FIRST NEARCTIC RECORDS OF *OLIVEIRIELLA* WIEDENBRUG AND FITTKAU, WITH NEW DISTRIBUTIONAL RECORDS FOR TWO OTHER NEW WORLD SPECIES OF ORTHOCLADIINAE (DIPTERA: CHIRONOMIDAE)[1]

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ABSTRACT: Taxonomic and distributional information need to be constantly updated as federal, state, and local agencies continue to use aquatic macroinvertebrates as biological indicators of water quality. While processing benthic macroinvertebrate samples provided by federal and state agencies, production taxonomists at EcoAnalysts, Inc. encountered larvae and pupae of the Neotropical chironomid *Oliveiriella* Wiedenbrug and Fittkau (Orthocladiinae) and *Onconeura semifimbriata* (Sæther) (Orthocladiinae) from sites in New Mexico and Arizona, USA. These occurrences represent the first Nearctic records of *Oliveiriella*, establishing a New World distribution, and expand the Nearctic range of *Onconeura semifimbriata*. We also identified larvae of *Tempisquitoneura merrillorum* Epler (Orthocladiinae) from 1 site in Nevada, 1 site in Utah, and 6 sites in Arizona, USA. These records expand the Nearctic range for *T. merrillorum*. These genera are very similar in appearance to other commonly encountered Orthocladiinae genera, but only the larva of *Tempisquitoneura* is included in a current taxonomic key for North America.

KEY WORDS: Diptera, Chironomidae, Orthocladiinae, *Oliveiriella*, *Onconeura*, *Tempisquitoneura*, new record, Nearctic, distributional records, New World

Precise and accurate taxonomy is an essential part of any successful biological monitoring, assessment, mitigation, or remediation program. Projects yield optimal results only when organisms are properly identified and their ecological roles are understood. As such, it is important to continually update taxonomic and distributional information. If a taxon is not included in a key because its presence is unknown, it will likely be misidentified when encountered. The purpose of this paper is to report range extensions for three New World chironomids, of which only one has recently been accounted for in a North American taxonomic key (larva only), and to generate awareness that these taxa are morphologically similar to other commonly occurring Orthocladiinae chironomids.

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METHODS

Biological, physical, and chemical data were collected in Arizona, Nevada, New Mexico, and Utah as part of federal and state water quality monitoring programs. Benthic macroinvertebrate samples were processed and identified by EcoAnalysts, Inc. (EI) under contracts with the United States Environmental Protection Agency (USEPA) Western Environmental Monitoring and Assessment Program (WEMAP), Arizona Department of Environmental Quality (AZDEQ), Nevada Department of Environmental Protection (NVDEP), and New Mexico Environment Department (NMED). John H. Epler (J. H. E.) verified initial determinations of larvae and pupae. For comparison purposes, digital images were taken of CMC-10 slide mounted pupae and larvae through a phase contrast compound microscope.

