022, 2F, 2E (NCDWR); same data, emerged 23 February 2022, 1M, 1F, 2E (NCDWR); same location, 25 February 2022, C. Verdone, S. Beaty, V. Holland, 3L (NCDWR); same data, emerged 28 February 2022, 2F, 2E (NCDWR); same data, emerged 2 March 2022, C. Verdone, S. Beaty, V. Holland, 1M, 1E (NCDWR); same data, emerged 3 March 2022, 1M, 1E (NCDWR). **Richmond Co.,** Rocky Ford Branch, Gibson Mill Rd., 35.12360, -79.66283, 8 February 2023, C. Verdone, V. Holland. D. Harwood, 1L (NCDWR); Rocky Fork Creek, Gibson Mill Rd., 35.06448, -79.69316, 8 February 2023, C. Verdone, V. Holland, D. Harwood, 1L (NCDWR).

Adult male (Fig. 21A). Macropterous. Length of forewings 7.7–8.1 mm (n = 6). Length of body 6.1–7.9 mm (n = 10). General body color dark-brown.

Head. (Fig. 21A). Dorsum of head mostly dark-brown. Labrum pale anteriorly, brown posteriorly. Anterior frontoclypeus light-brown. Frons with a dark-brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella dark brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Rugosities anterolateral to lateral ocelli and ecdysial suture. Pale triangular areas distal of lateral ocelli and posterior to ecdysial suture, often appearing rectangular due to darker pigment on anterior half. Interocellar area uniformly dark-brown and slightly depressed. Occiput with dark brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Fig. 21A). Pronotum subquadrate, wider than long (length 0.8X width) with posterior width slightly wider than anterior width; brown overall with darker rugosities. Anterior and posterior margins of pronotal flange often pale. Disk with irregular dark rugosities; a transverse furrow at anterior 1/4. Prosternum moderately sclerotized. Meso- and metathorax dark-brown, heavily sclerotized dorsally and ventrally. Thoracic nota and coxae uniformly covered with sparse, short, fine clothing hairs. Legs with contrasting pigment. Femur pale with an incomplete mottled brown stripe on the anterodorsal and posterodorsal faces; distal portion of femur with darker pigment. Tibia light-brown, darker brown on distally, proximal callus pale; apex of tibiae with 2-stout apical spines. Tarsus dark-brown. Legs uniformly covered with dark, short stout setae. Wings hyaline; venation brown. Forewing with light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked. Hindwing mottling less developed, absent in anal region.

Abdomen. Dorsum of tergum-1 with a U-shaped pale area (Fig. 20B). Abdominal segments 1–9 lightly covered with short, fine clothing hairs. Terga 2–7 uniformly brown; terga 8–9 with a posteromedial membranous cleft. Sterna 1–9 uniformly brown; sterna 2–8 with a pair of anterior sublateral oval brown spots. Sternum-9 with a lightly sclerotized, broadly circular vesicle (Fig. 21C) that is attached to sternum-9 from directly beneath the vesicle. Sternum-9 elongated into a scooped plate (Fig. 22D), width subequal from base to apex (Fig. 21C); apex square with rounded lateral margins (Fig. 22A); plate with numerous long setae on dorsal and ventral surfaces (Figs 22A, D); plate covering sternum-10 ventrally and extending beyond.

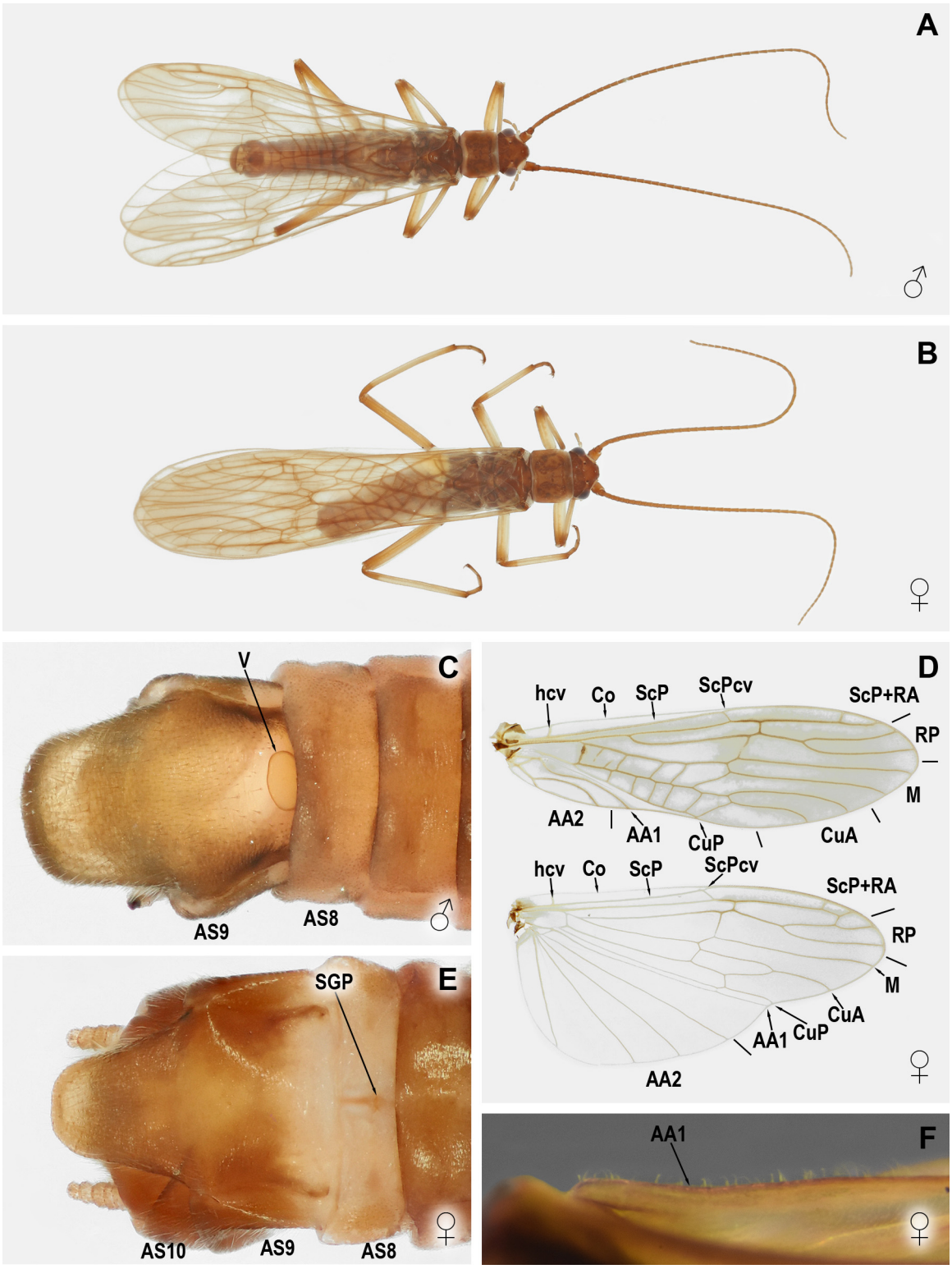

FIGURE 21. *Oemopteryx tuscarora* **sp. nov.**, Haystack Creek, Moore Co., North Carolina, adults. **A.** Male habitus, dorsal. **B.** Female habitus, dorsal. **C.** Male sterna, ventral. **D.** Female wings. **E.** Female sterna, ventral. **F.** Female forewing, lateral. [morphological abbreviations: see Table 1].

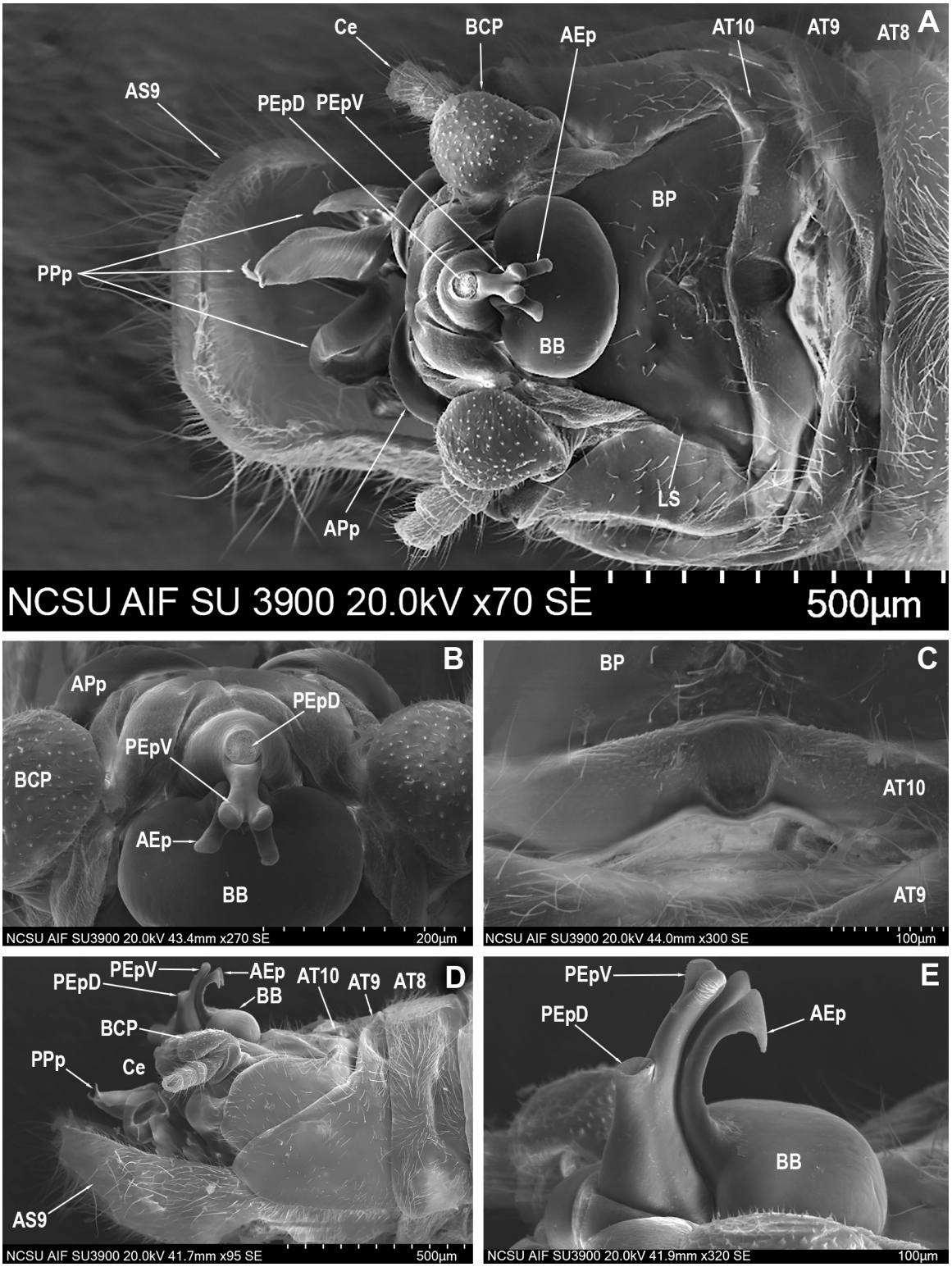

FIGURE 22. *Oemopteryx tuscarora* **sp. nov.**, Haystack Creek, Moore Co., North Carolina, adult male. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** Abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

Terminalia (Figs 22A–E). Abdominal segment-10 nested within segment-9. Anterior margin unsclerotized. Tergal sclerite-10 with a subtle medial cleft, paired anterior processes absent (Figs 22A, 22C). Cercus 4-segmented, excluding vestigial apical segment (Figs 22A, 22D), and with a low, rounded, posteriorly directed basalcercal process covered in socketed setae and sensilla basiconica (Figs 22A–B, 22D). Basal plate of tergum-10 relatively flat, sclerotized with a wrinkled texture (Fig. 22A). Lateral struts present, median strut absent, but with a small medial point (Fig. 22A). Basal bulb (Figs 22A–B), glabrous, oval, bulbous, moderately sclerotized and with an oval inner bulb bearing a small hollow stalk, which terminates at a pore on the anterior face near the junction of the 2-anterior epiproct processes. Anterior epiproct prong fused to basal bulb, divided halfway to base, each arm terminating an anteriorly facing sclerotized foot-shaped process that it pointed at its apex and recurved ventrally (Figs 22A–B, 22D–E). Posterior epiproct prong closely appressed to anterior prong and subdivided into 2-processes. Ventral process lightly sclerotized, divided near apex into 2-glabrous, rounded lobes (Figs 22A–B, 22D–E). Dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing 2–3 internal filaments that are not eversible (Figs 22A–B, 22D–E); filaments sometimes visible on left side of basal bulb. Paraprocts subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical, bi-lobed posterior paraprocts. Anterior paraproct, conical, medially directed, evenly tapering to a point (Figs 22A–B). Posterior paraprocts (Figs 22A, 22D) subdivided, fused near bases. Left outer prong short, flattened and lightly sclerotized. Left inner prong long, flattened, twisted and striated, terminating with an acute sclerotized spine. Right outer prong short, flattened and moderately sclerotized. Right inner prong tubular, twisted and striated, tapering to apex.

Adult female (Figs 20A, 21B). Macropterous. Length of forewings 8.5–8.9 mm (n = 6). Length of body 6.9–7.5 mm (n = 10). General body color brown. Overall appearance similar to male. Wings hyaline; venation brown. Forewing with light mottling; without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 21D). AA1 vein of forewing with short fine setae ≤0.5mm (Fig. 21F). Hindwing mottling less developed, absent in anal region (Fig. 21D). Dorsum of tergum-1 with a U-shaped pale area (Fig. 20C); terga 2–8 uniformly brown dorsomedially; terga 9–10 sclerotized dorsally and laterally. Lateral margins of abdomen segments 1–8 unsclerotized. Sternum-8 weakly sclerotized (Fig. 21E). Subgenital plate weakly sclerotized (Fig. 21E), but with a lightly sclerotized medial tab (Figs 23A–B). Sternum-9 parabolic, produced just beyond the apex of abdominal segment-10 (Figs 21E, 23A); length of free portion of sternum-9 0.8X basal width; uniformly covered with long setae that become longer posteriorly; lateral margins slightly narrowing to a truncated apex. Cercus 4–5 segmented, excluding vestigial apical segment (Figs 21E, 23A).

Ovum. Unknown.

Mature larva (Fig. 24A). Length of male body 5.7–7.9 mm (n = 6), female body 7.7–9.2 mm (n = 6). General color light-brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture with the head touching or approaching the abdomen apex, similar to other Taeniopterygidae.

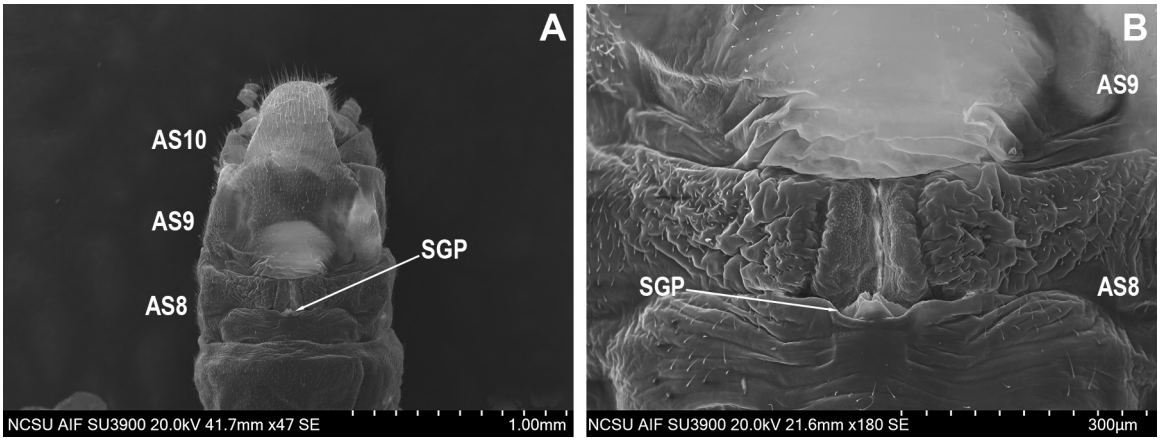

FIGURE 23. *Oemopteryx tuscarora* **sp. nov.**, Haystack Creek, Moore Co., North Carolina, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

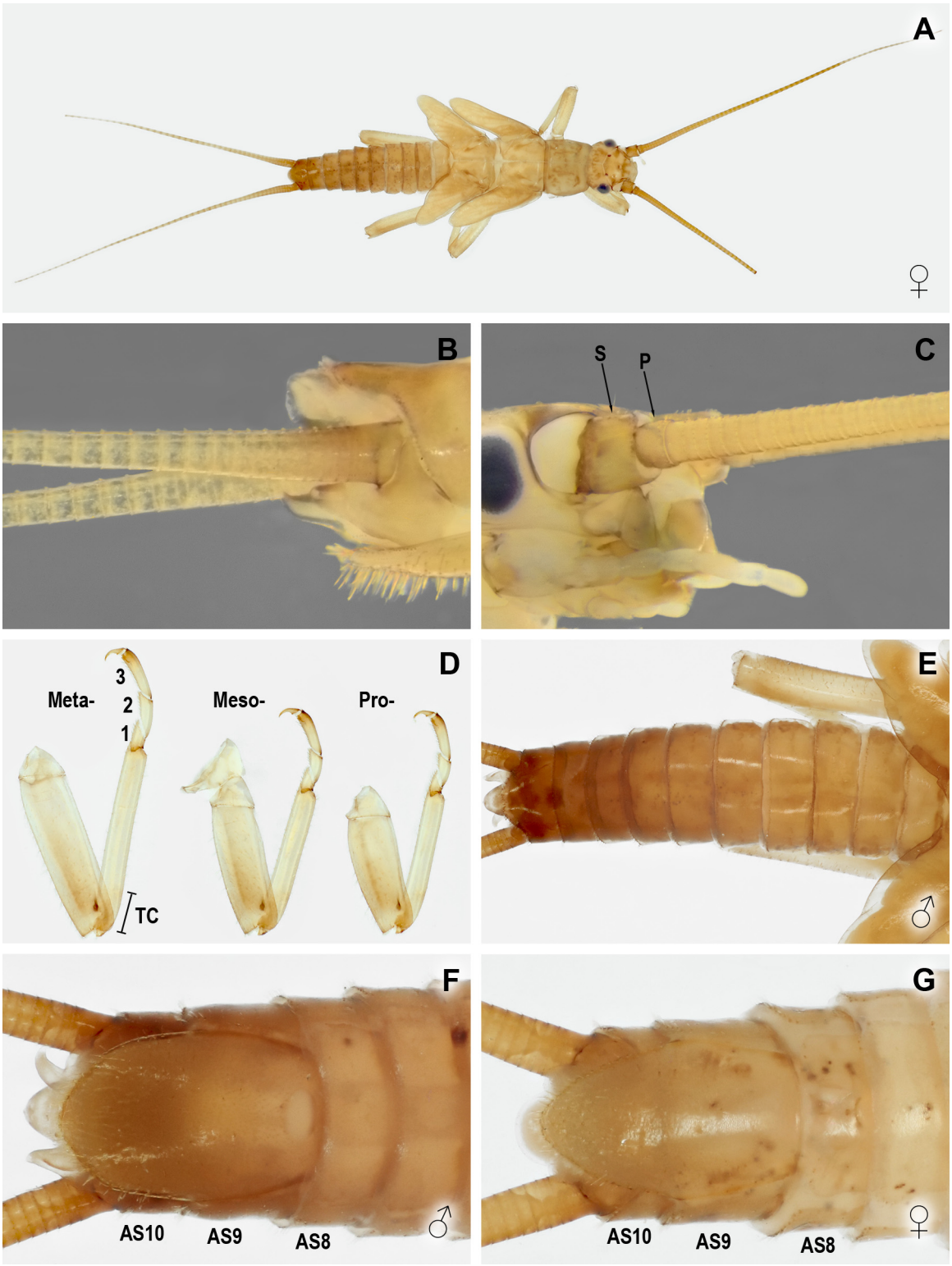

FIGURE 24. *Oemopteryx tuscarora* **sp. nov.**, Haystack Creek, Moore Co., North Carolina, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, ventral. **G.** Female sterna, ventral. [morphological abbreviations: see Table 1].

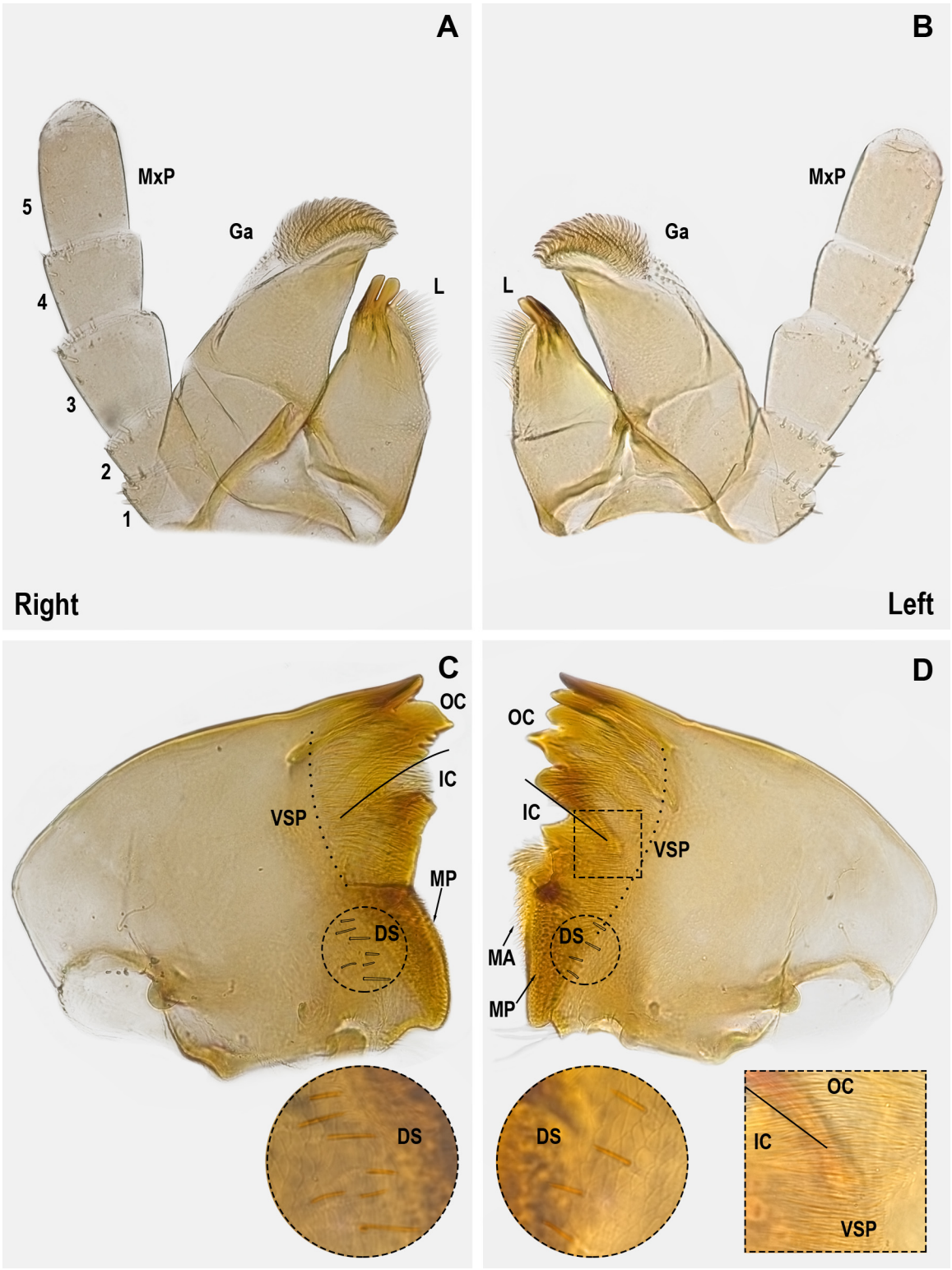

FIGURE 25. *Oemopteryx tuscarora* **sp. nov.**, Haystack Creek, Moore Co., North Carolina, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp. **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventro-apical setal patch (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

Head (Fig. 24A). Dorsum of head light-brown with darker brown maculations variously developed. Antelabrum light-brown; anterior margin with a dense brush of golden setae. Postlabrum pale. Anterior frontoclypeus pale. Frons with a brown U-shaped marking with posterolateral extensions; light-brown subrectangular markings directly anterior to lateral ocelli. Interocellar area diffusely light-brown. Occipital area diffusely light-brown near ecdysial suture and with irregular brown rugosities. Eyes with pigmented ommatidia reduced, not reaching eye margins. A single long seta both anterior and posterior to eyes. Antennal scape brown; scape and flagella light-brown; dorsobasal apically inserted setae absent (Fig. 24C); antenna slightly shorter than body (Fig. 24A).

Maxilla (Figs 25A–B). Lacinia triangular with a sinuous inner margin. Lacinia with 2-apical, cupped teeth and 3–4 subapical denticles on ventral face. Apical teeth subequal in length; length of apical teeth 0.3X palm length and 0.6X palm width. Inner palm margin with 19-stout socketed marginal setae below apical teeth; first marginal seta robust. Basal 1/3 of palm with a cluster of 6–8 thin dorsal setae. A single acutely pointed sensilla basiconica on palm surface near the basal 1/4. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 2/3; a thin patch of setae on inner margin below apical setae, which extends about halfway to base. Length of galea, including apical setae, 1.3X length of lacinia; width of galea 1.1X the lacinia width. Maxillary palp with 5-segments; 1.7X length of lacinia; palp with sensilla basiconica developed primarily on the apical and distal margins of each segment; segments 3–4 with 1–2 short hair-like sensillae.

Mandible. Right mandible (Fig. 25C) bicuspid, outer cusp with 3-teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of pointed acanthae (length 1.0X width). Palm dorsum with 4-dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 25C circle inset); the proximal basal corner with a marginal patch of 3-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 25C). Left mandible (Fig. 25D) bicuspid, outer cusp with 5-teeth, basal cusp with 1-broad concave tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 2.0X width). Palm dorsum 4–6 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 25D circle inset); proximal basal corner with a marginal patch of 3-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 25D, square inset).