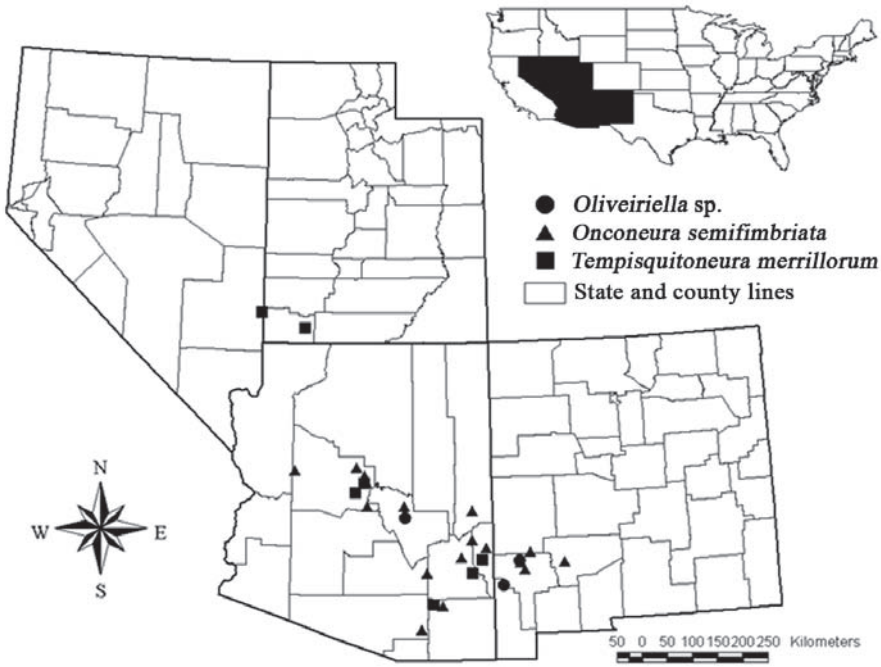

Figure 1. Sample site locations in Nevada, Utah, Arizona, and New Mexico, USA.

RESULTS

Larvae and pupae of *Oliveiriella* were identified from 2 sites on the Gila River in New Mexico (NMED) and from Cherry Creek (Salt River drainage) in Arizona (WEMAP) (Fig. 1). As the larvae of *Oliveiriella* have not been described, our determinations were based on pre-pupal characters. The number of pupae and larvae, and the physicochemical measurements for the sites are included in Table 1. As *Oliveiriella* was previously described from South America (Wiedenbrug and Fittkau 1997; Wiedenbrug 2000; Paggi and Donato 2007),

these occurrences represent the first Nearctic records of this genus, thereby establishing a New World distribution. Because we had no adult males, and the taxonomy of this genus is uncertain at the species level, we could not determine the species of our specimens. It is possible that our material represents an undescribed species. Larvae and pupae from the Gila River, New Mexico, U.S.A. are deposited at the National Museum of Natural History (NMNH) in Washington D.C., USA.

Table 1. Physical and chemical data for *Oliveiriella* sp. sites

Waterbody	Cherry Creek	Gila River		Gila River
State in the U.S.A.	Arizona	New Mexico		New Mexico
County	Gila	Grant		Grant
Government Agency	EPA	NMED		NMED
Collection date	22 June 2004	19 Oct. 2004	7 Nov. 2005	8 Nov. 2005
No. of larvae collected	0	3	12	1
No. of pupae collected	2	3	3	0
Elevation (m)	1230	1449	1449	1180
Water temperature (^{o}C)	n/a	14.4	10.6	14.2
Dissolved oxygen (mg/L)	n/a	8.8	10.6	9.4
Conductivity (uS/cm)	462	314	323	435
pH	7.3	8.2	8.0	8.1
Alkalinity (mg/L)	n/a	100	n/a	164
Hardness (mg/L) ($CaCO_3$)	n/a	81	n/a	157
Total dissolved solids (mg/L)	n/a	222	n/a	276
Total phosphorus (mg/L)	0.04	0.14	0.06	0.06
Total Kjehldal nitrogen (mg/L)	0.25	0.17	0.13	0.13

Larvae and pupae of *Onconeura semifimbriata* (Sæther) were identified from 21 sites in Arizona (AZDEQ) and 4 sites in New Mexico (NMED) (Fig. 1). The number of pupae and larvae, and the physicochemical measurements for the sites are included in Table 2. As the only other reported Nearctic occurrence of *O. semifimbriata* was in Mexico (Andersen and Sæther 2005), these occurrences expand the Nearctic range of this genus. Larvae and pupae from the San Francisco River, Arizona, USA, are deposited as above.

Table 2. Physical and chemical data for *Onconeura semifimbriata* sites.