Thorax (Fig. 24A). Pronotum wider posteriorly; light-brown with faint rugosities; Length of forewing pad 3.3X width; length of hindwing pad 1.8X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with light-brown spicules laterally and a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules dense medially and sporadic distally. Mesothorax with an oval prefurcasternal pit; light-brown spicules present both anterior and posterior to pit; lateral areas glabrous. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, longer than wide (length 1.2X width). Metathoracic basisterna with a medial patch of light-brown spicules and a pair of furcasternal pits. Anterior face of femur usually pale, darker distally (Fig. 24D). Femur and tibia pale and with a fringe of silky setae (not shown); length of femoral setae about 1/2 the width of the femur; length of tibial setae about equal to tibial width. Anterior and posterior faces of the femur with scattered short stout setae. Tibial callus pale (Fig. 24D). Tarsus with a sparse dorsal fringe of silky setae (not shown); tarsus pale to light-brown and becoming progressively darker towards distal half of tarsal segment 3. Venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen uniformly light-brown (Fig. 24E). Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of tergum-8 and tergum-9 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 1–8 with light-brown spicules. Sternum-9 with an elongate plate (male = length 1.7X width; female = length 1.9X width); plate width relative to sternal width (male = 0.8X; female = 0.8X). Male plate (Fig. 24F) with sides parallel past the posterior margin of sternum-9, posterolateral margins convex, evenly rounded towards apex. Female plate (Fig. 24G) narrower basally, widest at posterior margin of sternum-9; posterolateral margins convex, evenly narrowing towards apex. Plates of both males and females with short stout setae sparse basally, becoming denser towards apex. Cercus uniformly brown; dorsobasal apically inserted setae absent (Fig. 24B); cercus longer than body (Fig. 24A).

Diagnosis. *Oemopteryx tuscarora* **sp. nov.** is defined in the adult male by the lack of paired anterior processes on tergum-10 in addition to a U-shaped pale area on tergum-1, which the female also possesses. The larvae are defined by their pale tibial callus.

FIGURE 26. *Oemopteryx tuscarora* **sp. nov.**, type locality, Haystack Creek, Moore Co., North Carolina. **A–B.** Haystack Creek before timber harvest. **C.** Haystack Creek after timber harvest.

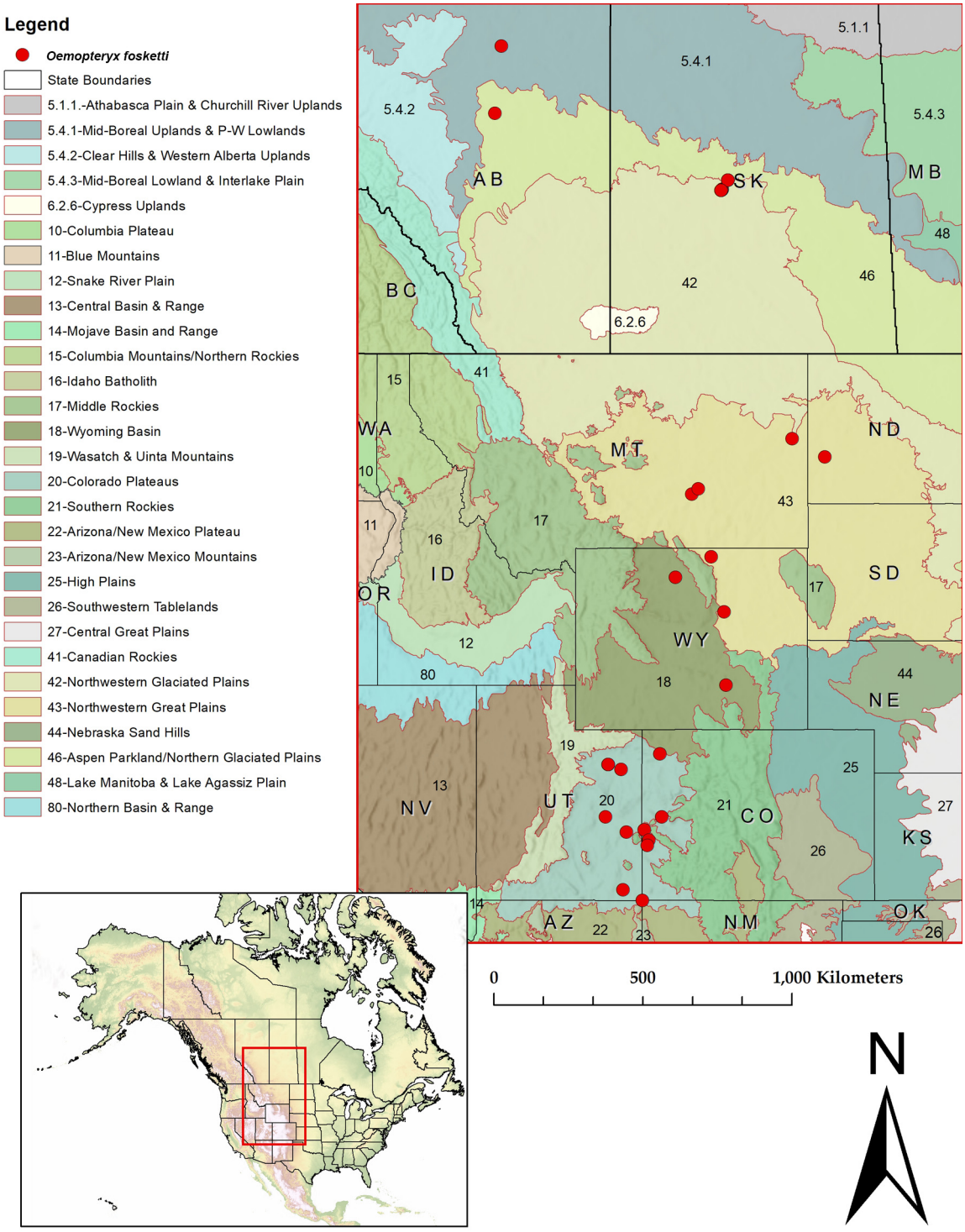

FIGURE 27. Distribution map of *Oemopteryx fosketti.* Records include examined material and unpublished data from the CNCI.

Type locality (Figs 24A–C). Haystack Creek is a small ecotonal tributary of Suck Creek located within the Boy Scouts of America Camp Reeves property in Moore County, North Carolina. The collection site is 152 m ASL and has a drainage area of just 1.7 km^2 before it flows into John Beard Lake. The creek possesses characteristics of streams from both the Slate Belt and Sand Hills Level IV ecoregions. Substrates consist of gravel, sand, cobble, petrified wood, woody debris and coarse particulate organic matter.

Water quality at the type locality has been assessed four times since 1984 using North Carolina Biotic Index protocols (Lenat 1993; NCDEQ 2016). In April 2024, Haystack Creek rated "Good" boasting an EPT richness of 26 taxa. In total, at least 125 aquatic taxa have been recorded from the site. Other notable stoneflies collected from the creek include *Leuctra alta* James, 1974, *Prostoia hallasi* Kondratieff & Kirchner, 1984, *Zealeuctra uwharrie* Verdone, Beaty, Holland & Kondratieff, 2019, and an undescribed species of *Isoperla* Banks, 1906.

Haystack Creek is the only location where a robust population of the new species occurs and while half the watershed is conserved as a Boy Scout camp, the other half is managed for timber. The southwest side of the watershed was clear cut in 2023 and additional logging is planned for 2025. The North Carolina Biological Assessment Branch is currently studying the impact of the clearing on the macroinvertebrate assemblage.

Biological notes. Though many streams were surveyed, *O. tuscarora* **sp. nov.** has only been recorded from three locations in the Sand Hills Level IV ecoregion in North Carolina, where it is thought to be endemic. Due to the few known occurrences, a pollution tolerance value is currently unknown for this taxon. Elevations of collection locations range between 60 m to 152 m ASL. Based on known records, the new species appears to be allopatric with *O. contorta*, which occurs in the mountainous ecoregions of the Appalachians. Available records indicate adults are active from late February to mid-March. Larvae were most common in clean gravel riffles and have been collected from streams with drainage areas ranging from 1.7 km^2 to 22.9 km^2. Larvae were not present in benthic samples during the late spring through the end of October 2024, suggesting egg or larval diapause to survive low water levels and high summer temperatures that affect the small streams from which this species in known. The species appears to exhibit a univoltine life cycle.

Because of its rarity and geographic location, *O. tuscarora* **sp. nov.** is vulnerable to extirpation due to habitat loss and climate change. Much of the general area including the type locality are subject to periodic timber harvesting. This combined with changes to precipitation patterns and increasing temperatures could pose a threat to the long term viability of this little known animal. A conservation rank of G1 was calculated for this species indicating a high risk of extinction or collapse because of an exceptionally narrow range and few populations or occurrences (NatureServe 2020).

The *O. glacialis* Group

Oemopteryx fosketti (Ricker, 1965)

Figs (28–32)

Saskatoon Willowfly

Brachyptera fosketti Ricker, 1965: 475. Holotype male (CNCI), [Clarkboro Ferry], Saskatchewan, Canada.
Brachyptera zelona Ricker, 1965: 477. Holotype male (INHS), Plecoptera 1584; [Duchesne River] Myton, Duchesne Co., Utah, USA. Syn. Zwick, 1973: 313.
Oemopteryx fosketti: Zwick 1973: 313.
Oemopteryx fosketti: Dosdall & Lehmkuhl 1979: 23.
Oemopteryx fosketti: Kondratieff & Baumann 2002: 392.
Oemopteryx fosketti: Stewart & Oswood 2006: 107.
Oemopteryx fosketti: Kondratieff & Baumann 2009b: 221.
Oemopteryx fosketti: Dosdall & Giberson 2014: 217.

Distribution. Canada—AB, MB, SK. USA.—CO, MT, ND, UT (Fig. 27)

Material examined. **Canada—Alberta: Athabasca Co.,** Athabasca River, Athabasca, [54.72233, -113.28583], 7 April 1999, E. Fuller, 12M, 1F (CSUIC). **City of Edmonton**, Edmonton, North Saskatchewan River, [53.53990, -113.48193], 10 April 1993, E. Fuller, 10M, 3F (CSUIC). **USA.—Colorado: Mesa Co.,** Dolores River, [Hwy 121] at Gateway, [38.68051, -108.98019], 3 March 1990, B. Kondratieff, J. Welch, 26M, 12F, 16L (CSUIC); same location, 17 March 2011, B. Kondratieff, R. Durfee, 1M (CSUIC). **Moffat Co.,** Yampa River, Deerlodge [Park Campground],

Dinosaur National Monument, [40.44637, -108.51164], Nelson, Anderson, 5M, 1F (CSUIC). **Montezuma Co.,** San Juan River, Hwy 160, Four Corners, [37.00245, -109.03225] March 2001, B. Kondratieff, 7F (CSUIC). **Montrose Co.,** Dolores River, [Hwy 141] at Mesa Creek, [38.43767, -108.83944], 3 March 1990, B. Kondratieff, J. Welch, 4M, 1F, 17L (CSUIC); Dolores River, at Bedrock [Hwy 90], [38.31048, -108.88575], 3 March 1990, B. Kondratieff, J. Welch, 8M, 4F (CSUIC). **North Dakota: Billings Co.,** Little Missouri River, Medora, [46.916613, -103.53161], 9 March 1998, C. Milue, 3M, 1F (CSUIC). **Utah: Grand Co.,** Colorado River, Hwy 128, mi 4.5, [38.62413, -109.51324], 9 March 1995, S. Fitzgerald, A. Foley, 20F (CSUIC). **San Juan Co.,** San Juan River, Hwy 191, Sand Island Campground, 37.25812, -109.61926, 11 March 2017, C. Verdone, F. Lichtner, 1F (CSUIC). **Wyoming: Big Horn Co.,** Big Horn River, Hwy 30 at Basin, [44.38146, -108.03502], 10 March 2000, B. Kondratieff, Doyle, 1M (CSUIC). **Carbon Co.,** Medicine Bow River, CR 291 at gauging station, [42.01006, -106.51310], 7 March 2006, D. Rees, 1M (CSUIC). **Johnson Co.,** South Fork Powder River, I-25 at mile marker 246, [43.62865, -106.5724], 16 April 2010, B. Kondratieff, R. Durfee, 8F (CSUIC). **Sheridan Co.,** Goose Creek, Fort [Rd.], Sheridan, [44.82108, -106.96170], 15April 2015, B. Kondratieff, R. Durfee, 1F (CSUIC).

Adult male (Fig. 28A). Forewing brachypterous. Length of forewings 1.9–2.5 mm (n = 10). Length of body 8.1–8.9 mm (n = 10). General body color brown to dark-brown.

Head (Fig. 28A). Dorsum of head mostly dark-brown. Labrum pale anteriorly, brown submedial spots posteriorly. Anterior frontoclypeus light-brown. Frons brown with a dark-brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella yellow-brown to dark brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Triangular raised rugosities anterolateral to lateral ocelli and ecdysial suture. Interocellar area uniformly dark-brown and slightly depressed. Occiput with dark brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Fig. 28A). Pronotum subquadrate, wider than long (length 0.8X width) with posterior width marginally wider than anterior width; brown overall with darker rugosities. Outer margins of pronotal flange often pale. Disk with irregular dark rugosities. Prosternum moderately sclerotized. Meso- and metathorax brown, heavily sclerotized dorsally and moderately sclerotized ventrally. Thoracic sterna and coxae uniformly covered with short, fine clothing hairs and longer brown setae. Legs brown, generally concolorous. Femur with an incomplete mottled brown stripe on the anterodorsal and posterodorsal faces. Tibia brown; apex of tibiae with 2-stout apical spines. Tarsus brown. Legs uniformly covered with dark, short stout setae. Wings hyaline; venation yellow-brown to brown; mottling absent. Forewing brachypterous, extending to at least the posterior margin of tergum-1; apex of forewing acutely pointed or rounded; upturned portion of forewing >1/3 total wing length. Hindwing extending beyond abdominal segment-10; pleated anal region absent.

Abdomen. Abdominal terga and sterna 1–9 uniformly brown. Abdominal segments 1–9 lightly covered with short, brown setae. Sterna 2–8 with a pair of anterior sublateral oval brown spots. Terga 6–9 with a concave anterior margin. Vesicle absent on sternum-9 (Fig. 28C). Sternum-9 elongated into a scooped plate (Fig. 29D), width widest at mid-length, apex broadly rounded, overall shape circular, ventrally (Fig. 28C); dorsally, apex broadly rounded medially and enfolded anteriorly; plate with numerous long setae on dorsal and ventral surfaces (Figs 28C; 29A, D); plate covering sternum-10 ventrally and extending beyond.

Terminalia (Figs 29A–E). Abdominal segment-10 nested within segment-9. Tergal sclerite-10 moderately sclerotized with a heavily sclerotized medial cleft (Fig. 29C); paired anterior processes absent. Cercus 5–7 segmented, excluding vestigial apical segment (Figs 29A, 29D), and with a small, finger-like, posteriorly directed basalcercal process covered in socketed setae and sensilla basiconica (Figs 29A, 29D–E). Basal plate of tergum-10 slightly produced dorsally, sclerotized with a medial furrow (Fig. 29A). Lateral struts present, median strut present (Fig. 29A). Basal bulb fused to anterior epiproct, covered in minute raised armature (Figs 29A–B, 29E), oval, bulbous, moderately sclerotized and with an oval inner bulb bearing a small hollow stalk, which terminates at a pore on the anterior face near the apex of the anterior epiproct. Anterior epiproct dorsoventrally flattened, widening laterally towards apex; apex with a rounded medial projection that is >1/3 epiproct width (Figs 29A–B). Posterior epiproct prong divided near apex into dorsal and ventral processes (Figs 29A–B, 29D–E). Apex of ventral process with a pair of bulbous lobes that are deeply divided medially, sclerotized ventrally and membranous with scale-like setae dorsally (Figs 29A–B). Dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing 2-internal eversible filaments; filament(s) generally not visible inside of basal bulb. Paraprocts subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical multi-lobed posterior paraprocts. Anterior paraproct, sub-rectangular medially directed, narrowing apically to a truncate apex with a rounded anterior margin

and angulate posterior margin (Fig. 29A). Posterior paraprocts (Fig. 29A) with 3-prongs, variously fused. Left outer prong broad, flat, concave posteriorly, apex scoop-shaped, directed anteriorly. Left middle prong projecting from the posterior proximal edge of outer prong, twisted, flat, lightly sclerotized, concave anteriorly, apex scoop-shaped. Left inner prong a sclerotized ridge bearing ~20 long stout golden setae, arising from the base on the posterior face of the posterior paraproct. Right outer prong, moderately sclerotized, C-shaped laterally, with a round, distally recurved apical projection. Right middle prong projecting from the posterior proximal edge of the right outer prong, tubular, twisted and tapering to apex. Right inner prong a raised sclerotized ridge bearing ~20 long stout golden setae.

Adult female (Fig. 28B). Macropterous. Length of forewings 11.6–12.1 mm (n = 10). Length of body 6.2–8.5 mm (n = 10). General body color brown. Overall appearance similar to male. Wings hyaline; mottling absent. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 28D). AA1 vein of forewing with long fine setae ≥1.0 mm (Fig. 28F). Hindwing mottling absent (Fig. 28D). Lateral margins of abdomen unsclerotized. Sternum-8 sclerotized laterally (Fig. 28E). Subgenital plate lightly to moderately sclerotized medially (Fig. 28E); moderately produced posteriorly; posterior margin typically with a shallow medial concavity (Figs 28E, 30A–B). Sternum-9 produced just beyond the paraproct bases; free portion of sternum (length 1.0X width); uniformly covered with long setae that become longer posteriorly; lateral margins slightly narrowing to a rounded apex. Cercus 7–8 segmented, excluding vestigial apical segment (Figs 28E, 30A).

Ovum. Unknown.

Mature larva (Fig. 31A). Length of male body 7.3–8.4 mm (n = 6), female body 9.6–10.9 mm (n = 6). General color light-brown to yellow. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture, rarely with the head touching or approaching the abdomen apex.

Head (Fig. 31A). Dorsum of head light-brown with darker brown maculations variously developed. Antelabrum light-brown; anterior margin with a dense brush of golden setae. Postlabrum pale. Anterior frontoclypeus pale; brown subrectangular markings directly anterior to lateral ocelli. Interocellar area diffusely light-brown, pigment extends anterolateral of median ocellus; pale area at junction of ecdysial suture. Occipital area diffusely light-brown and with irregular brown rugosities. Eyes with pigmented ommatidia reduced, not reaching eye margins. A single long seta both anterior and posterior to eyes. Scape, pedicel and flagella pale yellow-brown; dorsobasal apically inserted setae present (Fig. 31C); antenna slightly shorter than body (Fig. 31A).

Maxilla (Figs 32A–B). Lacinia triangular with a straight inner margin. Lacinia with 2-apical, cupped teeth and 2–4 subapical denticles on ventral face. Apical teeth subequal in length; relative length of apical teeth to palm length difficult to discern due to wear. Inner palm margin with 11-stout socketed marginal setae below apical teeth; first marginal seta robust. Basal 1/3 of palm with a cluster of >10 thin dorsal setae. Acutely pointed sensilla basiconica below apical teeth and on inner palm margin near the middle. A single acutely pointed sensilla basiconica on palm surface near the basal 1/5. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 1/4; a thin patch of setae on inner margin below apical setae, which extends about halfway to base. Length of galea, including apical setae, 1.1X length of lacinia; width of galea 1.1X the lacinia width. Maxillary palp with 5-segments; 2.2X length of lacinia; palp sensilla basiconica on distal and apical margins.

Mandible. Right mandible (Fig. 32C) bicuspid, outer cusp with 2–3 teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of truncate acanthae (length 1.0X width). Palm dorsum with 4–6 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 32C circle inset); the proximal basal corner with a marginal patch of 3–5 hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 32C). Left mandible (Fig. 32D) bicuspid, outer cusp with 4-teeth, inner cusp with 1-triangular tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 4.5X width). Ventral face of molar pad with 6–9 conical acanthae on (Fig. 32D square inset). Palm dorsum with 1–2 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 32D circle inset); the proximal basal corner with a marginal patch of 4–5 hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 32D).

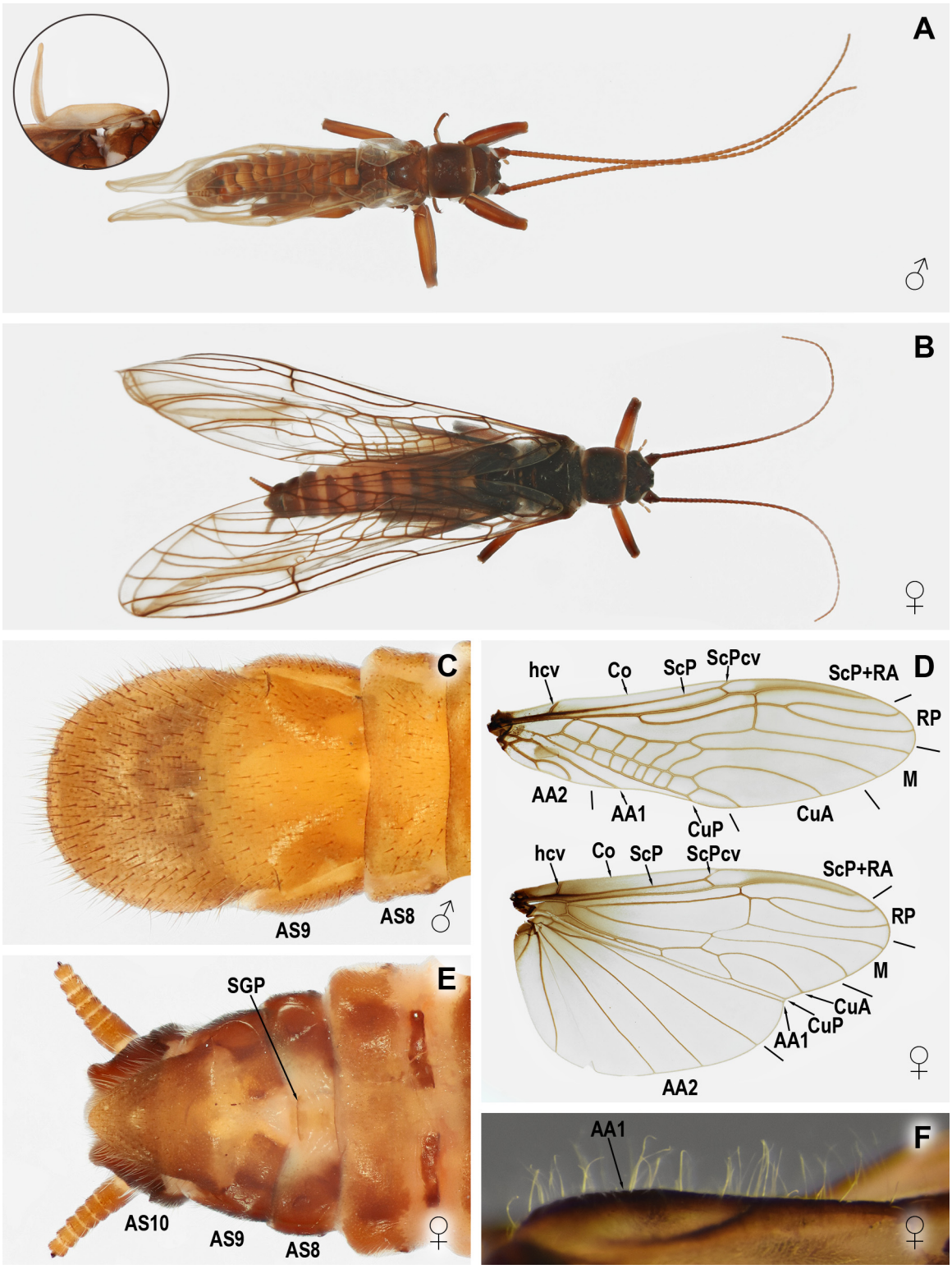

FIGURE 28. *Oemopteryx fosketti,* adults. **A.** Athabasca River, Athabasca Co., Alberta, Canada, male habitus, dorsal; forewing, lateral (circle inset). **B.** Colorado River, Grand Co., Utah, female habitus, dorsal. **C.** Athabasca River, Athabasca Co., Alberta, Canada, Male sterna, ventral. **D–E.** Colorado River, Grand Co., Utah. **D.** Female wings. **E.** Female sterna, ventral. **F.** Colorado River, Grand Co., Utah, Female forewing, lateral. [morphological abbreviations: see Table 1].

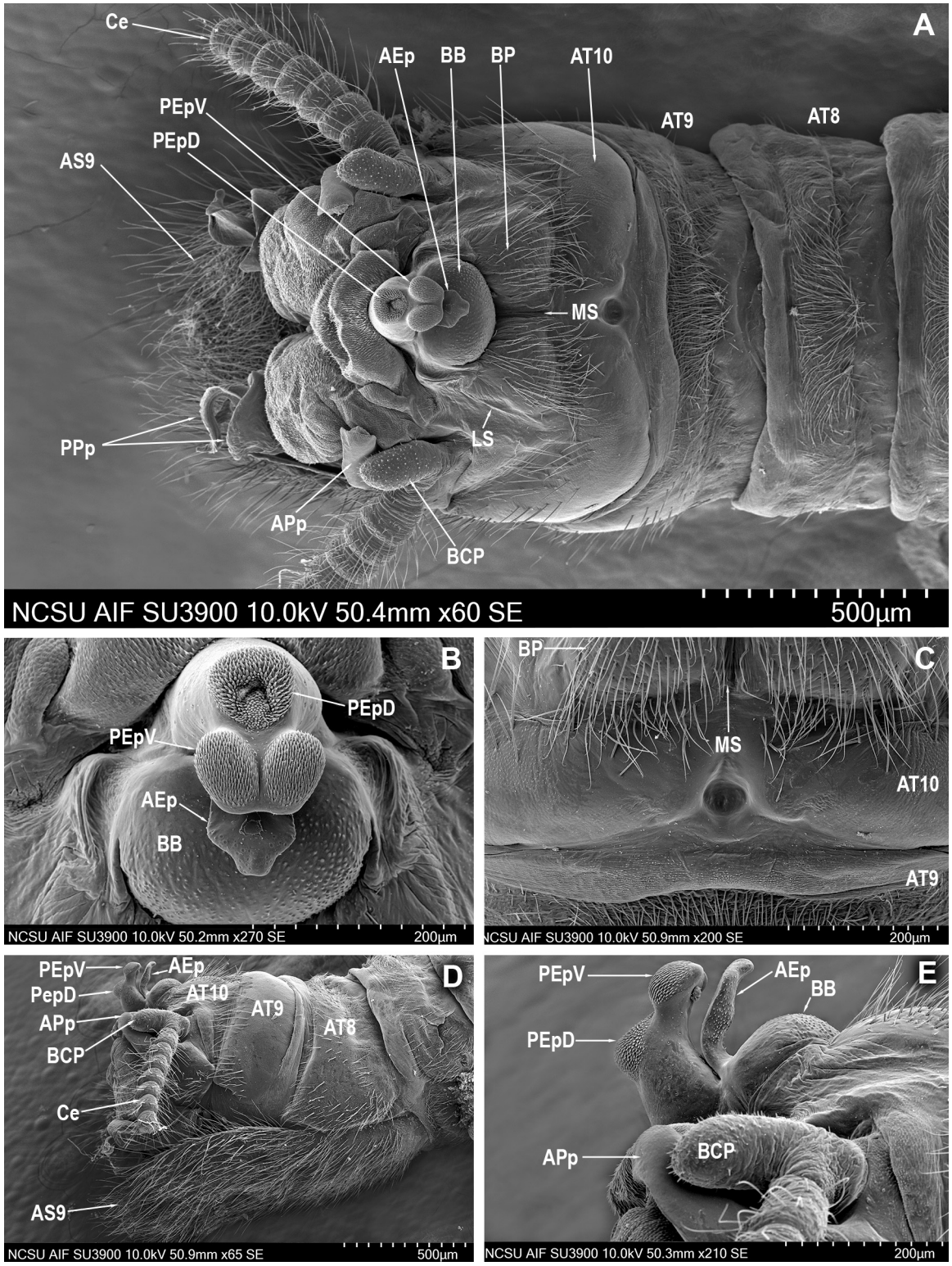

FIGURE 29. *Oemopteryx fosketti*, Delores River, Mesa Co., Colorado, adult male. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** Abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

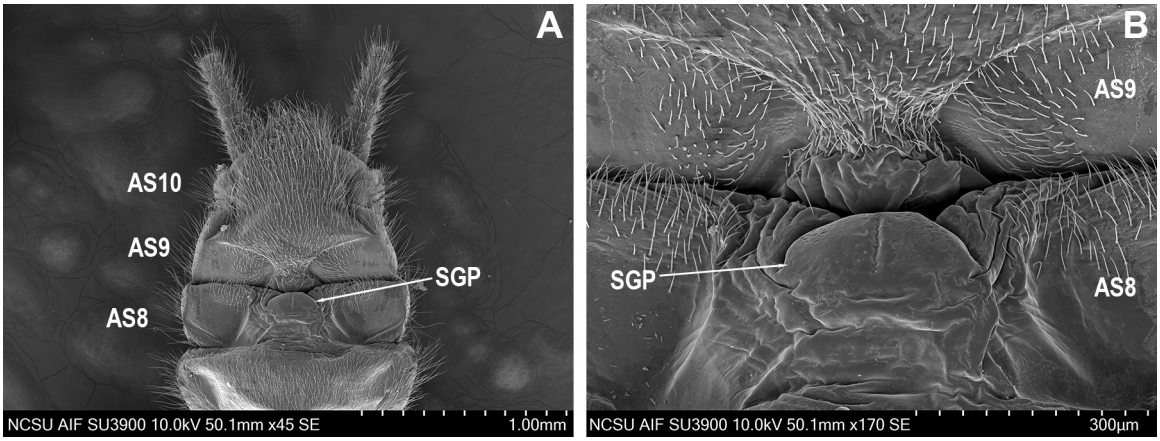

FIGURE 30. *Oemopteryx fosketti*, Delores River, Mesa Co., Colorado, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

Thorax (Fig. 31A). Pronotum marginally wider posteriorly; light-brown with faint rugosities and a pale posteromedial spot. Length of forewing pad male = 1.7 X; female = 3.9X width. Length of hindwing pad male = 2.4X; female = 2.3X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules if present, indistinct. Mesothorax with an oval prefurcasternal pit. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, wider than long (length 0.5X width). Metathoracic basisterna with a pair of furcasternal pits. Femur and tibia generally pale (Fig. 31D) and with a fringe of silky setae (not shown); length of femoral setae less than 1.5X the width of the femur; length of tibial setae about 1.4X tibial width. Anterior and posterior faces of the femur with scattered short stout setae. Tibial callus pale (Fig. 31D). Tarsus with a sparse dorsal fringe of silky setae (not shown); tarsus pale (Fig. 31D). Venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen uniformly light-brown (Fig. 31E). Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of terga 8–10 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 7–8 lacking conspicuous sensillae (Fig. 31F); Sternum-9 with an elongate plate (male = length 1.4X width; female = length 1.5X width); plate width relative to sternal width (male = 0.8X; female = 0.8X). Male plate (Fig. 31G) with sides slightly widening towards posterior margin of sternum-9, posterolateral margins convex, evenly rounded towards apex. Female plate (Fig. 31H) narrower basally, widest at posterior margin of sternum-9; posterolateral margins convex, evenly narrowing towards apex. Plates of both males and females with stout setae sparse on basal half, becoming denser towards apex. Cercus uniformly pale yellow-brown; dorsobasal apically inserted setae present (Fig. 31B); cercus about as long as body (Fig. 31A).

Diagnosis. *Oemopteryx fosketti* is defined in the adult male by the lack of a vesicle, brachypterous forewings, the upturned portion of forewing being >1/3 total wing length, the medial apical lobe of anterior epiproct being >1/3 epiproct width, the apical lobes of posterior epiproct being divided by a deep furrow and the free portion of sternum-9 being circular ventrally. The female is distinguished by having long fine setae ≥1mm extending to the base of AA1 vein. The larvae are defined by having a pale third tarsal segment, and abdominal sterna 7–8 lacking conspicuous sensillae.

Taxonomic notes. The larva of *O. fosketti* was first described by Dosdall & Lehmkuhl (1979) from specimens collected in Saskatchewan, Canada. They described the larva as being dark brown to nearly black, which is apparently incorrect or an eco-phenotype. Their material, while abundant, consisted of emergent larvae, in which adult characters including coloration can be seen through the larval cuticle. Their illustration of the antennal scape (fig. 155) shows dark pigment laterally. Among the material examined in the current study this pigment was only observed in late instar larvae and was developed beneath the larval cuticle, which we concluded was adult pigmentation. Care should be taken when using the larval sternal sensillae character as adults will have sensillae in these locations. However, if viewed laterally, adult characters will be observed to be beneath the larval cuticle.

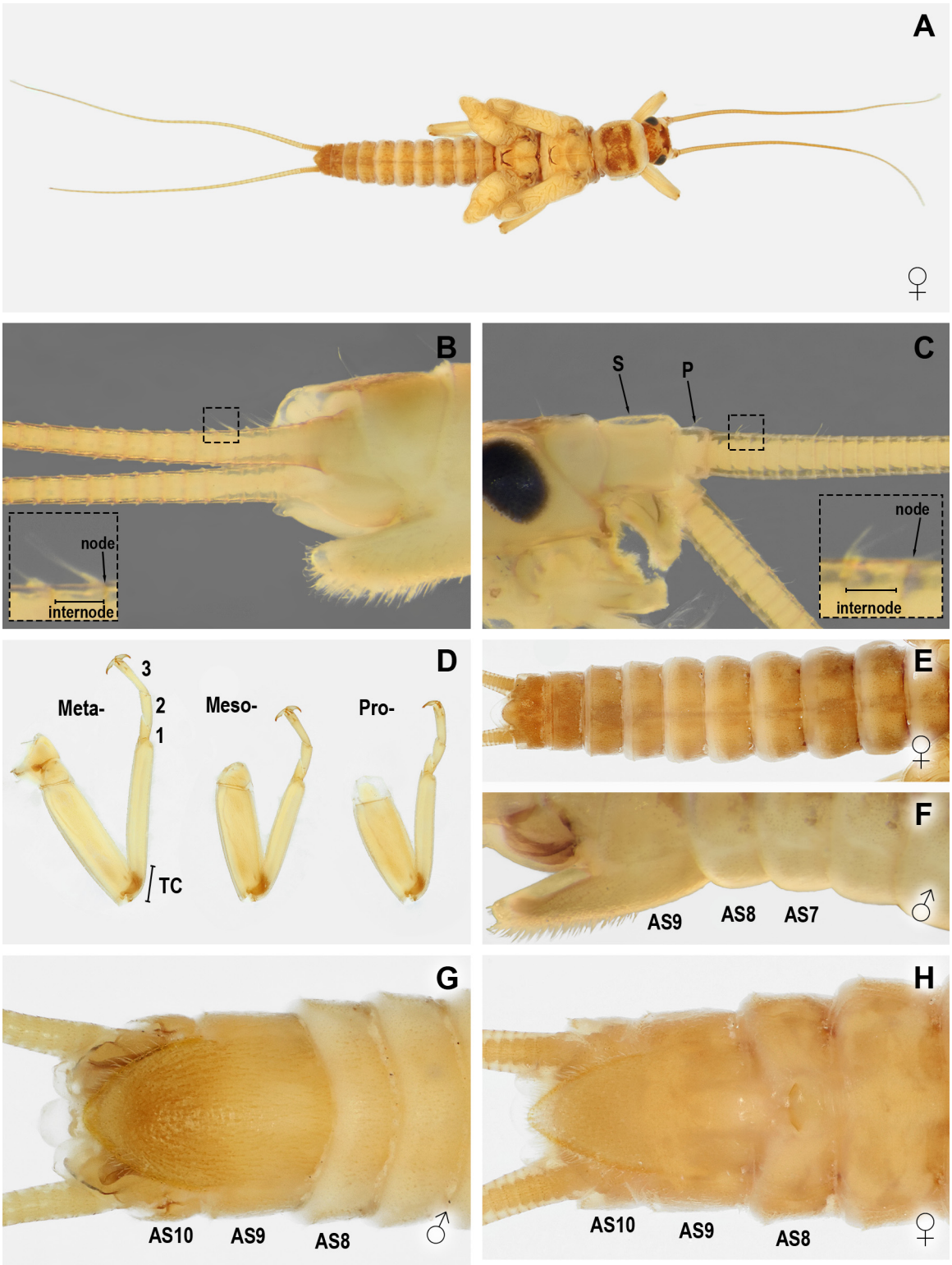

FIGURE 31. *Oemopteryx fosketti*, Delores River, Mesa Co., Colorado, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, lateral. **G.** Male sterna, ventral. **H.** Female sterna, ventral. [morphological abbreviations: see Table 1].

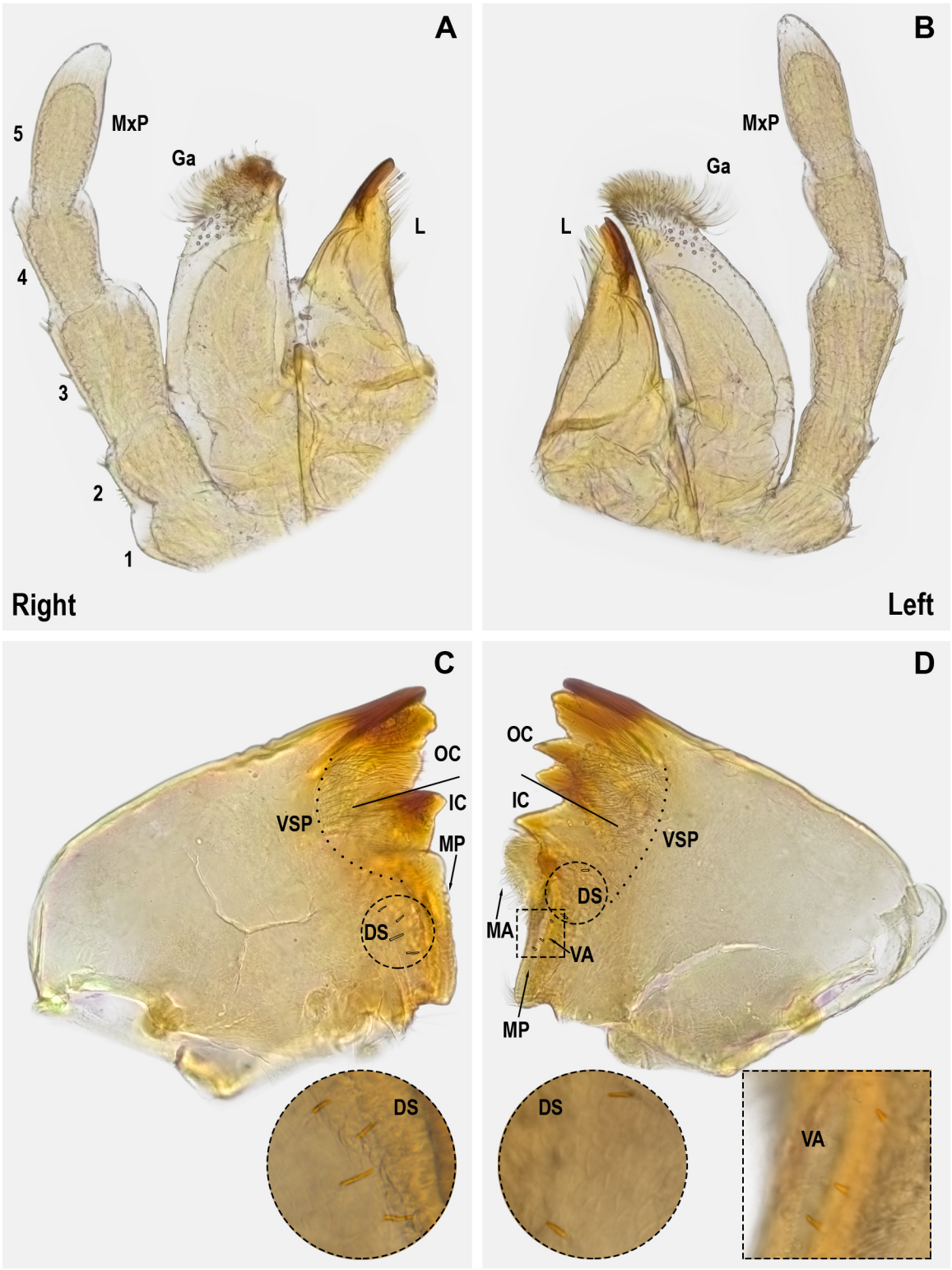

FIGURE 32. *Oemopteryx fosketti*, Delores River, Mesa Co., Colorado, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp. **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventral acanthae (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

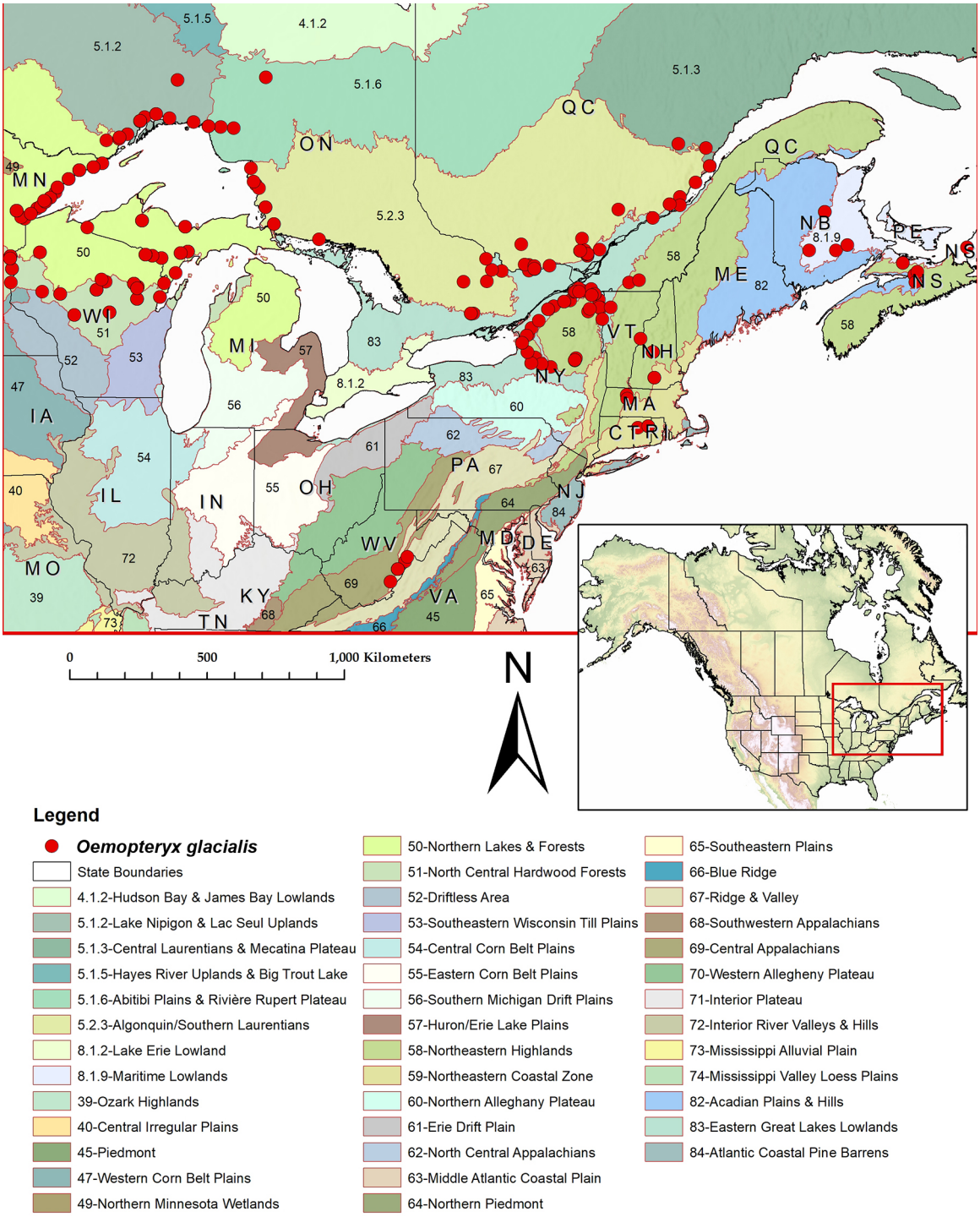

FIGURE 33. Distribution map of *Oemopteryx glacialis*. Records include examined material, BOLD records included in genetic analysis and unpublished data from the CNCI.

Biological notes. *Oemopteryx fosketti* is endemic to the uplands, plateaus, and plains associated with the Rocky Mountains. Records are known from the Four Corners area of Arizona, Colorado, New Mexico and Utah north to Saskatchewan and Alberta, Canada. Elevations of collection locations range between 466 m to 1957 m ASL. Based on known records, *O. fosketti* appears to be allopatric with *O. glacialis* with which it is most similar morphologically. Available records indicate adults are active from early March to late April. Larvae have been collected from streams with drainage areas ranging from 11,292 km^2 to 35,601 km^2. Dosdall & Lehmkuhl (1979) documented several life history strategies for the species in Saskatchewan including protandry and fully mature eggs in emergent female

larvae. They also hypothesized a univoltine life cycle with larval diapause for *O. fosketti.* NatureServe (2024) has assigned this species a conservation rank of G5, defined as having a low risk of extinction due to its wide ranging distribution and little concern from populations declines, or threats to habitat.

***Oemopteryx glacialis* (Barnston, 1848)**

(Figs 34–38)

Canadian Willowfly

Nemoura (*Brachyptera*) *glacialis* Barnston, 1848: 389. Holotype male (USNM), Wells, Sacandaga River, Hamilton Co., New York, USA.
Taeniopteryx glacialis: Hagen 1861: 36.
Perla chicoutimiensis Provancher, 1878: 75. Syn. Ricker 1952:158.
Brachyptera glacialis: Frison 1929: 373.
Nemoura (*Brachyptera*) *glacialis*: Ricker,1938: 131.
Taeniopteryx alex Hanson, 1938: 79. Holotype male; (USNM); Sacandaga River, Hamilton Co., New York, USA. Syn. Frison 1942: 251.
Taeniopteryx alex: Claassen 1940: 39.
Taeniopteryx glacialis: Claassen 1940: 43.
Nemoura (*Brachyptera*) *glacialis*: Frison 1942: 251.
Taeniopteryx (*Brachyptera*) *glacialis*: Harden 1942: 321.
Brachyptera (*Oemopteryx*) *glacialis*: Ricker 1952: 158.
Oemopteryx glacialis: Illies 1966: 63.
Nemoura (Brachyptera) glacialis: Kimmins 1970: 343.
Oemopteryx glacialis: Zwick 1973: 313.
Oemopteryx glacialis: Kondratieff & Kirchner 1987: 27.
Oemopteryx glacialis: Kondratieff & Kirchner 1988: 205.
Oemopteryx glacialis: Grubbs & Bright 2003: 78.
Oemopteryx glacialis: Myers, Kondratieff, Mihuc & Ruiter 2011: 96.
Oemopteryx glacialis: Grubbs, Pessino & DeWalt 2012: 165.

Distribution. Canada—NB, NS, ON, QC. USA.—CT, MA, MI, MN, NH, NY, VT, WI, WV (DeWalt *et al.* 2024 *in part*) (Fig. 33)

Material examined. **Canada—Nova Scotia: Colchester County,** Salmon River, [Valley Rd.], 45.38938, -63.18037], 25 March 2016, J. Ogden, 1M (CSUIC). **Quebec: Les Pays-d'en-Haut Regional County Municipality,** Riverie Du Nord, 1.0 km SE Saine-Adele, at Rue Vallee Du Golf, 45.94328, -74.12445, 21 March 2016, R.E. DeWalt, P.P. Harper, 3M, 1F (INHS: Insect Collection 659063). **Le Haut-Saint-Laurent Regional County Municipality,** Trout River, Chemin 1st Concession, 45.00828, -74.31238, 22 March 2016, R.E. DeWalt, P.P. Harper, 3M, 1F (INHS: Insect Collection 659117). **USA.—Minnesota: Pine Co.,** Snake River, 8.6 km NW Grantsburg, 200m upstream St. Croix River, 45.82306, -92.77001, 23 March 2013, E.J. South, R.E. DeWalt, 5M (INHS Insect Collection 631289). **New York: Clinton Co.,** North Branch Great Chazy River, Moores at Wood Falls Rd., 44.95646, -73.63919, 23 March 2016, R.E. DeWalt, 2M (INHS: Insect Collection 659142); Little Chazy River, Rt. 22 West Chazy, [44.82211, -73.509017], 14 March 2007, L. Myers, 2M (CSUIC); Salmon River, US 9 South of Plattsburgh, [44.62795, -73.44752], 1 April 2008, M. Malchoff, 2M (CSUIC); Salmon River, Salmon River Rd., 44.64010, -73.49470, 16 March 2012, L. Myers, 32M (CSUIC); [Saranac River], Silver Lake Rd., [44.54532, -73.86182], 15 March 2005, L. Myers, R. Younghanz, 9L (CSUIC); same location, 12 March 2006, L. Myers, 2M (CSUIC); Saranac River, Rt. 3 & Strackville Rd., [44.60540, -73.80239], 12 March 2007, L. Myers, 1M, 3F (CSUIC). **Essex Co.,** Bouquet River, Rt. 22, Willsboro, 44.36370, -73.39080, 16 March 2012, L. Myers, 6M (CSUIC); North Branch Bouquet River, US 9 & Trout Pond Rd., 44.35300, -73.54378, 12 March 2007, L. Myers, J. Myers, 2F (CSUIC). **Franklin Co.,** Develin Brook, Rt. 11b, West of Bangor, 44.80030, -74.44540, 18 March 2008, L. Myers, R. Mowrey, 1M (CSUIC). **Hamilton Co.,** Sacandaga River, Jct. Rt. 8 & Rt. 30, 43.44530, -74.25244, B. Kondratieff, L. Myers, 4M (CSUIC). **Herkimer Co.,** West Canada Creek, Jct. Rt. 28 & Rt. 8, [43.23088, -75.08965], 12 March 2012, L. Myers, B. Kondratieff, 1M (CSUIC). **Lewis Co.,** East Branch Fish Creek, Osceola Rd., Lewis, [43.46239, -75.59737], 31 March 2009, L. Myers, 2M, 3F (CSUIC). **Oneida Co.,** Mohawk River, Stokes Westernville Rd., North Westernville, 43.3116, -75.3816, 18 March 2009, L. Myers, 1M (CSUIC); West Branch Fish Creek, Brewer Rd., SE Camden, 43.32570, -75.71850, 19 March 2009, L. Myers, 2M (CSUIC). **Oswego Co.,** North Branch Salmon River, CR 17,

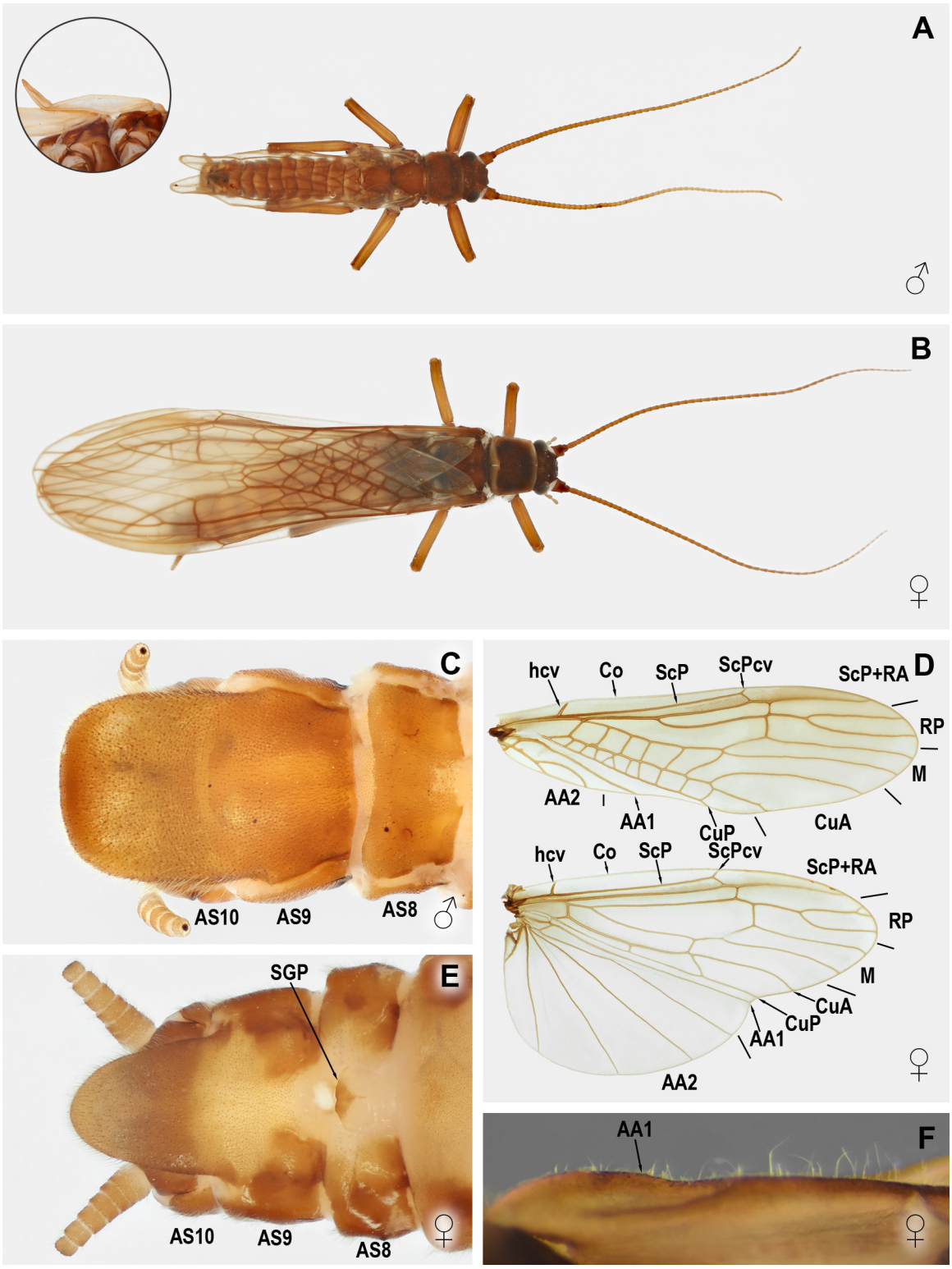

FIGURE 34. *Oemopteryx glacialis*. **A.** Salmon River, Clinton Co., New York, male habitus, dorsal; forewing, lateral (circle inset). **B.** Saranac River, Clinton Co., New York, female habitus, dorsal. **C.** Salmon River, Clinton Co., New York, Male sterna, ventral. **D–E.** Saranac River, Clinton Co., New York. **D.** Female wings. **E.** Female sterna, ventral. **F.** Deer River, St. Lawrence Co., New York, Female forewing, lateral. [morphological abbreviations: see Table 1].