Waterbody	Francis Creek	Bonita Creek	Eagle Creek	San Francisco R.	W. Fork Little Colorado River	Cherry Creek	Aravaipa Canyon Creek	Hot Springs Canyon
State in the U.S.A.	Arizona	Arizona	Arizona	Arizona	Arizona	Arizona	Arizona	Arizona
County	Yavapai	Graham	Greenlee	Greenlee	Apache	Gila	Pinal	Cochise
Government Agency	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ
Collection date	22 Apr. 97	25 Apr. 06	17 May 06	18 May 06	1 June 98	13 May 97	28 Apr. 97	29 Apr. 97
No. of larvae collected	1	1	2	8	2	1	13	6
No. of pupae collected	0	0	0	2	0	0	0	0
Elevation (m)	975	1024	1657	1213	2606	1338	908	1167
Water temperature (^{o}C)	24.3	16.3	22.5	22.1	13	23.7	21.5	17.5
Dissolved oxygen (mg/L)	n/a	6.8	6.9	5.6	7.3	7.28	6.9	6.96
Conductivity (uS/cm)	n/a	424	266	540	17	362	311	284
pH	n/a	7.9	8.5	7.8	7.22	8.55	8.22	8.11
Alkalinity (mg/L)	140	n/a	5	2	11	170	170	180
Hardness (mg/L) ($CaCO_3$)	110	190	130	130	12	150	150	100
Total dissolved solids (mg/L)	230	272	170	354	66	210	270	250
Percent fine sediment (%)	8.0	n/a	n/a	9.0	n/a	25.0	25.0	25.0
Total phosphorus (mg/L)	0.02	0.03	0.04	0.78	0.043	0.049	0.038	0.058
Total Kjehldal nitrogen (mg/L)	0.25	0.05	n/a	0.19	0.38	0.2	0.16	0.22

Table 2. Physical and chemical data for *Onconeura semifimbriata* sites (continuation)									
Waterbody	Cienega Creek	Spring Creek	Sycamore Creek	West Clear Creek	Wet Beaver Creek	Bear Creek	Gila River	Las Animas Creek	West Fork Gila River
State in the U.S.A.	Arizona	Arizona	Arizona	Arizona	Arizona	New Mexico	New Mexico	New Mexico	New Mexico
County	Pima	Yavapai	Yavapai	Yavapai	Yavapai	Grant	Grant	Sierra	Grant
Government Agency	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ	NMED	NMED	NMED	NMED
Collection date	30 Sept. 98	25 June 97	4 May 98	1 Sept. 97	7 July 06	14 Nov. 06	7 Nov. 05	27 Oct. 06	25 Oct. 06
No. of larvae collected	52	1	2	3	3	1	1	5	1
No. of pupae collected	0	0	0	0	0	0	1	0	0
Elevation (m)	1285	1098	634	944	1073	n/a	1449	1554	1740
Water temperature (^{o}C)	17.3	22.5	n/a	21.3	n/a	12.3	10.62	11.7	9
Dissolved oxygen (mg/L)	7.17	7.57	n/a	8.41	n/a	9.1	10.63	9.5	9.1
Conductivity (uS/cm)	451	534	n/a	530	n/a	427	323	238	120
pH	8.31	7.61	n/a	8.02	n/a	8	8	7.3	7.1
Alkalinity (mg/L)	220	240	n/a	230	n/a	n/a	n/a	n/a	n/a
Hardness (mg/L) ($CaCO_3$)	160	270	n/a	300	n/a	195	n/a	n/a	n/a
Total dissolved solids (mg/L)	310	310	n/a	360	n/a	312	n/a	226	130
Percent fine sediment (%)	67.0	66.0	n/a	7.0	n/a	n/a	n/a	n/a	n/a
Total phosphorus (mg/L)	0.021	0.1	n/a	0.1	n/a	0.03	0.06	0.04	0.03
Total Kjehldal nitrogen (mg/L)	0.14	0.22	n/a	0.19	n/a	0.15	0.13	0.39	0.26

Larvae of *Tempisquitoneura merrillorum* Epler, recently included in Ferrington et al. (2008), were identified from Beaver Creek in Nevada (NVDEP), North Creek in Utah (WEMAP), and 6 sites in Arizona (AZDEQ) (Fig. 1). The number of larvae and the physicochemical measurements for the sites are included in Table 3. As *T. merrillorum* was previously reported in the Nearctic only from Arizona (Lester *et al.* 2003), these occurrences in Nevada and Utah are state records and expand its Nearctic range.