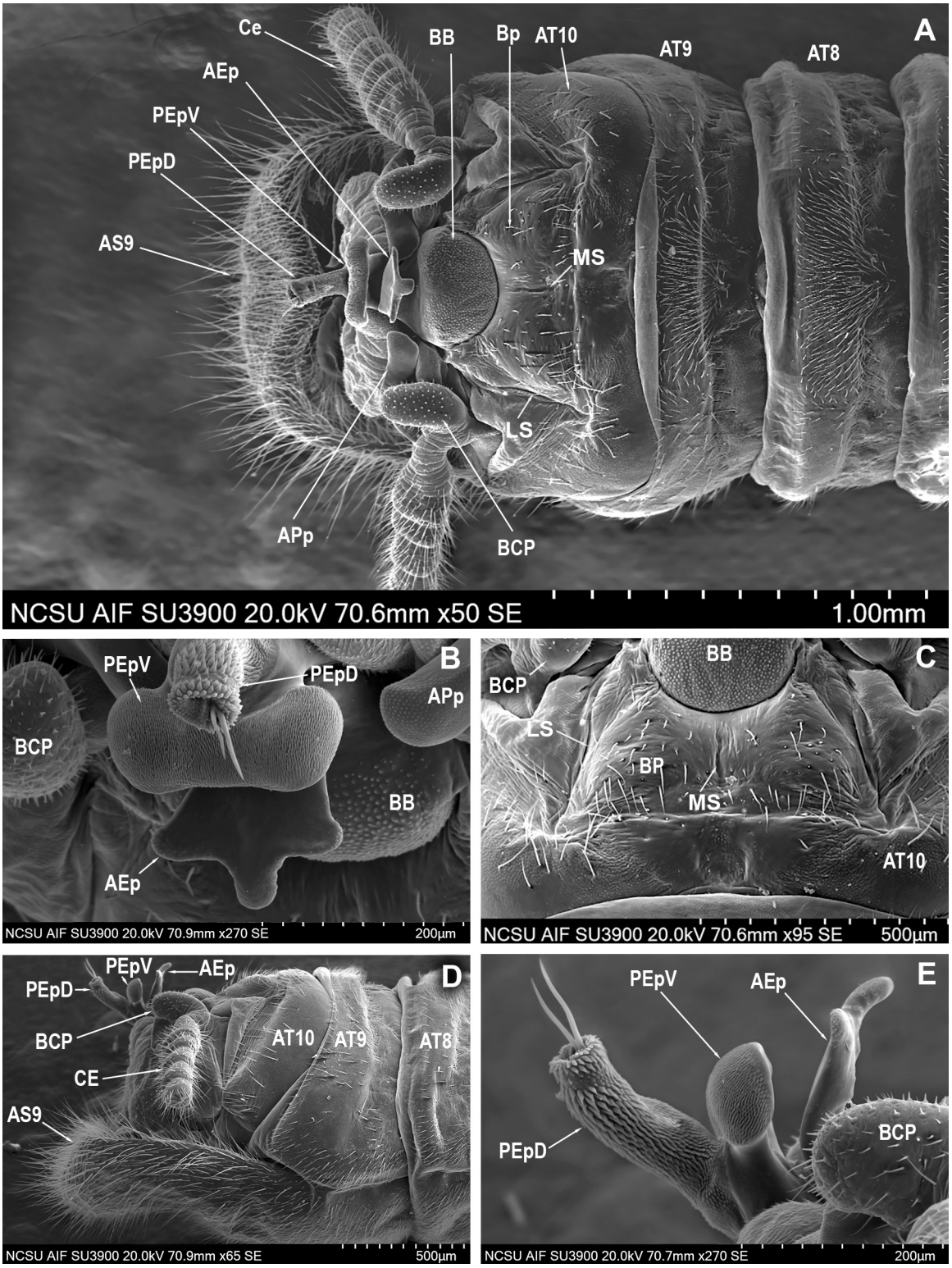

FIGURE 35. *Oemopteryx glacialis*, Lamoille River, Chittenden Co., Vermont, adult male. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** Abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

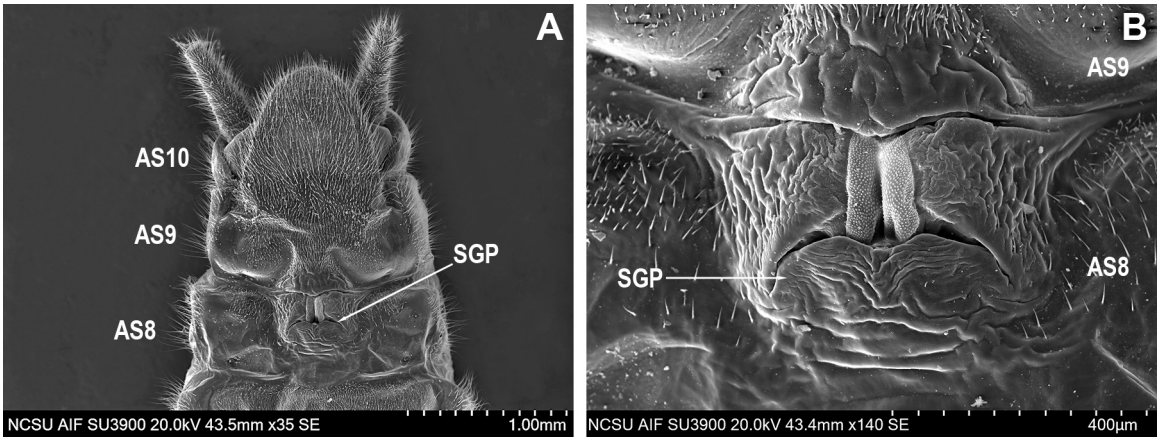

FIGURE 36. *Oemopteryx glacialis*, Lamoille River, Chittenden Co., Vermont, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

Upstream of reservoir, 43.58740, -75.8478, 31 March 2009, L. Myers, 4M, 2F (CSUIC). **St. Lawrence Co.,** Deer River, Rt. 11, 44.77570, -74.64880, 14 March 2009, T. Mihuc, 1F (CSUIC); Grass River, Canton at US 11, 44.59454, -75.17412, 24 March 2010, R.E. DeWalt, M. Pessino, 8M, 2F (INHS: Insect Collection 551145); Raquette River, Rt. 11, Potsdam, 44.66740, -74.98880, 14 March 2009, T. Mihuc, 1M (CSUIC). **Vermont: Chittenden Co.,** Lamoille River, Rt. 7, Clarks Falls, Milton, 44.64060, -73.11300, 19 March 2012, L. Myers, J. Myers. 18M, 1F (CSUIC). **West Virginia: Greenbrier Co.,** Greenbrier River, Anthony, [37.89595, -80.33201], 29 February 2004, L.T. Miller, 5M, 2F (CSUIC). **Pocahontas Co.,** [North Fork], WV 28 at Green Bank, [38.41482, -79.850228], 13 January 1987, R.F. Kirchner, 5L (CSUIC); Greenbrier River, Rt. 39 at Marlinton, [38.22449, -80.09596], 7 March 1987, R.F. Kirchner, 8M (CSUIC); same location, 8 March 1988, R.F. Kirchner, 7M, 2F (CSUIC); same location, 3 March 1989, R.F. Kirchner, 12L (CSUIC).

Adult male (Fig. 34A). Forewing brachypterous. Length of forewings 1.7–2.6 mm (n = 10). Length of body 8.7–10.4 mm (n = 10). General body color brown to dark-brown.

Head (Fig. 34A). Dorsum of head mostly dark-brown. Labrum pale anteriorly, brown submedial spots posteriorly. Anterior frontoclypeus light-brown. Frons brown with a dark-brown U-shaped marking with posterolateral extensions. Antenna longer than body. Scape, pedicel, and flagella yellow-brown to dark brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Triangular raised rugosities anterolateral to lateral ocelli and ecdysial suture. Interocellar area uniformly dark-brown and slightly depressed. Occiput with dark brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Fig. 34A). Pronotum subquadrate, wider than long (L 0.75X width) with posterior width marginally wider than anterior width; brown overall with darker rugosities. Outer margins of pronotal flange often pale. Disk with irregular dark rugosities. Prosternum moderately sclerotized. Meso- and metathorax brown, heavily sclerotized dorsally and moderately sclerotized ventrally. Thoracic sterna and coxae uniformly covered with short, fine clothing hairs and longer brown setae. Legs brown, generally concolorous. Femur with an incomplete mottled brown stripe on the anterodorsal and posterodorsal faces. Tibia brown; apex of tibiae with 2-stout apical spines. Tarsus brown. Legs uniformly covered with dark, short stout setae. Wings hyaline; venation yellow-brown to brown; mottling absent. Forewing brachypterous, extending to posterior margin of tergum-1; apex acutely pointed; upturned portion of forewing <1/3 total wing length. Hindwing extending beyond abdominal segment-10; pleated anal region absent.

Abdomen. Abdominal terga and sterna 1–9 uniformly brown, lightly covered with short, brown setae. Sterna 2–8 with a pair of anterior sublateral oval brown spots. Vesicle absent on sternum-9 (Fig. 34C). Sternum-9 elongated into a scooped plate (Fig. 35D); width slightly wider towards base; overall shape rectangular, ventrally (Fig. 34C); apex square with rounded lateral margins. Dorsally, apex broadly rounded medially and enfolded anteriorly (Fig. 35A); plate with numerous long setae on dorsal and ventral surfaces (Figs 35A, D); plate covering sternum-10 ventrally and extending beyond.

Terminalia (Figs 35A–E). Abdominal segment-10 nested within segment-9. Tergal sclerite-10 moderately sclerotized with a heavily sclerotized medial cleft; paired anterior processes absent (Fig. 35C). Cercus 5–6

segmented, excluding vestigial apical segment (Figs 35A, 35D), and with a small, finger-like, posteriorly directed basalcercal process covered in socketed setae and sensilla basiconica (Figs 35A–B, 35D–E). Basal plate of tergum-10 slightly produced dorsally, sclerotized with a medial furrow (Figs 35A, 35C). Lateral struts present, median strut present (Figs 35A, 35C). Basal bulb fused to anterior epiproct, covered in minute raised armature (Figs 35A–C), oval, bulbous, moderately sclerotized and with an oval inner bulb bearing a small hollow stalk, which terminates at a pore on the anterior face near the apex of the anterior epiproct. Anterior epiproct dorsoventrally flattened, widening laterally towards trilobed apex with rounded apices; width of medial lobe <1/3 epiproct width (Figs 35A–B). Posterior epiproct prong divided near apex into dorsal and ventral processes. Apex of ventral process with a pair of bulbous lobes that are contiguous medially; sclerotized ventrally and membranous with scale-like setae dorsally (Figs 35A–B). Dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing 2-internal eversible filaments (Figs 35B, 35D–E); filament(s) generally not visible inside of basal bulb. Paraprocts subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical multi-lobed posterior paraprocts. Anterior paraproct, sub-rectangular medially directed, narrowing apically to a rounded apex (Figs 35A–B). Posterior paraprocts with 3-prongs, variously fused (not visible in Figs 35A–E). Left outer prong broad, flat, concave posteriorly, apex scoop-shaped, directed anteriorly. Left middle prong projecting from the posterior proximal edge of outer prong, twisted, flat, lightly sclerotized, concave anteriorly, apex scoop-shaped. Left inner prong with a sclerotized ridge bearing 12-long stout golden setae, arising from the base on the posterior face of the posterior paraproct. Right outer prong, moderately sclerotized, C-shaped laterally, with a round, distally recurved apical projection; right middle prong projecting from the posterior proximal edge of the right outer prong, tubular, twisted and tapering to apex. Right inner prong a raised sclerotized ridge bearing 12-long stout golden setae.

Adult female (Fig. 34B). Macropterous. Length of forewings 13.6–14.7 mm (n = 10). Length of body 12.0–13.2 mm (n = 10). General body color brown. Overall appearance similar to male. Wings hyaline; mottling absent. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 34D). AA1 vein of forewing with short fine setae, a few longer setae distally (Fig. 34F). Lateral margins of abdomen unsclerotized. Sternum-8 sclerotized laterally (Fig. 34E). Subgenital plate concave on posterior margin (Figs 34E, 36A–B); moderately produced posteriorly (Figs 34E, 36A–B) with a moderately sclerotized triangular area medially (Fig. 34E). Sternum-9 produced just beyond the apex of abdominal segment-10; free portion of sternum (length 1.0X width); uniformly covered with long setae that become longer posteriorly; lateral margins slightly narrowing to a rounded apex. Cercus 8-segmented, excluding vestigial apical segment (Figs 34E; 36B).

Ovum. Unknown.

Mature larva (Fig. 37A). Length of male body 8.7–10.9 mm (n = 5), female body 10.5–13.3 mm (n = 6). General color light-brown to brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture rarely with the head touching or approaching the abdomen apex.

Head (Fig. 37A). Dorsum of head brown with brown maculations variously developed. Antelabrum pale; anterior margin with a dense brush of golden setae. Postlabrum pale. Anterior frontoclypeus pale. Frons with a brown U-shaped marking with posterolateral extensions; light-brown subrectangular markings directly anterior to lateral ocelli. Interocellar area diffusely light-brown to brown. Occipital area brown near ecdysial suture and with irregular brown rugosities. Eyes with pigmented ommatidia reduced, not reaching eye margins. A single long seta both anterior and posterior to eyes. Antennal scape brown; pedicel and flagella light-brown; dorsobasal apically inserted setae present (Fig. 37C); antenna slightly shorter than body (Fig. 37A).

Maxilla (Figs 38A–B). Lacinia triangular with a straight inner margin. Lacinia with 2-apical, cupped teeth and 6–7 subapical denticles on ventral face. Apical teeth subequal in length; relative length of apical teeth to palm length difficult to discern due to wear. Inner palm margin with 12-stout socketed marginal setae below apical teeth; first marginal seta robust. Basal 1/3 of palm with a cluster of >10 thin dorsal setae. A single acutely pointed sensilla basiconica on palm surface near the basal 1/4. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 2/3; a thin patch of setae on inner margin below apical setae, which extends about halfway to base. Length of galea, including apical setae, 1.3X length of lacinia; width of galea 0.8X the lacinia width. Maxillary palp with 5-segments; 1.8X length of lacinia; all palpal segments with sensilla basiconica sparsely scattered over entire surface.

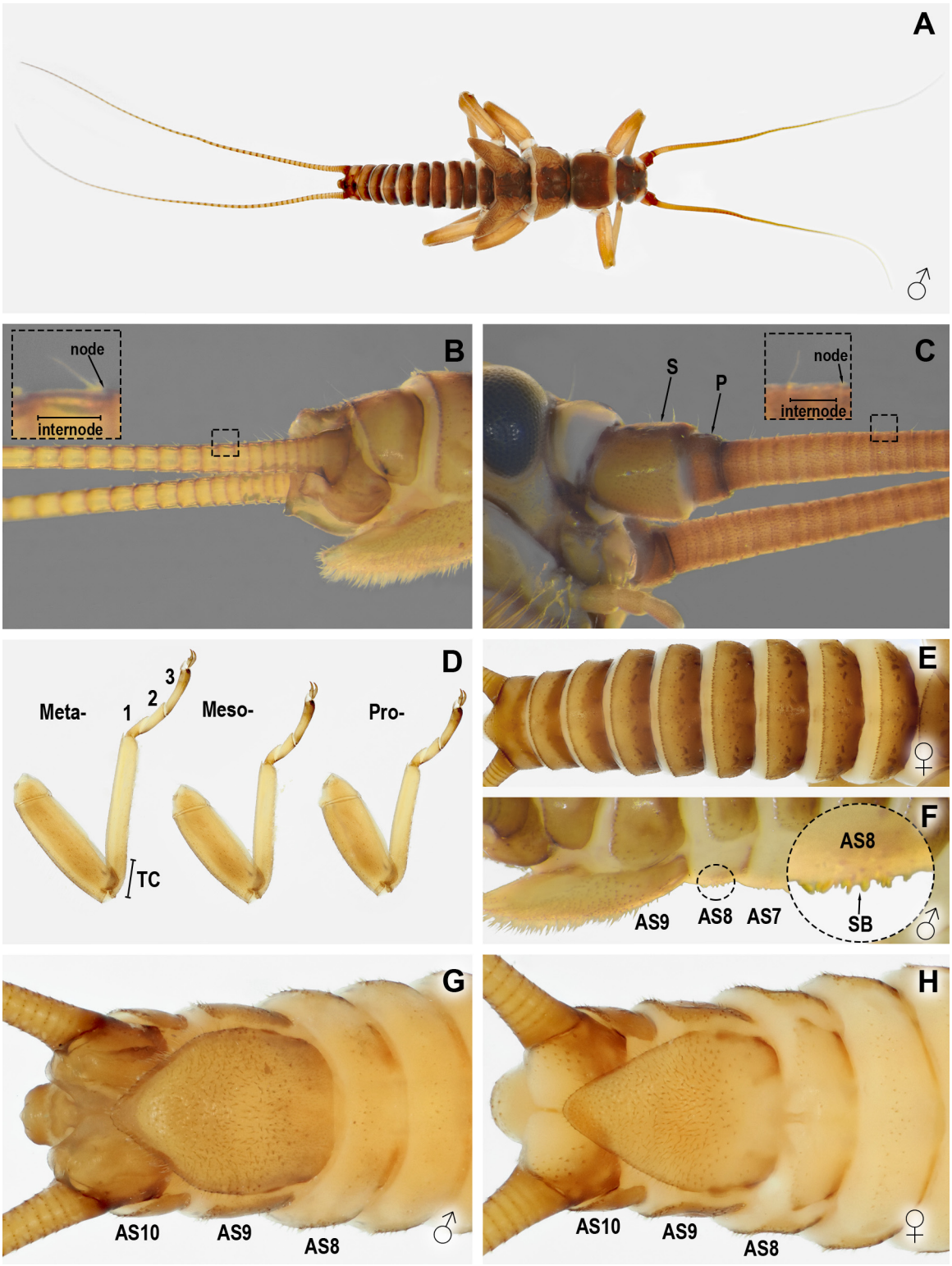

FIGURE 37. *Oemopteryx glacialis*, Greenbrier River, Pocahontas Co., West Virginia, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, lateral; sensilla basiconica, lateral (circle inset). **G.** Male sterna, ventral. **H.** Female sterna, ventral. [morphological abbreviations: see Table 1].

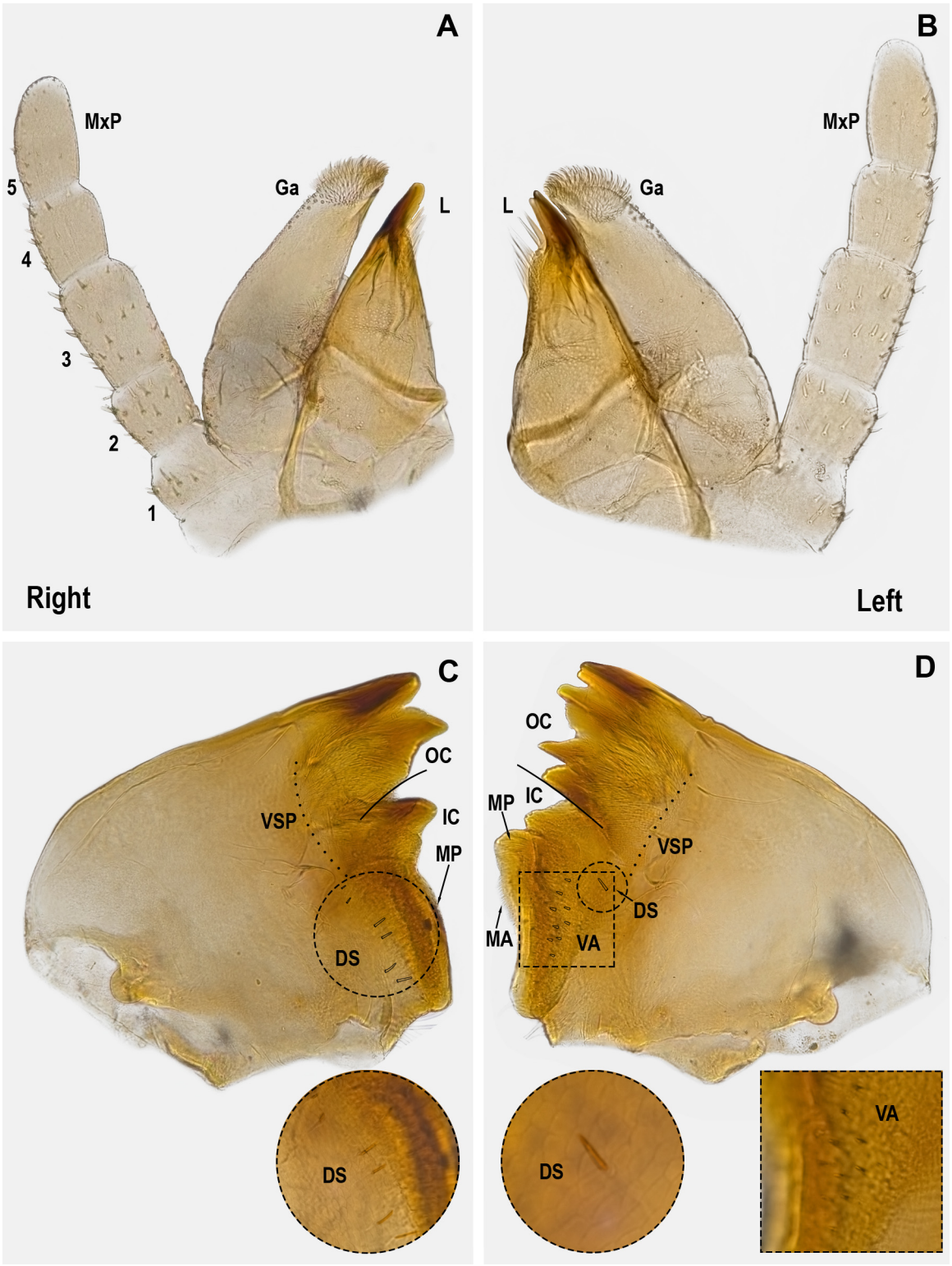

FIGURE 38. *Oemopteryx glacialis*, Greenbrier River, Pocahontas Co., West Virginia, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp. **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventral acanthae (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

Mandible. Right mandible (Fig. 38C) bicuspid, outer cusp with 2–3 teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of truncate acanthae. Palm dorsum with 6–8 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 38C circle inset); proximal basal corner with a marginal patch of 5-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 38C. Left mandible (Fig. 38D) bicuspid, outer cusp with 4-teeth, inner cusp with 1-triangular tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 2X width). Ventral face of molar pad with >15 conical acanthae (Fig. 38D square inset). Palm dorsum with 1–2 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 38D circle inset); the proximal basal corner with a marginal patch of 4-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 38D).

Thorax (Fig. 37A). Pronotum marginally wider posteriorly; light-brown with faint rugosities; Length of forewing pad male = 1.0X; female = 3.0X width. Length of hindwing pad male = 2.0X; female = 1.8X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules if present, indistinct Mesothorax with an oval prefurcasternal pit. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, wider than long (length 0.5X width). Metathoracic basisterna with a pair of furcasternal pits. Anterior face of femur generally light-brown; anterior and posterior faces of the femur with scattered short stout setae (Fig. 37D). Femur and tibia with a dorsal fringe of silky setae (not shown); length of femoral setae about 1.0X the width of the femur; length of tibial setae about 1.25X tibial width. Tibia light-brown; tibial callus not significantly darkened (Fig. 37D). Tarsus brown with a sparse fringe of silky setae. Venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen uniformly brown (Fig. 37E). Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of terga 8–10 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 1–8 with sparse sensillae that are abundant and conspicuous on sterna 7–8 (Fig. 37F). Sternum-9 with an elongate plate (male = length 1.5X width; female = length 1.5X width); plate width relative to sternal width (male = 0.7X; female = 0.7X). Male plate (Fig. 37G) with sides marginally wider towards posterior margin of sternum-9, posterolateral margins convex, evenly rounded towards apex. Female plate (Fig. 37H) narrower basally, widest at posterior margin of sternum-9; posterolateral margins convex, evenly narrowing towards apex. Plates of both males and females with stout setae sparse basally, becoming denser towards apex. Cercus uniformly light-brown; dorsobasal apically inserted setae present; cercus about as long as body (Fig. 37A).

Diagnosis. *Oemopteryx glacialis* is defined in the adult male by the lack of a vesicle, brachypterous forewings, the upturned portion of forewing being <1/3 total wing length, the medial apical lobe of anterior epiproct being <1/3 epiproct width, the apical lobes of posterior epiproct being contiguous medially and the free portion of sternum-9 being rectangular ventrally. The female is distinguished by long setae not extending to the base of AA1 vein and a subgenital plate with a moderately sclerotized triangular area medially. The larvae are defined by having a darkened third tarsal segment, and abdominal sterna 7–8 with conspicuous sensillae.

Biological notes. *Oemopteryx glacialis* is known from the forests and uplands of the Upper Midwest, Great Lakes, Northeast region into Atlantic Canada and south to West Virginia. Elevations of collection locations range between 3 m to 841 m ASL. Based on known records *O. glacialis* appears to be allopatric with *O. fosketti* with which it is most morphologically similar. Available records indicate adults are active from late February to mid-April. Larvae have only been collected from a few streams with drainage areas ranging from 336 km^2 to 406 km^2. Harper *et al.* (1991) documented a univoltine fast life cycle in Quebec with direct spring hatching and subsequent larval diapause during summer. NatureServe (2024) has assigned this species a conservation rank of G4 indicating the species is at low risk of extinction due to its extensive range and numerous populations, but with possible cause for some concern as a result of threats to habitat.

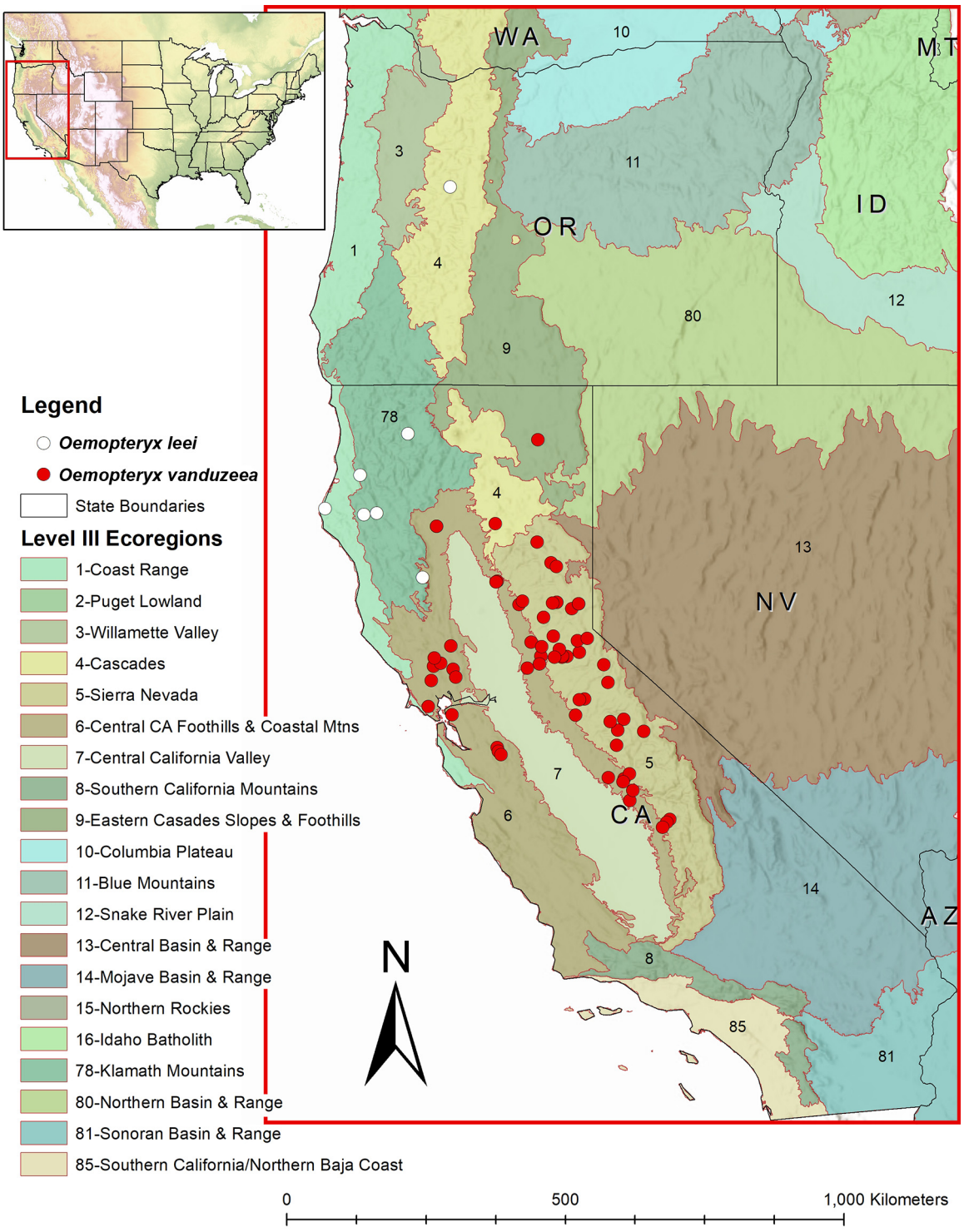

FIGURE 39. Distribution map of *Oemopteryx leei* and the *Oemopteryx vanduzeea* Group. Records include examined material, georeferenced data from Baumann & Kondratieff (2009a) and unpublished data from the CNCI.

The *O. leei* Group

Oemopteryx leei Baumann & Kondratieff, 2009

(Figs 40–44)
Headwater Willowfly

Oemopteryx leei Baumann & Kondratieff, 2009a: 199. Holotype male (CAS), Willow Creek, Humboldt Co., California, USA.

Distribution. USA.—CA, OR (Baumann & Kondratieff 2009a; DeWalt *et al.* 2024) (Fig. 39)

Material examined. USA.—California: Humboldt Co., Oil Creek headwaters, [Mattole Rd.], 40.49400, -124.30800, 2 May 2011, B. Kondratieff, J. Sandberg, 4M, 2F (CSUIC); Willow Creek, at Hwy 299, mile 29.54, [40.90443, -123.74335], 14 April 2006, L. Lee, 9M, 4F (CSUIC); [UT to Butte Creek], Butte Creek Access Rd, 1.8 mi S Hwy 36, 40.41982, -123.68350, 2 May 2011, B. Kondratieff, J. Sandberg, 32M, 8F, 5L (CSUIC). **Siskiyou Co.,** Etna Creek, Sawyers Bar Rd., 41.41157, -122.97366, 14 May 2016, C. Kerst, 1M (CSUIC). **Oregon: Linn Co.,** [Two Girls Creek], Two Girls Peak, Willamette National Forest, [44.34066, -122.29390], 25 August 2005, A. Moldenke, VerLinden, 4M, 2F (CSUIC).

Adult male (Fig. 40A). Macropterous. Length of forewings 7.3–8.0 mm (n = 10). Length of body 6.0–7.3 mm (n = 10). General body color brown.

Head. (Fig. 40A). Dorsum of head mostly light-brown. Labrum pale anteriorly, brown posteriorly. Anterior frontoclypeus light-brown. Frons with a brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Interocellar area uniformly brown, darker than rest of head and slightly depressed. Dark rugosities anterior to lateral ocelli. Pale transverse band posterior to lateral ocelli. Occiput with brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

Thorax (Fig. 40A). Pronotum subquadrate, wider than long (length 0.8X width) with posterior width slightly wider than anterior width; light-brown overall with brown rugosities. Disk with irregular brown rugosities. Prosternum lightly sclerotized. Meso- and metathorax dark-brown, heavily sclerotized dorsally and ventrally. Mesonotum with a triangular pale anteromedial spot. Thoracic nota and coxae uniformly covered with sparse, short, fine clothing hairs. Legs light-brown with contrasting pigment. Distal portion of femur with darker pigment. Tibia light-brown, darker brown on proximal and distal portions; apex of tibiae with 2-stout apical spines. Tarsus light-brown distal segments progressively darker. Legs uniformly covered with dark, short stout setae. Wings hyaline, amber; venation brown; mottling absent. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked.

Abdomen. First abdominal tergite completely pale. Abdominal segments 1–9 lightly covered with short, fine clothing hairs. Terga 2–6 with posterior sublateral patches of stout dark brown setae. Terga 3–7 with intersegmental sublateral membranous bulges. Terga 6–9 pale posteromedially, otherwise terga brown. Sterna 1–9 brown with a pair of sub-lateral brown spots. Sternum-9 with a lightly sclerotized, clavate, tab-like vesicle that is attached to sternum-9 at the anterior margin of the vesicle. (Fig. 40C). Sternum-9 elongated into a scooped plate, width subequal from base to apex; apex truncate (Fig. 41C); plate with numerous long setae on dorsal and ventral surfaces (Figs 41A, 41D); plate covering sternum-10 ventrally and extending beyond.

Terminalia (Figs 41A–E). Abdominal segment-10 nested within segment-9. Anterior margin unsclerotized. Tergal sclerite-10 lightly sclerotized with a medial cleft, paired anterior processes absent (Fig. 41C). Cercus 5–6 segmented, excluding vestigial apical segment (Figs 40C, 41A, 41D). Basalcercal process dorsally directed with an acutely pointed posteriorly oriented apex and covered dorsally with sensilla basiconica and long socketed setae; basalcercal process much shorter than cercus (Figs 41A, 41D). Basal plate of tergum-10 bulbous with 2-hemispherical lobes divided by a median furrow and bearing long socketed setae (Figs 41A–E). Lateral struts present (Fig. 41A), median strut present (not shown). Basal bulb (Figs 41A–B), glabrous, oval, bulbous, moderately sclerotized and with an inner bulb bearing a small hollow stalk, which terminates at a pore at the apical 1/4 on the ventral face of the anterior epiproct. Anterior epiproct prong fused to basal bulb, broadly spatulate with sinuous lateral margins and a hood-like tip (Figs 41A–E). Posterior epiproct prong closely appressed to anterior prong, lightly sclerotized, divided near apex with dorsal and ventral processes. Ventral process thin and cylindrical with posteriorly directed plate-like setae and long sensillae (Figs 41A–B, 41D–E). Dorsal process pouch-like, armed with posteriorly directed spine-

like setae with an apical sleeve containing an internal filament (Figs 41A–B, 41D–E). Internal filament eversible and apparently composed of 2-strands that are twisted, fused and hooked near the apex. Filament(s) visible inside basal bulb. Paraprocts (Fig. 41A) subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical multi-lobed posterior paraprocts. Anterior paraproct posterior to cercus, base triangular, well sclerotized with a small, lightly sclerotized finger-like mediodorsal projection. Posterior paraprocts with 4-prongs, variously fused. Left outer prong flattened with a truncate apex; left outer middle prong flattened, lightly sclerotized, apex spatulate. Left inner middle prong cupped longitudinally, moderated sclerotized, apex truncate. Left inner prong thinner and shorter, moderately sclerotized with a rounded apex bearing 3-spines. Right outer prong lightly sclerotized, flattened, concave posteriorly with lateral flanges and a curved spinous apex. Right outer middle prong moderately sclerotized with a broadly rounded apex; right inner middle prong twisted with a membranous filamentous apex; right inner prong thinner and shorter, moderately sclerotized, apex rounded bearing 4-stout spines.

Adult female (Fig. 40B). Macropterous. Length of forewings 8.5–8.9 mm (n = 10). Length of body 7.3–8.5 mm (n = 10). General body color brown. Overall appearance similar to male. Wings hyaline, amber; venation brown; mottling absent. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 40D). AA1 vein of forewing with short fine setae ≤0.5mm (Fig. 40F). Dorsum of abdomen lightly sclerotized, otherwise unmodified. Venter of abdomen similar to male. Sternum-8 lightly to moderately sclerotized anteriorly (Fig. 40E). Subgenital plate moderately produced posteriorly with a narrow U-shaped notch medially (Figs 40E; 42A–B); moderately sclerotized (Fig. 40E). Sternum-9 parabolic, produced just beyond the apex of abdominal segment-10; length of free portion of sternum-9 0.8X basal width; uniformly covered with long setae that become longer posteriorly; lateral margins moderately narrowing to a rounded apex (Figs 40E; 42A–B). Cercus 5–6 segmented, excluding vestigial apical segment (Figs 40E; 42A).

Ovum. Unknown.

Mature larva (Fig. 43A). Length of male body 6.4–6.5 mm (n = 2), female body 6.8–7.5 mm (n = 3). General color brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture with the head touching or approaching the abdomen apex, similar to other Taeniopterygidae.

Head (Fig. 43A). Dorsum of head brown with indistinct darker brown maculations variously developed. Antelabrum and postlabrum brown with 2-anterolateral pale spots; anterior margin with a dense brush of golden setae. Anterior frontoclypeus brown. Interocellar area brown. Occipital area brown with indistinct, irregular brown rugosities. Eyes with pigmented ommatidia sometimes reduced, not reaching eye margins. A single long seta both anterior and posterior to eyes. Antennal scape, pedicel and flagella brown; dorsobasal apically inserted setae present up to segment-15 (Fig. 43C); antenna slightly shorter than body (Fig. 43A).

Maxilla (Figs 44A–B). Lacinia triangular with a straight inner margin. Lacinia with 2-apical, cupped teeth and weakly developed denticles on ventral face; actual number difficult to discern due to wear. Apical teeth subequal in length; length of apical teeth relative to palm length difficult to discern due to wear. Inner palm margin with 10–11 stout socketed marginal setae below apical teeth; first setae below apical teeth robust; a patch of hair like acanthae present below apical teeth; acutely pointed sensilla basiconica below apical teeth and on inner palm margin near the middle. Basal 1/3 of palm with a cluster of >10 thin dorsal setae. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 1/4. A marginal row of long setae below apical setae extends about 2/3 to base. Length of galea, including apical setae, 1.1X length of lacinia; width of galea subequal to lacinia width. Maxillary palp with 5-segments; 2.2X length of lacinia; palp with sensilla basiconica developed on the apical and lateral margins of each segment.

Mandible. Right mandible (Fig. 44C) bicuspid, outer cusp with 3-teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of rounded acanthae (length 2.0X width). Palm dorsum with 8–9 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 44C circle inset); proximal basal corner with a marginal patch of 3–4 hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 44C) Left mandible (Fig. 44D) bicuspid, outer cusp with 5-teeth, inner cusp with 1-broad tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 5.0X width). Palm dorsum with 8–9 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 44D circle inset); the proximal basal corner with a marginal patch of 3–4 hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to middle of the inner cusp (indicated by dotted line in Fig. 44D, square inset).

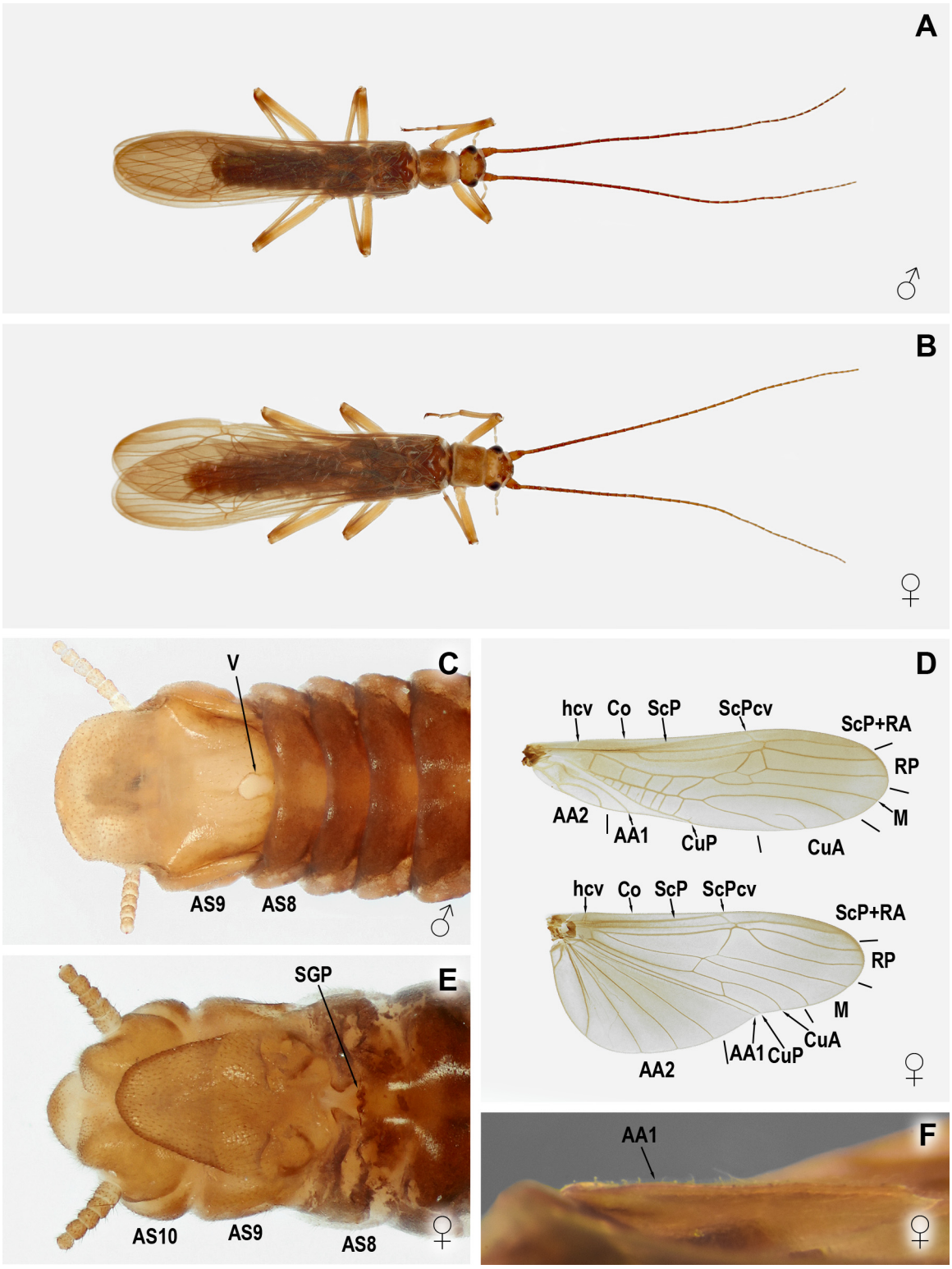

FIGURE 40. *Oemopteryx leei,* UT Butte Creek, Humboldt Co., California, adults. **A.** Male habitus, dorsal. **B.** Female habitus, dorsal. **C.** Male sterna, ventral. **D.** Female wings. **E.** Female sterna, ventral. **F.** Female forewing, lateral. [morphological abbreviations: see Table 1].

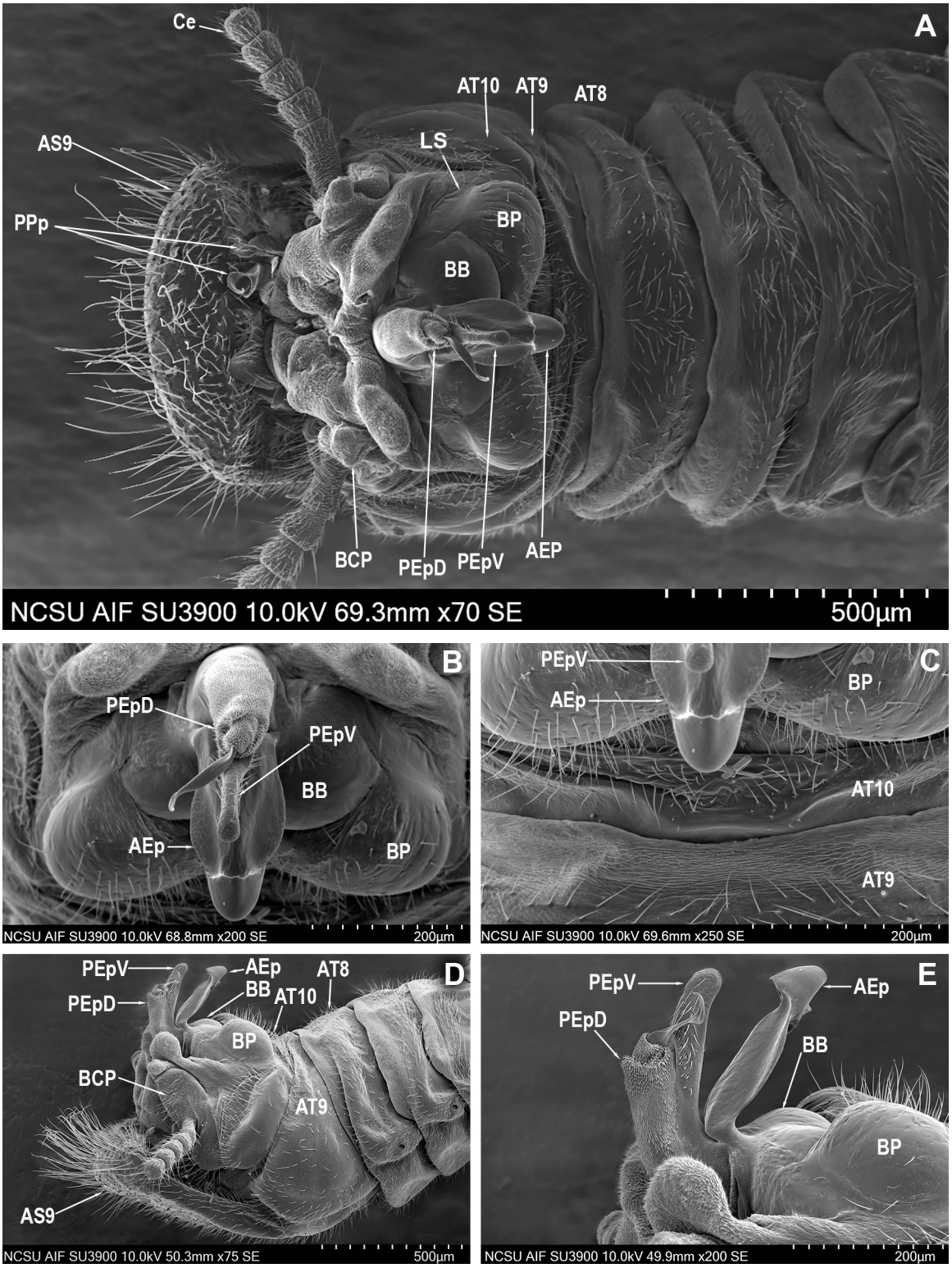

FIGURE 41. *Oemopteryx leei,* UT Butte Creek, Humboldt Co., California, adult male. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** Abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

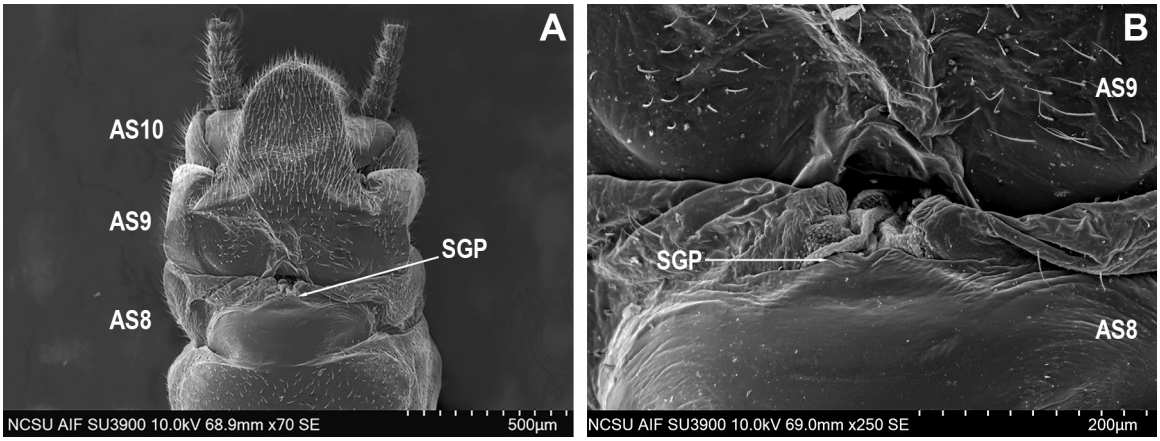

FIGURE 42. *Oemopteryx leei,* UT Butte Creek, Humboldt Co., California, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

Thorax (Fig. 43A). Pronotum wider posteriorly; light-brown with faint rugosities; Length of forewing pad 3.3X width; length of hindwing pad 1.8X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with light-brown spicules laterally and a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown; spicules dense medially and sporadic distally. Mesothorax with an oval prefurcasternal pit; light-brown spicules present both anterior and posterior to pit; lateral areas glabrous. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, wider than long (length 0.9X width). Metathoracic basisterna with a medial patch of light-brown spicules and a pair of furcasternal pits. Femur and tibia generally light-brown and with a fringe of silky setae (not shown); length of femoral setae about ½ the width of the femur; length of tibial setae longer than tibial width. Anterior and posterior faces of the femur with scattered short stout setae. Tibial callus darkened (Fig. 43D). Tarsus with a sparse dorsal fringe of silky setae (not shown); tarsus light-brown to brown. Venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen uniformly brown (Fig. 44E). Terga with a sparse posterior row of short, stout sensillae and pair of longer submedial stout sensillae anterior to those. Posterior margins of terga 8–10 with a pair of thin, erect, submedial setae. Venter of abdomen brown or with a purple hue; sterna 1–8 with light-brown spicules. Sternum-9 with an elongate plate (male = length 1.6X width (Fig. 43F); female = length 1.6X width (Fig. 43G)); plate width relative to sternal width (male = 0.75X; female = 0.75X). Both male and female with plate narrower basally, widest at posterior margin of sternum-9; posterolateral margins convex, evenly narrowing towards apex; apex broadly rounded. Plates of both males and females with stout setae begin at basal 1/5, becoming denser towards apex. Cercus uniformly brown; dorsobasal apically inserted setae present up to segment-15 (Fig. 42B); cercus longer than body (Fig. 43A).

Diagnosis. *Oemopteryx leei* is defined in the adult male by the anterior prong of the epiproct having a hood-like tip and the basal cercal processes being dorsally directed with a posteriorly oriented, pointed apex. The female is distinguished by having a subgenital plate with a narrow U-shaped notch medially. The larvae are unique in having long hair-like sensillae on distal margins of segments 3–4 of the maxillary palps.

Biological notes. *Oemopteryx leei* is presently known from the three EPA Level III ecoregions (Coast Range, Klamath Mountains, and Cascades) in northern California to west-central Oregon. Elevations of collection locations range between 447 m to 1411 m ASL. Based on known records *O. leei* appears to be allopatric with *O. vanduzeea,* which occurs in the Central California Foothills/Coastal Mountains, Sierra Nevada, Cascades, and Eastern Cascades Slopes and Foothills Level III ecoregions in California, though some range overlap could occur in the Cascades Level III ecoregion. Available records indicate adults are generally active from mid-April to mid-May; however, one record from Two Girls Peak in Willamette National Forest, Oregon was collected 25 August. Larvae have been collected from only one location with a drainage area of 1.6 km^2. Nothing is known regarding this taxon's life history. A conservation rank of G3 was calculated for this species indicating a moderate risk of extinction because of its relatively restricted range and few known populations (NatureServe 2020).

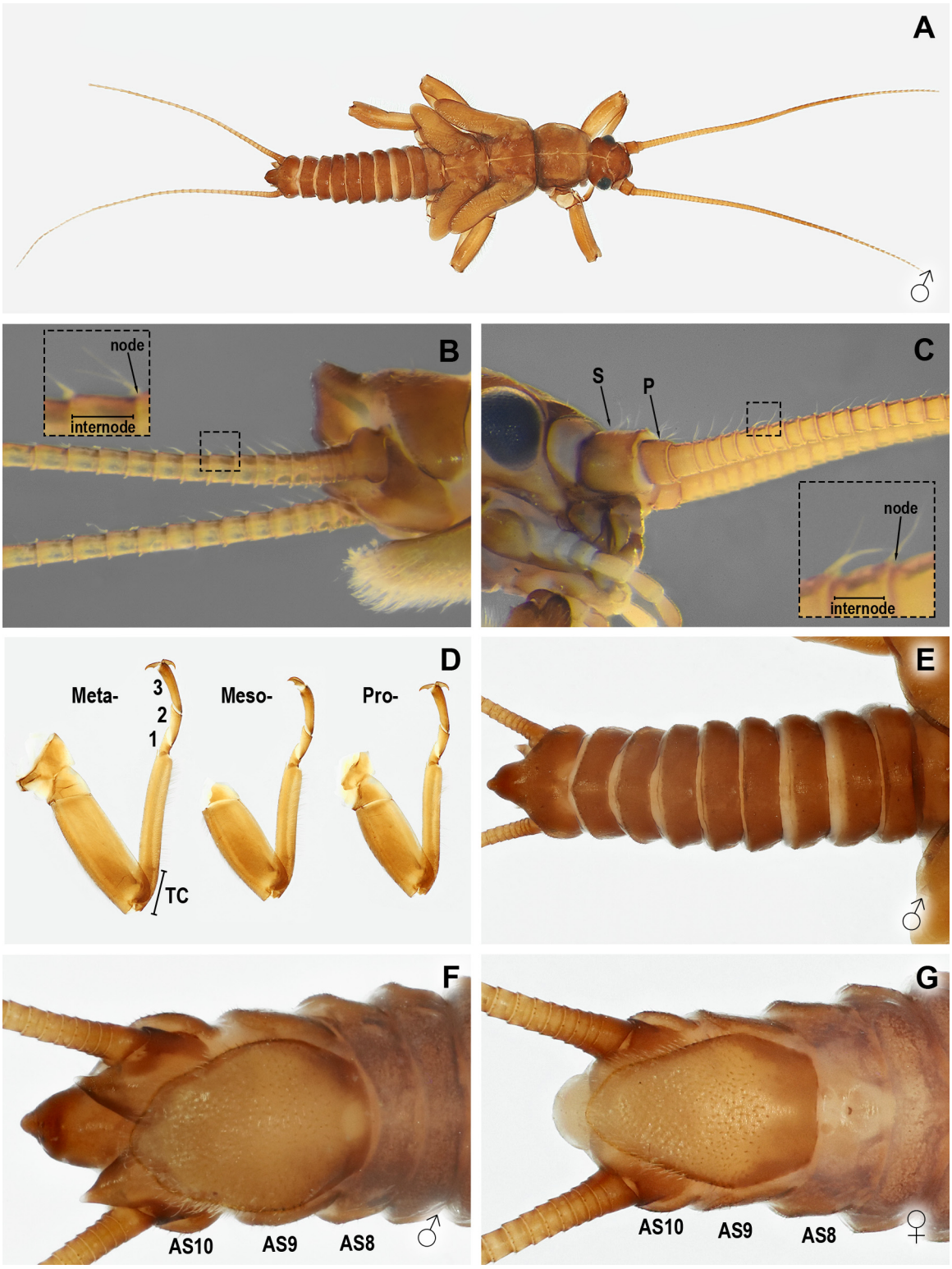

FIGURE 43. *Oemopteryx leei,* UT Butte Creek, Humboldt Co., California, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, ventral. **G.** Female sterna, ventral. [morphological abbreviations: see Table 1].

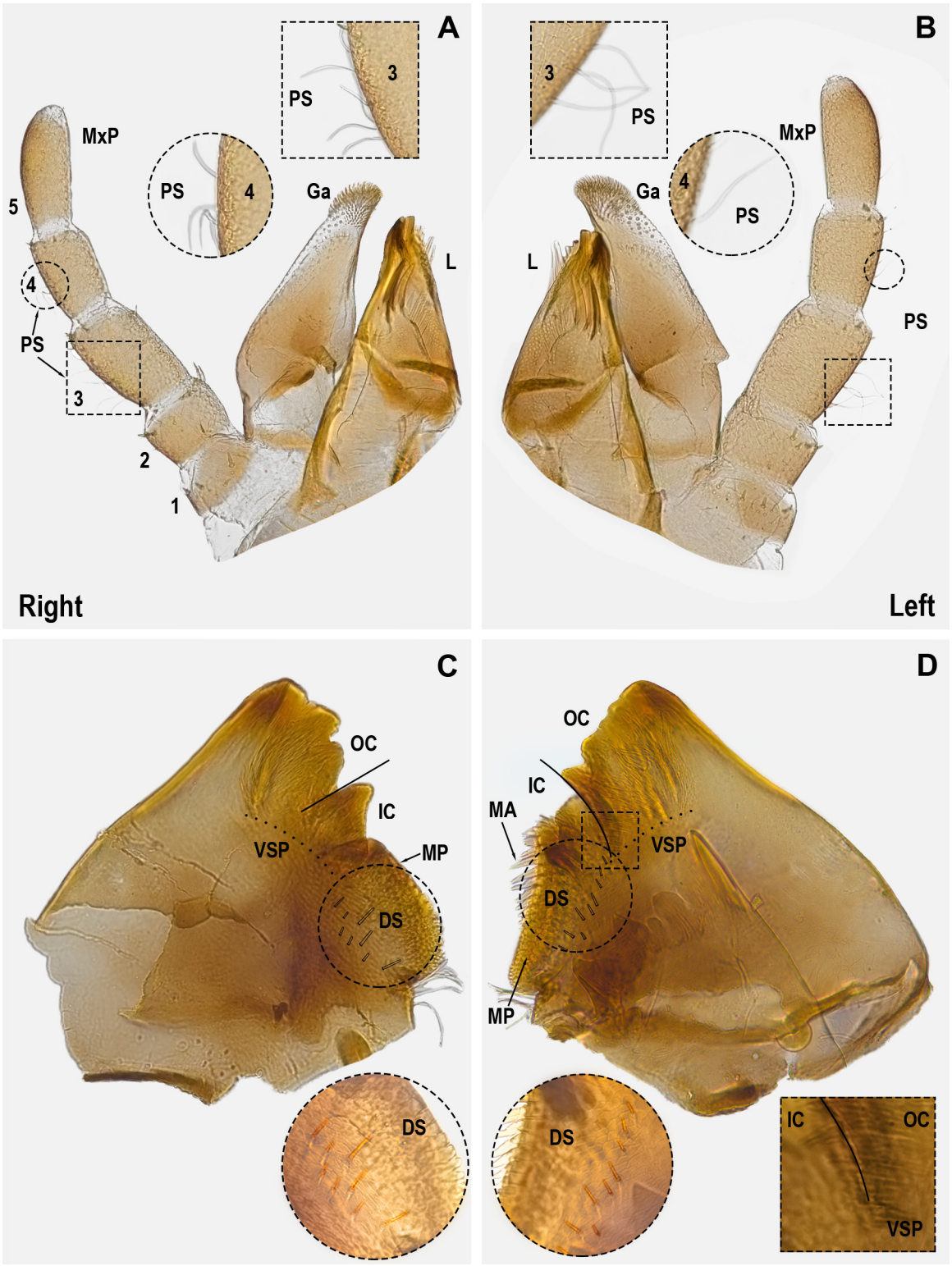

FIGURE 44. *Oemopteryx leei,* UT Butte Creek, Humboldt Co., California, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp. **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventro-apical setal patch (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

The *O. vanduzeea* Group

Oemopteryx vanduzeea (Claassen, 1937)

(Figs 45–49)
Seep Willowfly

Taeniopteryx vanduzeea Claassen, 1937: 46. Holotype male (CUIC), [Glen Alpine Creek, El dorado Co.,] California, USA.
Oemopteryx vanduzeea: Illies 1966: 64.
Taenionema vanduzeea: Zwick 1973: 317.
Oemopteryx vanduzeea: Ricker & Ross 1975: 141.
Taenionema vanduzeeum: Steyskal 1976: 410.
Oemopteryx vanduzeea: Baumann & Kondratieff 2009a: 197.

Distribution. USA.—CA (DeWalt *et al.* 2024) (Fig. 39)

Material examined. **USA.—California: Butte Co.,** Oregon Gulch, Oregon Gulch Rd. at [Castleberry] Covered Bridge, [39.59369, -121.52996], April 2010, B. Kondratieff, R. Baumann 5F; UT to Campbell Creek, 5.6 mi. S of Cherokee, [39.59779, -121.54646], April 2008, J. Sandberg, 2M, 8F (CSUIC); same location, 27 April 2010, B. Kondratieff, R. Baumann, 5F (CSUIC). **El Dorado Co.,** Blue Tent Creek, Hwy 49, [38.82974, -120.98256], 29 April 2010, B. Kondratieff, R. Baumann, 1L (CSUIC); Deadman Creek, Church Mine Rd., [38.65164, -120.82598], 28 April 2010, B. Kondratieff, R. Baumann, 1M, 3F, 1L (CSUIC); unnamed tributary seep to American River, FR 7 at Silver Fork [Campground], [38.69914, -120.20783], B. Kondratieff, R. Baumann, 19 June 2009, 1M (CSUIC); unnamed tributary seep to North Fork Cosumnes River, Capps Crossing, E Grizzly Flats, [38.64608, -120.40967], 5 June 1983, R.L. Bottorff, 5M, 5F (CSUIC); unnamed tributary, Long Canyon, NE Grizzly Flats, [38.63858, -120.4861], B. Kondratieff, R. Baumann, 5M, 20F, 12L (CSUIC); unnamed tributary off Church Mine Rd., [unable to approximate coordinates], 29 April 2010, B. Kondratieff, R. Baumann, 1M, 3F (CSUIC); unnamed tributary to [South Fork] Silver Creek, [38.84474, -120.235893], 19 June 2009, B. Kondratieff, R. Baumann, 1M, 4F (CSUIC). **Modoc Co.,** Johnson Creek, 3 mi. off Hwy 299/139, [41.3359, -120.87647], 24 May 2007, B. Kondratieff, R. Baumann, 2M (CSUIC). **Nevada Co.,** French Corral Creek, Pleasant Valley Rd., [39.30166, -121.17894], 28 April 2010, B. Kondratieff, R. Baumann, 1M, 2F (CSUIC); [unnamed tributary to South Yuba River], Indian Springs [Campground], Indian Springs Trailhead, [39.32934, -120.56943], 22 June 2009, B. Kondratieff, R. Baumann, 1M, 3F (CSUIC); Rattlesnake Creek, Woodchuck Flat Campground, [39.33283, -120.51916], 22 June 2009, B. Kondratieff, R. Baumann, 1M (CSUIC); South Yuba River, Indian Springs [Campground], [39.32817, -120.57132], 22 June 2009, B. Kondratieff, R. Baumann, 1M (CSUIC); Sweetland Creek, nr. Jct. Hwy 49 & Pleasant Valley Rd., Sweetland, [39.34306, -121.12472], 28 April 2010, B. Kondratieff, R. Baumann, 2M, 2F (CSUIC). **Placer Co.,** Soda Springs, Tahoe National Forest, [39.24740, -120.32631], 5 June 1998, E. Riley, 2M (CSUIC). **Plumas Co.,** Middle Fork Feather River, above Two Rivers Rd., 39.82321, -120.66591, 25 May 2019, B. Kondratieff, E. South, 1M (CSUIC). **Sonoma Co.,** Mark [West] Creek, St. Helena Rd., 38.52070, -122.56070, 24 April 2010, D.E. Ruiter, 1M (CSUIC). **Tehama Co.,** UT Mill Creek, Hole in the Ground Campground, 40.30962, -121.56105, 28 May 2019, B. Kondratieff, E. South, J. Sandberg, 8M, 3F (CSUIC); UT Mill Creek, Hole in the Ground Campground, 28N06A, 3.5 SW Mill Creek, 40.309357, -121.56932, 21 May 2024, J.B. Sandberg, 13M, 10F, 6L, 10E (NCDWR). **Tuolumne Co.,** unnamed tributary to South Fork Tuolumne River, Hwy 120, [unable to approximate coordinates], 22 June 2006, R. Baumann, B. Kondratieff, 19M (CSUIC); unnamed tributary to South Fork Tuolumne River, [unable to approximate coordinates], 22 June 2006, B. Kondratieff, R. Baumann, 9M (CSUIC).

Adult male (Fig. 45A). Macropterous. Length of forewings 6.9–8.7 mm (n = 10). Length of body 6.3–7.7 mm (n = 10). General body color light-brown to brown.

Head. (Fig. 45A). Dorsum of head mostly light-brown. Labrum pale anteriorly, brown posteriorly. Anterior frontoclypeus light-brown. Frons with a brown U-shaped marking. Antenna longer than body. Scape, pedicel, and flagella light-brown. Scape with a distal notch on anterior face. First flagellum subdivided at distal 1/4. Pale areas distal of lateral ocelli. Interocellar area uniformly light-brown and slightly depressed. Occiput with brown rugosities. Medial areas of the frons, interocellar surface, and occiput covered with fine, pale, clothing hairs.

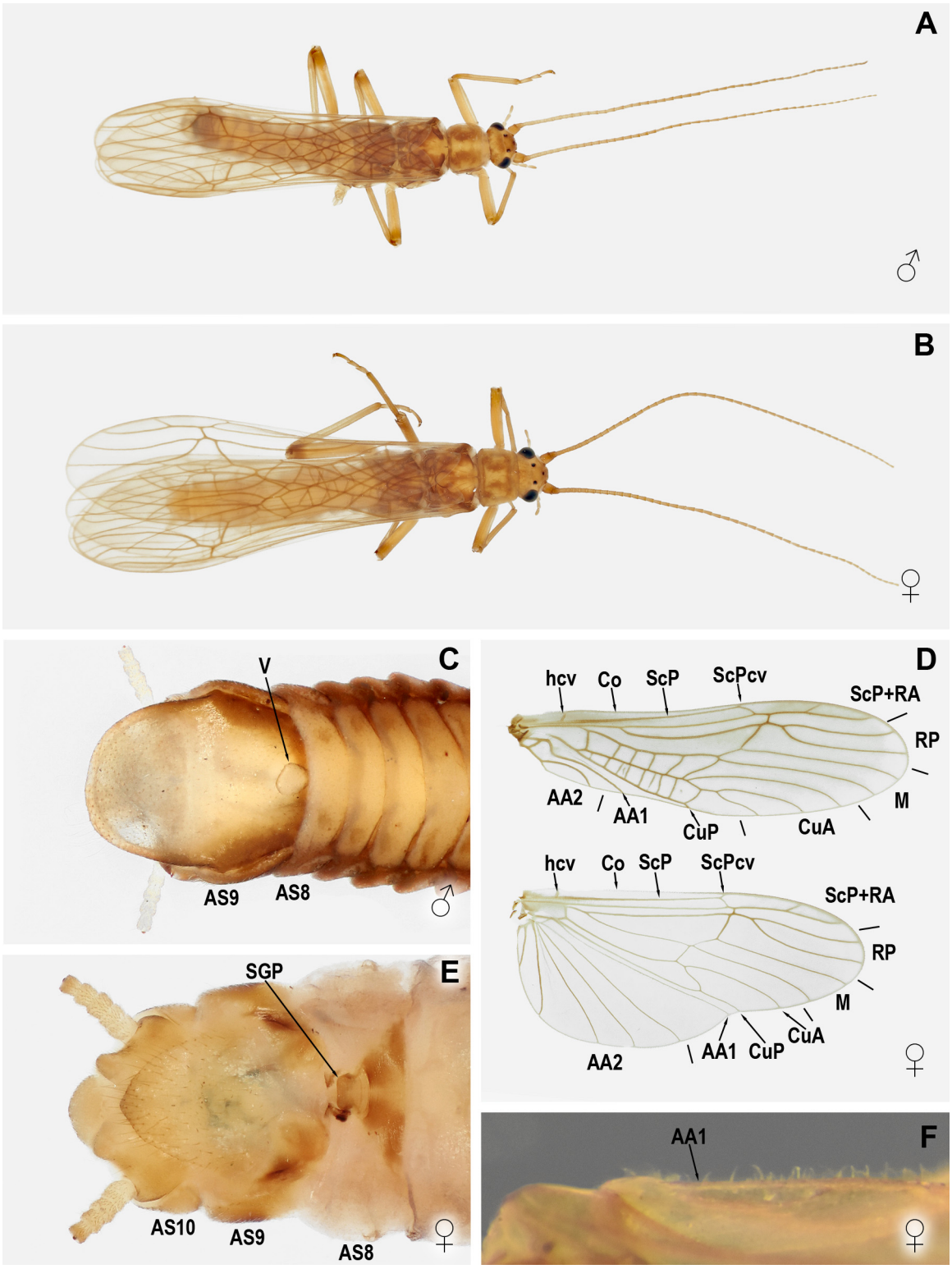

FIGURE 45. *Oemopteryx vanduzeea,* UT Long Canyon, El Dorado Co., California, adults. **A.** Male habitus, dorsal. **B.** Female habitus, dorsal. **C.** Male sterna, ventral. **D.** Female wings. **E.** Female sterna, ventral. **F.** Female forewing, lateral. [morphological abbreviations: see Table 1].

Thorax (Fig. 45A). Pronotum subquadrate, wider than long (length 0.9X width) with posterior width slightly wider than anterior width; light-brown overall with darker rugosities and a pale medial triangular area that widens posteriorly. Disk with irregular dark rugosities. Prosternum lightly sclerotized. Meso- and metathorax dark-brown, heavily sclerotized dorsally and ventrally. Mesonotum with a pale anteromedial spot. Thoracic nota and coxae uniformly covered with sparse, short, fine clothing hairs. Legs mostly light-brown. Distal portion of femur with darker pigment. Tibia light-brown, darker brown on proximal and distal portions. Apex of tibiae with 2-stout apical spines. Tarsus brown. Legs uniformly covered with dark, short stout setae. Wings hyaline, amber; venation brown; mottling absent. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked.

Abdomen. Abdominal segments 1–9 sparsely covered with short, fine clothing hairs. First abdominal tergite completely pale. Tergite-2 mostly brown. Terga 3–9 brown with a pale medial area that becomes progressively wider on posterior segments. Sterna 1–9 pale with a pair of sub-lateral brown spots. Sternum-9 with a lightly sclerotized clavate tab-like vesicle that is attached to sternum-9 at the anterior margin of the vesicle. (Fig. 45C). Sternum-9 elongated into a scooped plate (Fig. 46D), width narrowing from base to apex; apex with broadly rounded lateral margins (Fig. 45C). Dorso-apical margin of sternum-9 recurved anteriorly, broadly triangular with a minute, posterior medial protrusion (not visible in Fig. 45A). Plate with numerous long setae on dorsal and ventral surfaces (Figs 46A, 46D). Plate covering sternum-10 ventrally and extending beyond.

Terminalia (Figs 46A–E). Abdominal segment-10 nested within segment-9; anterior margin unsclerotized. Tergal sclerite-10 well sclerotized with a medial cleft, paired anterior processes absent (Fig. 46C). Cercus 5-segmented, excluding vestigial apical segment (Fig. 46A), and with a long basal-cercal process covered dorsally with long socketed setae; basal-cercal process about as long cercus, bent at midlength anteriorly (Figs 46A, 46D–E). Basal plate of tergum-10 bulbous with 2-hemispherical lobes divided by a median furrow and bearing, long socketed setae (Figs 46A–E). Lateral struts present, median strut present (Fig. 46C). Basal bulb (Figs 46A–B), glabrous, oval, bulbous, moderately sclerotized and with an inner bulb bearing a small hollow stalk, which terminates at a pore at the mid-length on the ventral face of the anterior epiproct. Anterior epiproct prong fused to basal bulb, heavily sclerotized, broadly spatulate and depressed medially (Figs 46A–B). Posterior epiproct prong closely appressed to anterior prong, lightly sclerotized, divided near apex with dorsal and processes armed with posteriorly direct scale-like setae (Figs 46A–B, 46D–E); ventral process sclerotized basally and ventrally, length exceeds dorsal process (Figs 46A–B, 46D–E); Dorsal process pouch-like, armed with posteriorly directed spine-like setae with an apical sleeve containing a single, eversible internal filament (Figs 46A–B, 46D–E); filament visible inside basal bulb. Paraprocts subdivided into 2-parts, symmetrical anterior paraprocts and asymmetrical multi-lobed posterior paraprocts. Anterior paraproct (Fig. 46D) posterior to cercus, base pentagonal, well sclerotized with a minute, membranous finger-like mediodorsal projection. Posterior paraprocts (Figs 46A, D) with 4-prongs, variously fused; left outer prong flattened with a sclerotized clavate apex; outer and inner middle prongs both flattened, twisted, apices spatulate; inner prong moderately sclerotized with a scoop-shaped apex; right outer prong lightly sclerotized, flattened, concave posteriorly with a sclerotized clavate apex; right outer middle prong flat sclerotized with a truncate apex; right inner middle prong twisted with a membranous filamentous apex; right inner prong light sclerotized, apex truncate and bearing 2-stout spines.

Adult female (Fig. 45B). Macropterous. Length of forewings 7.6–10.5 mm (n = 10). Length of body 5.7–9.7 mm (n = 10). General body color brown. Overall appearance similar to male. Wings hyaline, amber; venation brown; mottling absent. Forewing without costal crossveins between humeral crossvein and apex of the subcostal vein which may be forked (Fig. 45D). AA1 vein of forewing with short fine setae (Fig. 45F). Dorsum of abdomen lightly sclerotized, uniform. Venter of abdomen similar to male. Sternum-8 lightly sclerotized anteriorly (Fig. 45E). Subgenital plate entire, at most with a subtle medial depression posteriorly (Figs 45E, 47A–B), moderately sclerotized (Fig. 45E). Sternum-9 moderately sclerotized anterolaterally, plate parabolic, produced just beyond the apex of abdominal segment-10; length of free portion of sternum 0.7X basal width; uniformly covered with long setae that become longer posteriorly; lateral margins moderately narrowing to a rounded apex (Figs 45E, 47A). Cercus 5-segmented, excluding vestigial apical segment (Figs 45E, 47A).

Ovum. Unknown.

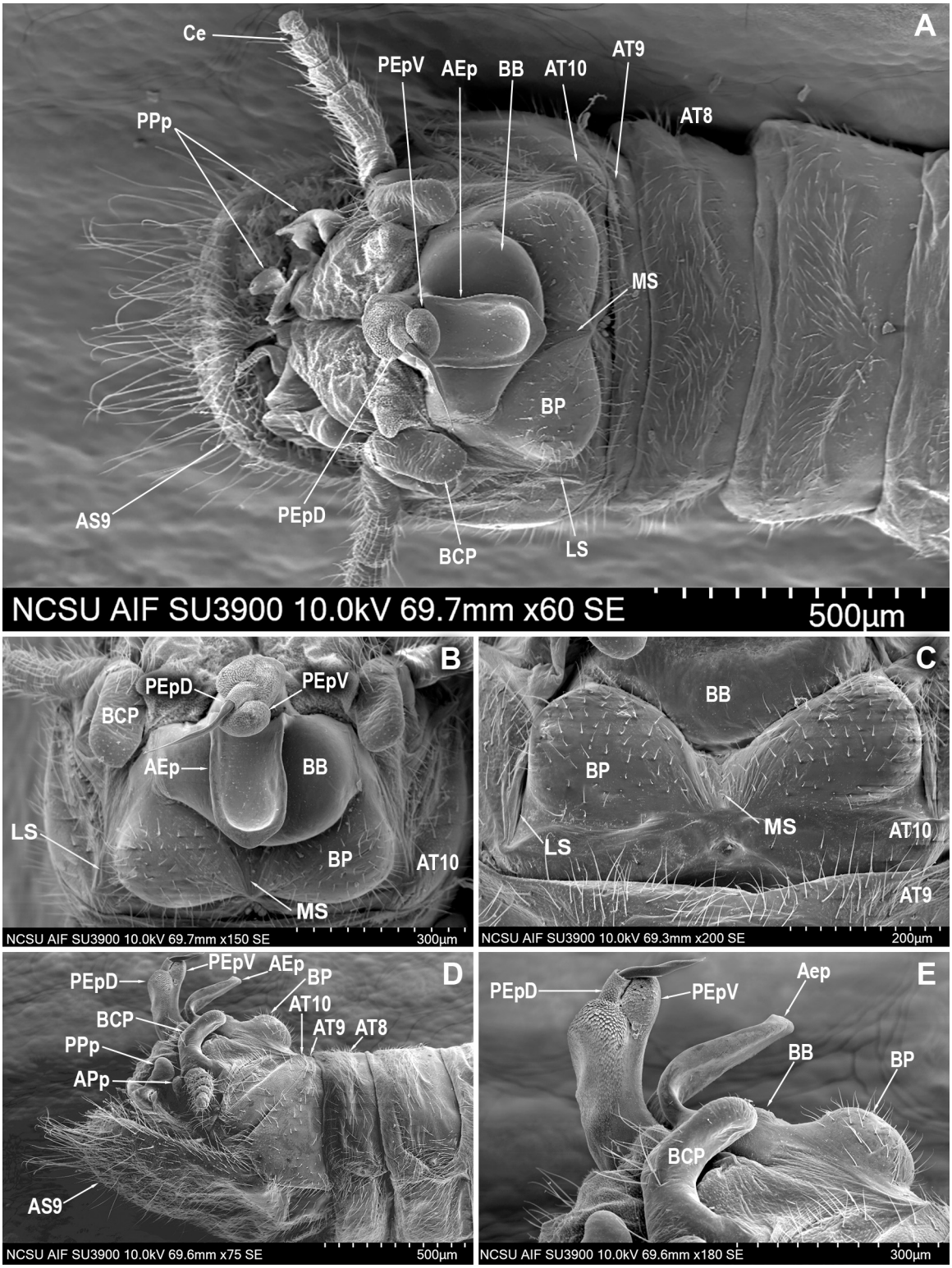

FIGURE 46. *Oemopteryx vanduzeea,* adult male. **A–B, D–E.** UT Tuolumne River., Tuolumne Co., California. **A.** Terminalia, dorsal. **B.** Terminalia, close, dorsal. **C.** UT Mill Creek, Tehama Co., California, abdominal terga, dorsal. **D.** Terminalia, lateral. **E.** Epiproct, lateral. [morphological abbreviations: see Table 1].

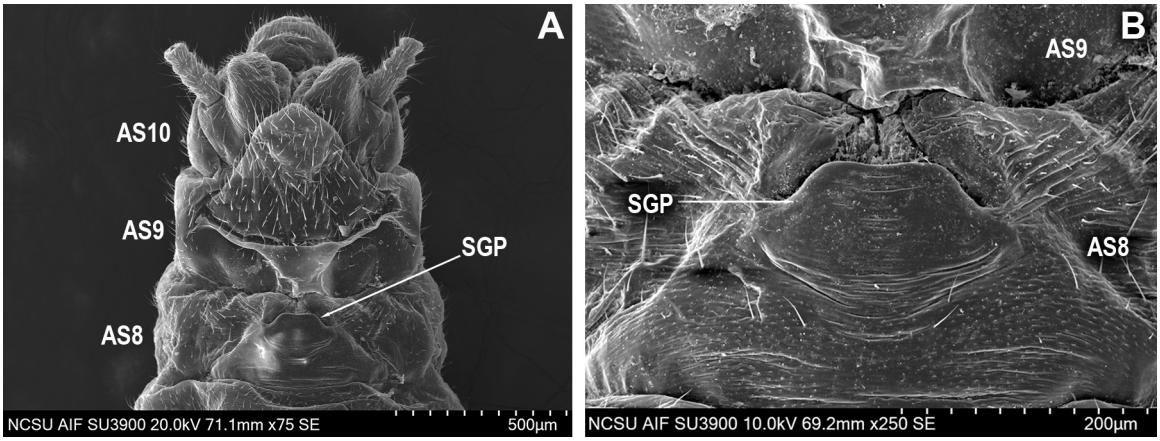

FIGURE 47. *Oemopteryx vanduzeea,* UT Long Canyon, El Dorado Co., California, adult female. **A.** Abdominal sterna, ventral. **B.** Subgenital plate. [morphological abbreviations: see Table 1].

Mature larva (Fig. 48A). Length of male body 6.8 mm (n = 1), female body 6.9–7.5 mm (n = 10). General color light-brown to brown. Integument glossy, much of the body with sparse, fine, hair-like sensillae and socketed stout setae, observable at >100X magnification. Specimens generally preserve in a curled posture with the head touching or approaching the abdomen apex, similar to other Taeniopterygidae.

Head (Fig. 48A). Dorsum of head light-brown with darker brown maculations variously developed. Antelabrum light-brown with 2-anterolateral pale spots; anterior margin of antelabrum with a dense brush of golden setae; postlabrum light-brown. Anterior frontoclypeus pale. Frons with a brown U-shaped marking with posterolateral extensions; light-brown rectangular markings near, but not touching the lateral ocelli, anterior to ecdysial suture. Interocellar area diffusely light-brown. Occipital area diffusely light-brown near ecdysial suture and with irregular brown rugosities. Eyes with pigmented ommatidia reaching eye margins. A single long seta both anterior and posterior to eyes. Antennal scape brown; scape and flagella light-brown; dorsobasal apically inserted setae absent (Fig. 48C); antenna slightly shorter than body (Fig. 48A).

Maxilla (Figs 49A–B). Lacinia triangular with a straight inner margin. Lacinia with 2-apical, cupped teeth with at least 1-large subapical denticle on ventral face; actual number difficult to discern due to wear. Apical teeth subequal in length; length of apical teeth relative to palm length difficult to discern due to wear. Inner palm margin with 12-stout socketed marginal setae below apical teeth; first setae below apical teeth robust. A patch of hair like acanthae absent below apical teeth; acutely pointed sensilla basiconica below apical teeth and on inner palm margin near the middle. Galea with a dense brush of curved setae on the distal apical margin, which transition to sparse peg-like setae at the apical 2/3. A thin marginal row of long setae below apical setae extends about 2/3 to base. Length of galea, including apical setae, 1.3X length of lacinia; width of galea 1.3X the lacinia width. Maxillary palp with 5-segments; 2.0X length of lacinia; palp with sensilla basiconica developed on the apical and lateral margins of each segment.

Mandible. Right mandible (Fig. 49C) bicuspid, outer cusp with 3-teeth, inner cusp with 1-tooth. Molar pad adorned with marginal rows of truncate peg-like acanthae (length 2.0X width). Palm dorsum with 8–9 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 49C circle inset); proximal basal corner with a marginal patch of 3-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 49C). Left mandible (Fig. 49D) bicuspid, outer cusp with 5-teeth, inner cusp with 1-broad tooth. Molar pad with marginal rows of rounded acanthae and long pointed acanthae (length 3.0X width). Palm dorsum with 7–9 dorsal sensillae adjacent to molar pad (requires focusing through the mandible) (Fig. 49D circle inset); the proximal basal corner with a marginal patch of 3-hair-like, branched setae. Ventro-apical setal patch extending from outer cusp to beyond the inner cusp basally (indicated by dotted line in Fig. 49D, square inset).

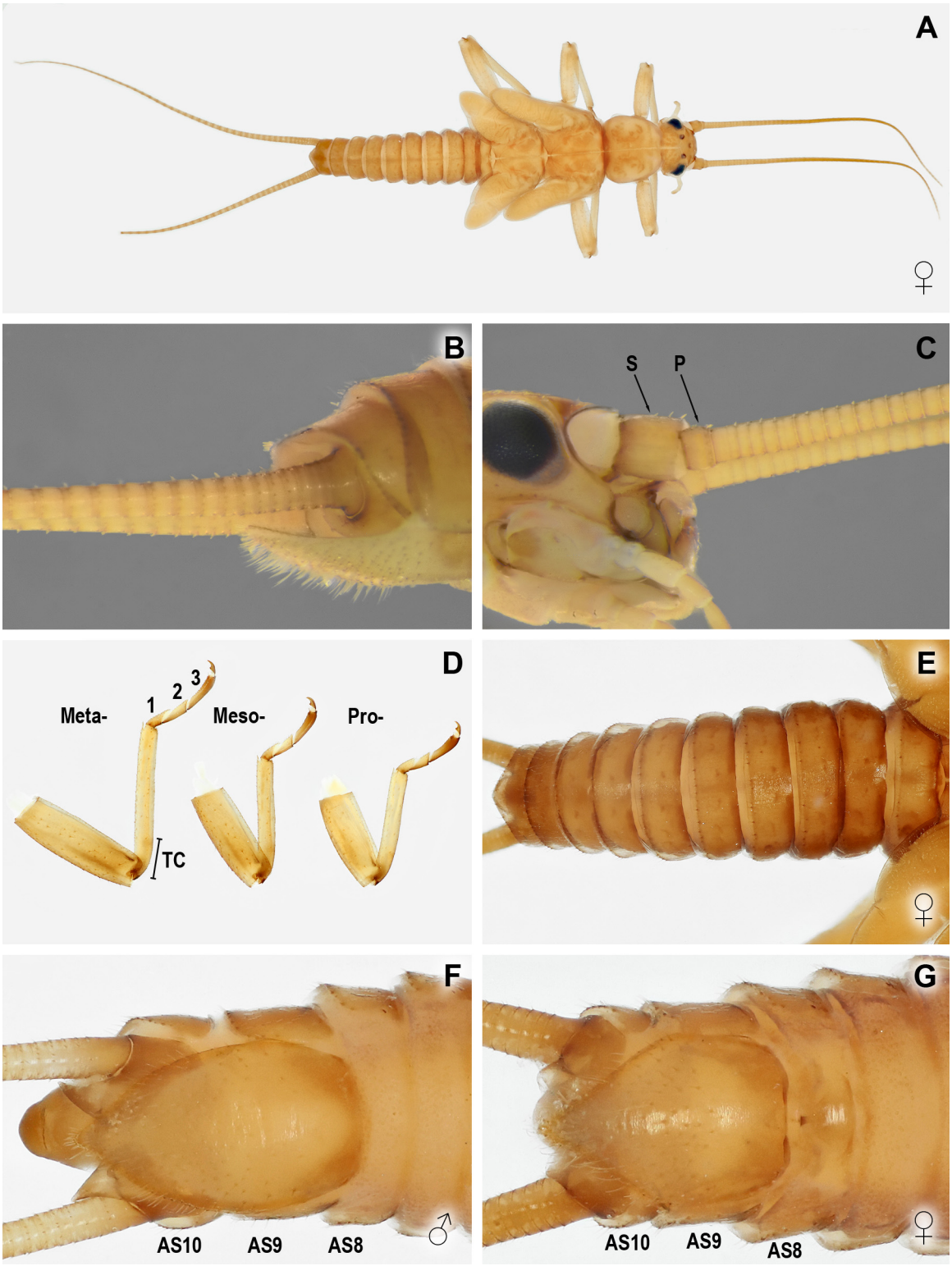

FIGURE 48. *Oemopteryx vanduzeea,* UT Long Canyon, El Dorado Co., California, larva. **A.** Habitus, dorsal. **B.** Right cercus, lateral. **C.** Right antenna, lateral. **D.** Legs, anterior. **E.** Abdomen, dorsal. **F.** Male sterna, ventral. **G.** Female sterna, ventral. [morphological abbreviations: see Table 1].

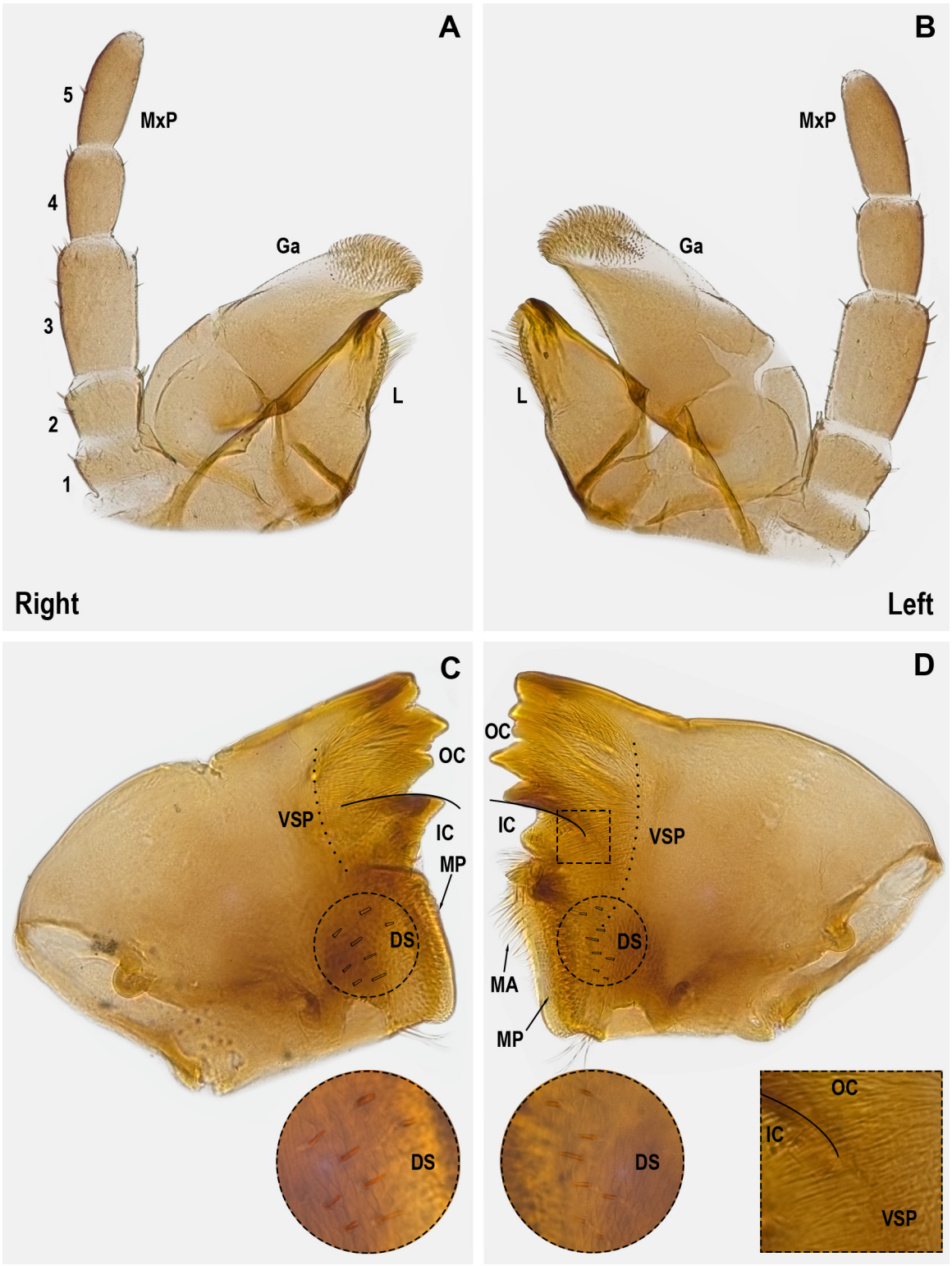

FIGURE 49. *Oemopteryx vanduzeea,* UT Long Canyon, El Dorado Co., California, larval mouthparts, ventral. **A.** Right lacinia, galea and maxillary palp. **B.** Left lacinia, galea and maxillary palp. **C.** Right mandible; dorsal sensillae (circle inset). **D.** Left mandible; ventro-apical setal patch (square inset); dorsal sensillae (circle inset). [morphological abbreviations: see Table 1].

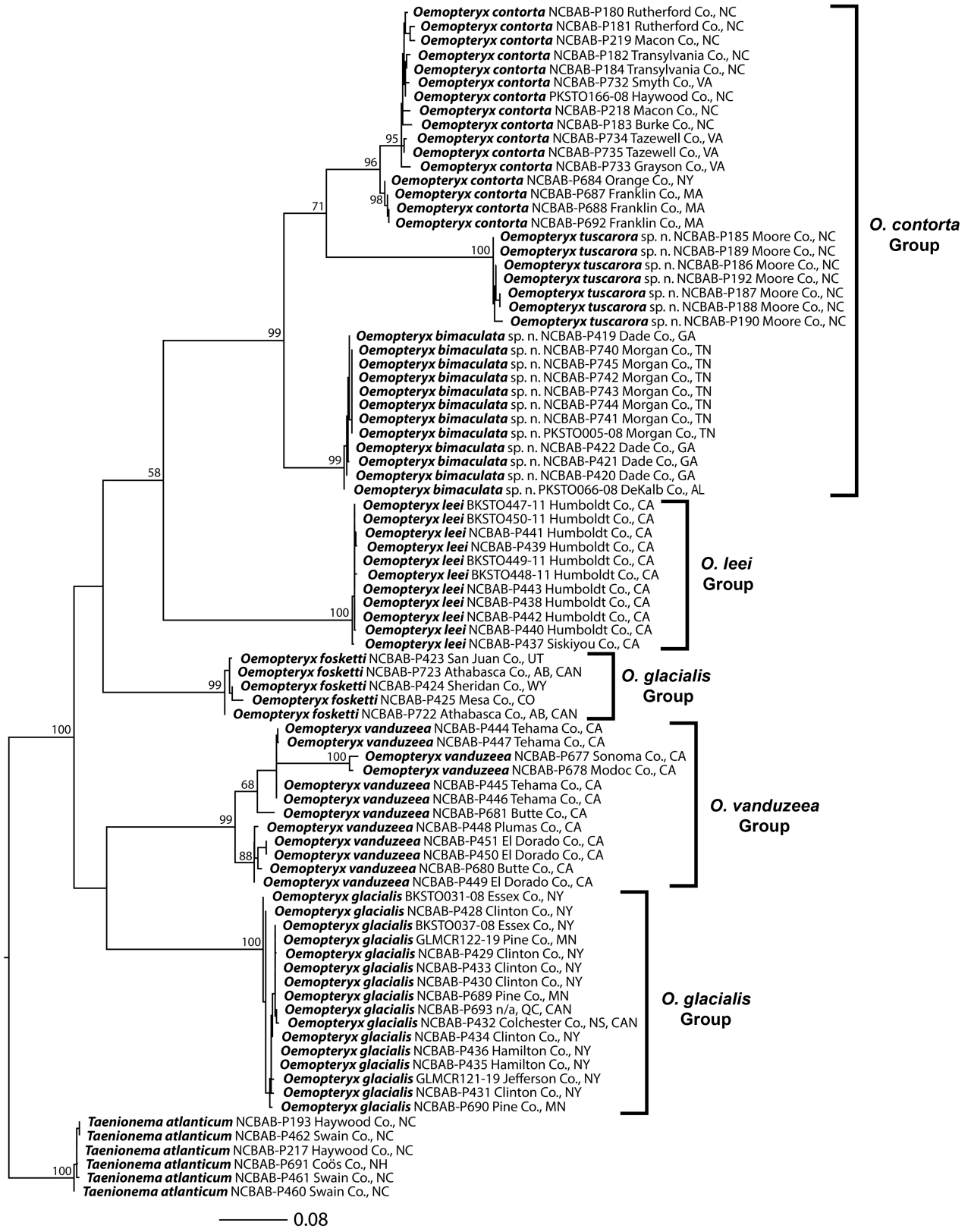

FIGURE 50. Phylogenetic representation of the IQTREE-estimated maximum likelihood tree of cytochrome c oxidase I (COI) sequences. Bootstrap values of >50 are shown at associated nodes; values are not provided for short internodes within species clades. Tips are labeled with species name, accession number, and county and state. The scale bar represents estimated number of nucleotide substitutions per site.

Thorax (Fig. 48A). Pronotum wider posteriorly; light-brown with faint rugosities; Length of forewing pad 3.2X width; length of hindwing pad 1.8X width. Venter of thorax pale. Prothoracic presternum mostly glabrous with light-brown spicules laterally and a pair of elongate lateral cervical sclerites. Prothoracic basisternum and furcasternum light-brown spicules dense medially and sporadic distally. Mesothorax with an oval prefurcasternal pit; light-brown spicules present both anterior and posterior to pit; lateral areas glabrous. Mesothoracic basisternum with light-brown spicules mostly concentrated medially. Furcasternal pit present between mesothoracic legs; furcasternum triangular, wider than long (length 0.8X width). Metathoracic basisterna with a medial patch of light-brown spicules and a pair of furcasternal pits. Femur and tibia generally light-brown (Fig. 48D) and with a sparse fringe of silky setae (not shown); length of femoral setae about 1/2 the width of the femur; length of tibial setae about equal to tibial width. Anterior and posterior faces of the femur with scattered short stout setae; anterior face usually with a thin, distal, longitudinal, brown stripe (Fig. 48D). Tibial callus darkened (Fig. 48D). Tarsus with a few sporadic setae; tarsus uniformly light-brown; venter of tibia and tarsus with scattered short stout setae.

Abdomen. Dorsum of abdomen uniformly light-brown (Fig. 48E). Posterior margins of terga with a single row of short, stout sensillae. Posterior margins of tergum-8 and tergum-9 with a pair of thin, erect, submedial setae. Venter of abdomen pale; sterna 1–8 light-brown. Female sternum-8 with developing subgenital plate visible, posterior edge notched medially. Sternum-9 with an elongate plate (male = length 1.7X width (Fig. 48F); female = length 1.6X width (Fig. 48G); plate width relative to sternal width (male = 0.7X; female = 0.8X). Both male and female with plate narrower basally, widest at posterior margin of sternum-9; posterolateral margins linear to convex, evenly narrowing towards apex; apex acutely pointed, nipple-like. Plates of both males and females with stout setae begin at basal 1/5, becoming denser towards apex. Cercus uniformly brown; dorsobasal apically inserted setae absent (Fig. 48B); cercus about as long as body (Fig. 48A).

Diagnosis. *Oemopteryx vanduzeea* is defined in the male by the anterior epiproct prong being broadly spatulate with a medial depression and having anteriorly directed basal cercal processes subequal in length to the cerci. The female is distinguished by having a subgenital plate that is moderately sclerotized throughout with an entire or minimally concave posterior margin. The larvae are unique in having a ninth sternum with an acute nipple-like projection at its apex.

Biological notes. *Oemopteryx vanduzeea* is presently known from four Level III ecoregions (Central California Foothills/Coastal Mountains, Sierra Nevada, Cascades, and Eastern Cascades Slopes and Foothills) in California. Elevations of collection locations range between 21 m to 3077 m ASL. Based on known records, *O. vanduzeea* appears to be allopatric with *O. leei,* which primarily occurs in the Coast Range, Klamath Mountains, though some range overlap could occur in the Cascades Level III ecoregion. Available records indicate adults are generally active from late January to mid-July. Larvae have been collected from streams with drainage areas ranging from 3.6 km^2 to 56.2 km^2. Nothing is known regarding this taxon's life history. A conservation rank of G3 was calculated for this species indicating a moderate risk of extinction because of its relatively restricted range and few known populations (NatureServe 2020).

Genetic data results

We generated a total of 74 new COI sequences for seven Nearctic *Oemopteryx* species and the outgroup taxon *Taenionema atlanticum*; an additional 11 sequences were obtained from BOLD (Table 2). Intraspecific genetic distances varied between species. Maximum intraspecific distances were high for *O. contorta* (max p-dist. = 5.71%) and *O. vanduzeea* (max p-dist = 11.58%) (Table 3). Specimens of *O. contorta,* formed clades representing the end boundaries of the species' range in the Northeast and Southeast. Whereas, specimens of *O. vanduzeea* generally formed clades representing either the Sierra Nevada, or the Central California Foothills/Coastal Mountains, Cascades, and Eastern Cascades Slopes and Foothills, collectively. However, both clades included *O. vanduzeea* specimens from a site in Butte County, California. As a result, these groupings suggest possible gene flow between transitionary populations of the Sierra Nevada, Cascades, and Coastal Mountains. Maximum intraspecific distances were closer to expected values for the remaining species (max p-dist ≤ 2.28%) (Table 3). Within the *O. contorta* Group, interspecific genetic distances between *O. contorta* and *O. bimaculata* **sp. nov.** (avg. p-dist. = 12.97%, min p-dist = 11.25%) and *O. contorta* and *O. tuscarora* **sp. nov.** (avg. p-dist = 16.04%, min p-dist = 13.22%) greatly exceeded the intraspecific distance for *O. contorta* (avg. p-dist = 2.43%, max p-dist = 5.71%) (Table 3).

TABLE 2. Data for specimens included in the phylogenetic analysis.

Taxon	Accession #	GenBank #	Stage	Sex	State	County	Waterbody	Date	Lat.	Long.	Barcoded by
O. bimaculata **sp. nov.**	NCBAB-P419	PQ827145	A	M	GA	Dade	Daniel Creek	18-Feb-17	34.82457	-85.49074	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P420	PQ827147	A	F	GA	Dade	Daniel Creek	18-Feb-17	34.82457	-85.49074	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P421	PQ827148	L	-	GA	Dade	Daniel Creek	18-Feb-17	34.82457	-85.49074	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P422	PQ827146	L	-	GA	Dade	Daniel Creek	18-Feb-17	34.82457	-85.49074	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P740	PQ827149	A	M	TN	Morgan	Smith Branch	15-Feb-24	36.0064	-84.60735	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P741	PQ827150	A	M	TN	Morgan	Hall Creek	15-Feb-24	36.03188	-84.56940	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P742	PQ827151	A	F	TN	Morgan	Hall Creek	15-Feb-24	36.03188	-84.56940	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P743	PQ827152	A	M	TN	Morgan	Green Branch	15-Feb-24	36.14807	-84.77806	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P744	PQ827153	L	-	TN	Morgan	Green Branch	15-Feb-24	36.14807	-84.77806	NCMNS
O. bimaculata **sp. nov.**	NCBAB-P745	PQ827154	L	-	TN	Morgan	Green Branch	15-Feb-24	36.14807	-84.77806	NCMNS
O. bimaculata **sp. nov.**	PKSTO005-08	-	A	F	TN	Morgan	Emory River	22-Feb-07	36.07600	-84.64900	CCDB
O. bimaculata **sp. nov.**	PKSTO066-08	-	A	F	AL	De Kalb	Laurel Creek	21-Mar-07	34.49600	-85.63400	CCDB
O. contorta	NCBAB-P180	PQ827131	A	M	NC	Rutherford	Pool Creek	17-Jan-19	35.42897	-82.22901	NCMNS
O. contorta	NCBAB-P181	PQ827138	A	F	NC	Rutherford	Pool Creek	17-Jan-19	35.42897	-82.22901	NCMNS
O. contorta	NCBAB-P182	PQ827132	A	M	NC	Transylvania	Coontree Creek	29-Jan-19	35.28967	-82.76324	NCMNS
O. contorta	NCBAB-P183	PQ827139	A	F	NC	Burke	Hall Creek	17-Jan-19	35.60501	-81.78294	NCMNS
O. contorta	NCBAB-P184	PQ827133	A	M	NC	Transylvania	Davidson River	29-Jan-19	35.28810	-82.76286	NCMNS
O. contorta	NCBAB-P218	PQ827140	A	F	NC	Macon	Bearpen Creek	5-Apr-14	35.18575	-83.61410	NCMNS
O. contorta	NCBAB-P219	PQ834354	A	F	NC	Macon	Bearpen Creek	5-Apr-14	35.18575	-83.61410	NCMNS
O. contorta	NCBAB-P684	PQ827141	A	M	NY	Orange	UT Lake Stahehe	9-Mar-09	41.23630	-74.15080	NCMNS
O. contorta	NCBAB-P687	PQ827142	A	F	MA	Franklin	Dean Branch	18-Feb-23	42.41863	-72.47603	NCMNS
O. contorta	NCBAB-P688	PQ827143	A	M	MA	Franklin	Dean Branch	18-Feb-23	42.41863	-72.47603	NCMNS
O. contorta	NCBAB-P692	PQ827144	A	F	NY	Franklin	Dean Branch	18-Feb-23	42.41863	-72.47603	NCMNS
O. contorta	NCBAB-P732	PQ827134	A	M	VA	Smyth	Big Laurel Creek	16-Feb-24	36.68190	-81.56527	NCMNS

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TABLE 2. (Continued)

Taxon	Accession #	GenBank #	Stage	Sex	State	County	Waterbody	Date	Lat.	Long.	Barcoded by
O. contorta	NCBAB-P733	PQ827137	A	M	VA	Grayson	Lewis Fork	16-Feb-24	36.69455	-81.51460	NCMNS
O. contorta	NCBAB-P734	PQ827135	A	M	VA	Tazewell	Cove Creek	14-Feb-24	37.17837	-81.29900	NCMNS
O. contorta	NCBAB-P735	PQ827136	A	F	VA	Tazewell	Cove Creek	14-Feb-24	37.17837	-81.29900	NCMNS
O. contorta	PKSTO166-08	-	A	M	NC	Haywood	Seep Devils Courthouse	4-Apr-06	35.30500	-82.90000	CCDB
O. fosketti	NCBAB-P423	PQ827181	A	F	UT	San Juan	San Juan River	11-Mar-17	37.25812	-109.61927	NCMNS
O. fosketti	NCBAB-P424	PQ827183	A	F	WY	Sheridan	Big Goose Creek	15-Apr-10	44.8211	-106.96171	NCMNS
O. fosketti	NCBAB-P425	PQ827185	A	M	CO	Mesa	Delores River	17-Mar-11	38.68051	-108.98019	NCMNS
O. fosketti	NCBAB-P722	PQ827184	A	M	AB	Athabasca	Athabasca River	7-Apr-99	54.72233	-113.28583	NCMNS
O. fosketti	NCBAB-P723	PQ827182	A	F	AB	Athabasca	Athabasca River	7-Apr-99	54.72233	-113.28583	NCMNS
O. glacialis	BKSTO031-08	-	A	M	NY	Essex	Bouquet River	17-Feb-08	44.18040	-73.6143	CCDB
O. glacialis	BKSTO037-08	-	A	F	NY	Essex	W. Br. Ausable River	13-Mar-07	44.30000	-73.92900	CCDB
O. glacialis	GLMCR121-19	-	A	M	NY	Jefferson	Indian River	19-Mar-16	44.15700	-75.71000	CCDB
O. glacialis	GLMCR122-19	-	A	M	MN	Pine	Snake River	23-Mar-13	45.82300	-92.77000	CCDB
O. glacialis	NCBAB-P428	PQ827119	A	M	NY	Clinton	Salmon River	16-Mar-12	44.64010	-73.49470	NCMNS
O. glacialis	NCBAB-P429	PQ827120	A	M	NY	Clinton	Salmon River	16-Mar-12	44.64010	-73.49470	NCMNS
O. glacialis	NCBAB-P430	PQ827122	A	M	NY	Clinton	Salmon River	16-Mar-12	44.64010	-73.49470	NCMNS
O. glacialis	NCBAB-P431	PQ827126	A	M	NY	Clinton	Salmon River	16-Mar-12	44.64010	-73.49470	NCMNS
O. glacialis	NCBAB-P432	PQ827125	A	M	NS	Colchester	Salmon River	25-Mar-16	45.38944	-63.18000	NCMNS
O. glacialis	NCBAB-P433	PQ827121	L	-	NY	Clinton	S. Br. [Saranac River]	15-Mar-06	44.59490	-73.83890	NCMNS
O. glacialis	NCBAB-P434	PQ827127	L	-	NY	Clinton	S. Br. [Saranac River]	15-Mar-06	44.59490	-73.83890	NCMNS

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TABLE 2. (Continued)

Taxon	Accession #	GenBank #	Stage	Sex	State	County	Waterbody	Date	Lat.	Long.	Barcoded by
O. glacialis	NCBAB-P435	PQ827128	A	M	NY	Hamilton	Sacandaga River	12-Mar-12	43.49552	-74.35860	NCMNS
O. glacialis	NCBAB-P436	PQ827129	A	M	NY	Hamilton	Sacandaga River	12-Mar-12	43.49552	-74.35860	NCMNS
O. glacialis	NCBAB-P689	PQ827123	A	M	MN	Pine	Snake River	23-Mar-13	45.82306	-92.77001	NCMNS
O. glacialis	NCBAB-P690	PQ827130	A	M	MN	Pine	Snake River	23-Mar-13	45.82306	-92.77001	NCMNS
O. glacialis	NCBAB-P693	PQ827124	A	M	ON	Quebec	Riviere Du Nord	21-Mar-16	45.94328	-74.12445	NCMNS
O. leei	BKSTO447-11	-	A	M	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	123.68300	CCDB
O. leei	BKSTO448-11	-	L	-	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	123.68300	CCDB
O. leei	BKSTO449-11	-	A	M	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	123.68300	CCDB
O. leei	BKSTO450-11	-	A	M	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	123.68300	CCDB
O. leei	NCBAB-P437	PQ827168	A	M	CA	Siskiyou	Etna Creek	14-May-16	41.41157	-122.97366	NCMNS
O. leei	NCBAB-P438	PQ827162	A	M	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	-123.68300	NCMNS
O. leei	NCBAB-P439	PQ827167	A	M	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	-123.68300	NCMNS
O. leei	NCBAB-P440	PQ827165	A	F	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	-123.68300	NCMNS
O. leei	NCBAB-P441	PQ827166	A	F	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	-123.68300	NCMNS
O. leei	NCBAB-P442	PQ827163	L	-	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	-123.68300	NCMNS
O. leei	NCBAB-P443	PQ827164	L	-	CA	Humboldt	UT Butte Creek	2-May-11	40.41900	-123.68300	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P185	PQ827155	A	M	NC	Moore	Haystack Creek	25-Feb-21	35.33888	-79.56610	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P186	PQ827157	A	M	NC	Moore	Haystack Creek	25-Feb-21	35.33888	-79.56610	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P187	PQ827159	A	M	NC	Moore	Haystack Creek	4-Mar-21	35.33888	-79.56610	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P188	PQ827160	A	F	NC	Moore	Haystack Creek	4-Mar-21	35.33888	-79.56610	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P189	PQ827156	A	F	NC	Moore	Haystack Creek	4-Mar-21	35.33888	-79.56610	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P190	PQ827161	L	-	NC	Moore	Haystack Creek	4-Mar-21	35.33888	-79.56610	NCMNS
O. tuscarora **sp. nov.**	NCBAB-P192	PQ827158	L	-	NC	Moore	Haystack Creek	25-Feb-21	35.33888	-79.56610	NCMNS

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TABLE 2. (Continued)

Taxon	Accession #	GenBank #	Stage	Sex	State	County	Waterbody	Date	Lat.	Long.	Barcoded by
O. vanduzeea	NCBAB-P444	PQ827169	A	M	CA	Tehama	UT Mill Creek	28-May-19	40.30962	-121.56105	NCMNS
O. vanduzeea	NCBAB-P445	PQ827170	A	M	CA	Tehama	UT Mill Creek	28-May-19	40.30962	-121.56105	NCMNS
O. vanduzeea	NCBAB-P446	PQ827171	A	F	CA	Tehama	UT Mill Creek	28-May-19	40.30962	-121.56105	NCMNS
O. vanduzeea	NCBAB-P447	PQ827172	A	F	CA	Tehama	UT Mill Creek	28-May-19	40.30962	-121.56105	NCMNS
O. vanduzeea	NCBAB-P448	PQ827174	A	M	CA	Plumas	Middle Fk. Feather River	25-May-19	39.82321	-120.65910	NCMNS
O. vanduzeea	NCBAB-P449	PQ827175	A	M	CA	El Dorado	Deadman Creek	28-Apr-10	38.65385	-120.82960	NCMNS
O. vanduzeea	NCBAB-P450	PQ827177	A	F	CA	El Dorado	Deadman Creek	28-Apr-10	38.65385	-120.82960	NCMNS
O. vanduzeea	NCBAB-P451	PQ827176	L	-	CA	El Dorado	Deadman Creek	28-Apr-10	38.65385	-120.82960	NCMNS
O. vanduzeea	NCBAB-P677	PQ827179	A	M	CA	Sonoma	Mark West Creek	24-Apr-10	38.52070	-122.56070	NCMNS
O. vanduzeea	NCBAB-P678	PQ827180	A	M	CA	Modoc	Johnson Creek	24-May-07	41.34214	-120.86522	NCMNS
O. vanduzeea	NCBAB-P680	PQ827178	A	M	CA	Butte	UT Campbell Creek	5-May-08	39.58841	-121.54542	NCMNS
O. vanduzeea	NCBAB-P681	PQ827173	A	F	CA	Butte	UT Campbell Creek	5-May-08	39.58841	-121.54542	NCMNS
T. atlanticum	NCBAB-P193	PQ834355	L	-	NC	Haywood	W. Fk. Pigeon R.	29-Jan-19	35.39619	-82.93839	NCMNS
T. atlanticum	NCBAB-P217	PQ834356	A	F	NC	Haywood	W. Fk. Pigeon R.	20-Mar-19	35.39619	-82.93839	NCMNS
T. atlanticum	NCBAB-P460	PQ834357	A	F	NC	Swain	Raven Fork	1-Mar-22	35.54378	-83.26643	NCMNS
T. atlanticum	NCBAB-P461	PQ834358	A	M	NC	Swain	Bunches Creek	1-Mar-22	35.53649	-83.20885	NCMNS
T. atlanticum	NCBAB-P462	PQ834359	A	M	NC	Swain	Bunches Creek	1-Mar-22	35.53649	-83.20885	NCMNS
T. atlanticum	NCBAB-P691	PQ834360	A	F	NH	Coos	Ellis River	15-Jun-23	44.25535	-71.25331	NCMNS

TABLE 3. Uncorrected percent (%) pairwise genetic distances, calculated from the COI data using MEGA v11.0.13. Minimum percent (%) uncorrected interspecific pairwise distances (white); average percent (%) uncorrected interspecific pairwise distances (gray); average and maximum percent (%) uncorrected intraspecific pairwise distances, along with sample size (green).

	1	2	3	4	5	6	7
1. *Oemopteryx bimaculata* **sp. nov.**	**0.36 | 0.95 | n=12**	11.25	17.59	14.30	18.24	14.10	18.09
2. *Oemopteryx contorta*	12.97	**2.43 | 5.71 | n=16**	18.35	16.99	16.87	13.22	16.11
3. *Oemopteryx fosketti*	18.25	20.56	**1.11 | 2.28 | n=5**	15.90	18.65	15.98	12.39
4. *Oemopteryx glacialis*	18.21	18.09	18.01	**0.76 | 2.22 | n=16**	18.24	17.17	15.00
5. *Oemopteryx leei*	20.63	19.71	18.85	19.85	**0.21 | 0.95 | n=11**	17.78	15.44
6. *Oemopteryx tuscarora* **sp. nov.**	14.73	16.04	17.33	18.36	20.02	**0.67 | 1.76 | n =7**	17.70
7. *Oemopteryx vanduzeea*	21.08	18.89	16.53	17.60	17.57	20.23	**5.95 | 11.58 | n=12**

Maximum likelihood phylogenetic reconstruction recovered all species clades with high nodal support, bootstrap value (bs) = 96% for *O. contorta* and 99% for all other taxa (Fig. 50). *Oemopteryx bimaculata* **sp. nov.**, *O. tuscarora* **sp. nov.**, and *O. contorta* formed a distinct well-supported clade, bs = 99%. The *O. glacialis* Group was not supported in the phylogenetic reconstruction. The *O. glacialis* Group (*O. fosketti* and *O. glacialis*) was paraphyletic (Fig. 50) with both species being closer to *O. vanduzeea* (avg. p-dist = 16.53%, min p-dist = 12.39% and avg. p-dist = 17.60%, min p-dist = 15.00%, respectively) than they were to each other (avg. p-dist = 18.1%, min p-dist = 15.90%) despite numerous morphological similarities (Table 3). The Taeniopterygidae are believed to be an early diverging lineage (Ricker 1949). Low bootstrap support for the *O. glacialis* Group and deeper nodes possibly suggest that COI data may be insufficient for resolving deeper relationships between *Oemopteryx* species (Ballard & Whitlock 2004). Future work may employ nuclear genes, RNA (South *et al.* 2021), or genomic methods to better resolve deep-level relationships between species of Taeniopterygidae.

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APPENDIX 1. Additional Taeniopterygidae specimens examined.

Taxon	#/stage	State	County	Waterbody	Date	Lat.	Long.	Institution
Bolotoperla rossi	13L	NC	Watauga	Beaverdam Creek	23-Mar-2009	36.27722	-81.86861	NCDWR
Bolotoperla rossi	1L	NC	Yancey	Cane River	22-Mar-2016	35.90311	-82.33040	NCDWR
Bolotoperla rossi	1M	NY	Essex	Boreas River	24-May-2007	43.94232	-73.95567	CSUIC
Bolotoperla rossi	11M, 3F	QB	Lac-Jacques-Cartier	Riviere Montmorency	9-Jun-1989	[47.32100]	[-71.13836]	CSUIC
Bolotoperla rossi	13L	VA	Washington	Straight Br. of Big Laurel Creek	26-Mar-1977	[36.64657]	[-81.72451]	CSUIC
Bolotoperla rossi	1F	WV	Greenbrier	Coats Run	21-May-2004	38.24149	-80.45168	NCDWR
Doddsia occidentalis	2M, 8F	AK	MOA	East Fork Sixmile Creek	24-Apr-2016	60.73172	-149.34000	CSUIC
Doddsia occidentalis	1M, 3F	AK	M.S. Borough	Moose Creek	27-Apr-2016	61.68280	-149.04700	CSUIC
Doddsia occidentalis	1F, 10L	CO	Clear Creek	Clear Creek	10-Apr-1996	[39.76209]	[-105.57723]	CSUIC
Doddsia occidentalis	12M, 5F	CO	Garfield	Grizzly Creek	11-Mar-2017	39.56110	-107.24981	CSUIC
Doddsia occidentalis	19M, 10F, 1L	CO	Garfield	Grizzly Creek	14-Mar-2018	39.56110	-107.24981	CSUIC
Doddsia occidentalis	17M, 2F, 1L	MT	Ravalli	Daly Creek	10-Apr-2019	[46.18160]	[-113.89635]	CSUIC
Strophopteryx appalachia Ricker & Ross, 1975	2M, 1F, 5L, 1E	NC	Caldwell	Wilson Creek	18-Jan-2019	35.98027	-81.76444	NCDWR
Strophopteryx appalachia	3M	NC	Polk	UT Green River	17-Jan-2019	35.31475	-82.24325	NCDWR
Strophopteryx appalachia	13L	NC	Rockingham	Mayo River	20-Jan-2015	[36.53508]	[-79.99073]	NCDWR
Strophopteryx appalachia	1M	SC	Oconee	Little River	3-Mar-11	34.83690	-82.98086	NCDWR
Strophopteryx arkansae Ricker & Ross, 1975	4M, 6F, 9L	AR	Pope	Illinois Bayou	6-Jan-1985	35.52838	-92.94142	INHS
Strophopteryx arkansae	2M, 1F, 5L	AR	Searcy	Middle Fk. Little Red River	6-Jan-1985	35.81644	-92.54944	INHS
Strophopteryx arkansae	1M	AR	Searcy	Middle Fk. Little Red River	17-Jan-2022	35.81601	-92.55057	NCDWR
Strophopteryx arkansae	6L	NC	Durham	UT Flat River	5-Mar-2022	36.13470	-78.84134	NCDWR
Strophopteryx arkansae	16M, 19F, 14E	NC	Durham	UT Flat River	16-Mar-2022	36.13470	-78.84134	NCDWR
Strophopteryx cucullata	2M, 1F, 2L	AR	Johnson	Haw Creek	21-Mar-84	35.67887	-93.25602	NCDWR
Strophopteryx cucullata Frison, 1934	24L	AR	Logan	Briar Creek	19-Mar-2022	35.15398	-93.72581	NCDWR
Strophopteryx cucullata	7M, 2F	AR	Saline	UT Alum Fork	21-Mar-2022	34.81681	-92.99907	NCDWR
Strophopteryx cucullata	1M, 1F	AR	Van Buren	UT Brock Creek	18-Mar-22	35.51128	-92.83682	NCDWR
Strophopteryx cucullata	2L	AR	Yell	East Gafford Creek	19-Mar-22	34.83118	-93.56962	NCDWR

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APPENDIX 1. (Continued)

Taxon	#/stage	State	County	Waterbody	Date	Lat.	Long.	Institution
Strophopteryx fasciata	1M	AR	Madison	White River	20-Mar-22	35.81883	-93.77991	NCDWR
Strophopteryx fasciata	1M, 1F	MS	Monroe	Buttahatchie River	2-Feb-09	[33.79029]	[-88.31531]	NCDWR
Strophopteryx fasciata	1F, 1L	MS	Newton	Tallahatta Creek	17-Feb-1979	[32.39359]	[-88.91587]	NCDWR
Strophopteryx fasciata	5L	MS	Newton	Tallahatta Creek	18-Jan-2003	[32.39359]	[-88.91587]	NCDWR
Strophopteryx fasciata	1L	MS	Newton	Tallahatta Creek	30-Jan-2016	[32.39359]	[-88.91587]	NCDWR
Strophopteryx fasciata	1M, 1F	NC	Durham	North Fork Little River	19-Jan-21	36.16643	-78.95689	NCDWR
Strophopteryx fasciata	1M	NC	Halifax	Little Fishing Creek	15-Jan-19	36.25726	-77.88773	NCDWR
Strophopteryx fasciata	3M, 2F, 14L	NC	Madison	Sandymush Creek	23-Jan-2024	35.70148	-82.75943	NCDWR
Strophopteryx fasciata	7L	NC	Montgomery	Barnes Creek	23-Jan-2019	35.43861	-79.99888	NCDWR
Strophopteryx fasciata	1F	NH	Franklin	Merrimack River	3-Apr-22	43.49552	-71.64352	NCDWR
Strophopteryx fasciata	12M, 13F	OK	Bryan	Blue River	31-Jan-1972	[34.05384]	[-96.34167]	NCDWR
Strophopteryx fasciata	1M	TN	Wayne	Cypress Creek	14-Mar-1989	[35.06626]	[-87.801735]	NCDWR
Strophopteryx limata	1L	NC	Avery	Wilson Creek	28-Apr-16	36.10134	-81.80751	NCDWR
Strophopteryx limata (Frison, 1942)	1M	NC	Haywood	UT bubbling Spring Branch	9-Apr-2019	35.30830	-82.90893	NCDWR
Strophopteryx limata	4M, 3L	TN	Sevier	[Walker Camp Prong]	15-Apr-1979	[35.62408]	[-83.41696]	NCDWR
Strophopteryx limata	23F, 6L	TN	Sevier	West Prong Little Pigeon River	18-May-1983	[35.63759]	[-83.48919]	NCDWR
Taenionema atlanticum	2L	NC	Haywood	West Fork Pigeon River	29-Jan-2019	35.39619	-82.93839	NCDWR
Taenionema atlanticum	1F	NC	Haywood	West Fork Pigeon River	20-Mar-2019	35.39619	-82.93839	NCDWR
Taenionema atlanticum	5M, 1F, 3L	NC	Swain	Bunches Creek	1-Mar-2022	35.53649	-83.20885	NCDWR
Taenionema atlanticum	1M, 3F	NC	Swain	Raven Fork	1-Mar-2022	35.54378	-83.26643	NCDWR
Taenionema atlanticum	32L	NC	Watauga	Meat Camp Creek	9-Mar-1990	36.27138	-81.65861	NCDWR
Taenionema atlanticum	7L	NC	Watauga	Spice Bottom Creek	5-Mar-1990	36.14861	-81.77083	NCDWR
Taenionema atlanticum	1F	NH	Coos	Ellis River	15-Jun-2023	44.25535	-71.25331	INHS

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APPENDIX 1. (Continued)

Taxon	#/stage	State	County	Waterbody	Date	Lat.	Long.	Institution
Taenionema californicum (Needham & Claassen, 1925)	7M, 12F	CA	Lake	Scotts Creek	28-Feb-2018	38.98919	-122.96822	CSUIC
Taenionema californicum	1M, 2L	CA	Lake	UT E. Fk. Middle Creek	28-Feb-2018	39.27316	-122.92264	CSUIC
Taenionema californicum	50M, 20F, 15E, 1L	CA	Mendocino	UT Dooley Creek	28-Feb-2018	38.97846	-123.06602	CSUIC
Taenionema californicum	1M,1F, 2L	CA	Santa Clara	Colorado Creek	27-Feb-2018	37.43389	-121.51095	CSUIC
Taenionema grinelli	1M	CA	San Diego	Kitchen Creek	9-Mar-2019	32.75306	-116.45222	CSUIC
Taenionema kincaidi (Hoppe, 1938)	2M, 8F	CA	Butte	Butte Creek	26-May-2019	40.10273	-121.49932	CSUIC
Taenionema kincaidi	1M, 1F	WA	Pierce	Spring fed stream	22-May-2003	[46.76328]	[-121.87730]	CSUIC
Taenionema oregonense (Needham & Claassen, 1925)	1M	CA	Mendocino	Baechtel Creek	28-Feb-2018	39.36779	-123.36713	CSUIC
Taenionema oregonense	5M, 5F	OR	Yamhill	[Nestucca River]	27-Mar-2016	45.32062	-123.41355	CSUIC
Taenionema pacificum (Banks, 1902)	11L	CO	Mesa	Delores River	3-Mar-1990	38.68051	-108.98019	CSUIC
Taenionema pacificum	1M, 1F	CO	Montrose	San Miguel River	14-Feb-2022	38.37591	-108.74490	NCDWR
Taenionema pallidum (Banks, 1902)	4M, 1F	CO	Boulder	James Creek	1-Jun-2013	40.10789	-105.37263	NCDWR
Taenionema pallidum	1M, 1F	ID	Kootenai	Fourth of July Creek	1-Jun-1996	[47.54368]	[-116.42499]	NCDWR
Taenionema pallidum	1M, 1F	WY	Albany	N. Fk. Little Laramie River	13-Jul-2017	41.33691	-106.16413	CSUIC
Taenionema pallidum	4M, 3F	WY	Sublette	Jamb Creek	10-Jun-2020	43.06454	-110.47900	CSUIC
Taenionema raynorium (Claassen, 1937)	13M, 15F	CA	Plumas	Greenhorn Creek	25-Apr-2010	[39.92261]	[-120.83439]	CSUIC
Taenionema raynorium	1M, 1F	CA	Tehama	[S. Fk.] Battle Creek	5-Jul-2011	40.34968	-121.62662	CSUIC
Taenionema uinta Stanger & Baumann, 1993	6M, 2F	CO	Moffat	Yampa River	11-Apr-2015	[40.54678]	[-108.19623]	CSUIC
Taenionema umatilla Stanger & Baumann, 1993	1M	OR	Umatilla	Meachum Creek	20-May-2014	45.50265	-118.42910	CSUIC
Taeniopteryx burksi	10L	NC	Madison	Sandymush Creek	23-Jan-2024	35.70148	-82.75943	NCDWR

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APPENDIX 1. (Continued)

Taxon	#/stage	State	County	Waterbody	Date	Lat.	Long.	Institution
Taeniopteryx burksi	15M, 9F	NC	Swain	Oconafultee River	14-Dec-2021	35.46139	-83.35361	NCDWR
Taeniopteryx robinae Kondratieff & Kirchner, 1984	3M, 1F	NC	Richmond	Rocky Ford Branch	26-Nov-2023	35.12360	-79.66283	NCDWR
Taeniopteryx robinae	1M, 1F, 2L	NC	Richmond	Rocky Ford Branch	4-Dec-2023	35.12360	-79.66283	NCDWR
Taeniopteryx ugola	5M, 5F, 10L	TN	Morgan	Green Branch	15-Feb-2024	[36.14807]	[-84.77806]	NCDWR