DISCUSSION

Morphology

Oliveiriella, *Onconeura*, and *Tempisquitoneura* are very similar to other commonly occurring North American Orthocladiinae genera and can be easily misidentified. *Oliveiriella* larvae and adults are very similar to some *Cricotopus* (J. H. E. has associated material from Costa Rica) (Wiedenbrug and Fittkau 1997), and it may be that this genus should be synonymized with *Cricotopus* (S. Wiedenbrug, pers. comm.; P. Cranston pers. comm.). The larva, which keys to the *Cricotopus (Cricotopus) tremulus* group in Hirvenoja (1973), has a bifid SI, simple premandibles, and a pecten epipharyngis with 3 scales (Fig. 2). Additionally, there are 13 teeth in the mentum with a single median tooth, no apparent cardinal beard (Fig. 3), and 5-segmented antennae. The pupa, however, is very distinct in that it resembles some *Chaetocladius*. It has 3 spine like anal macrosetae, with two situated distally and one approximately midway along the anal lobe. Additionally, it has a simple slender thoracic horn and strong hooklets along the posterior margin of tergites II–V (Fig. 4). For a more detailed description of the pupa see Wiedenbrug and Fittkau (1997) and Wiedenbrug (2000).

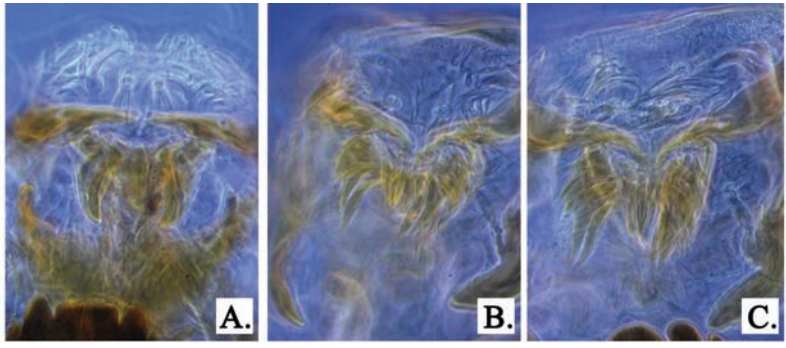

Figure 2. Labral region. A, *Oliveiriella*; B, *Cricotopus*; C, *Orthocladius*.

Onconeura and *Tempisquitoneura* are morphologically similar and share larval and pupal characters with *Corynoneura* and *Thienemanniella* (Sæther 1981; Epler and de la Rosa 1995; Andersen and Sæther 2005). A comparison of larval and pupal characters is given in Table 4. Larval antennal lengths range from one-fourth the length of the head capsule for *Tempisquitoneura* to greater than the

length of the head capsule for *Corynoneura* (Fig. 5). The sub-basal setae of the posterior parapods range from being simple in *Thienemanniella* and *Tempisquitoneura* to basally spinose in *Corynoneura* (Fig. 6). It should be noted that the sub-basal setae of our specimens of *O. semifimbriata* are apically trifid, whereas the specimens from the British West Indies appear to have strong simple setae (Sæther, pers. comm.). Strong body setation can occur in both *Thienemanniella* and *Onconeura*, whereas *Tempisquitoneura* and *Corynoneura* have moderate to no setation (Fig. 7). *Tempisquitoneura* differs from the other genera in that it has 2 large, well sclerotized claws on the anterior parapods (Fig. 8); these are used to aid in attachment to their corydalid hosts. For a more detailed comparison of characters for these genera see Epler and de la Rosa (1995), and Andersen and Sæther (2005).

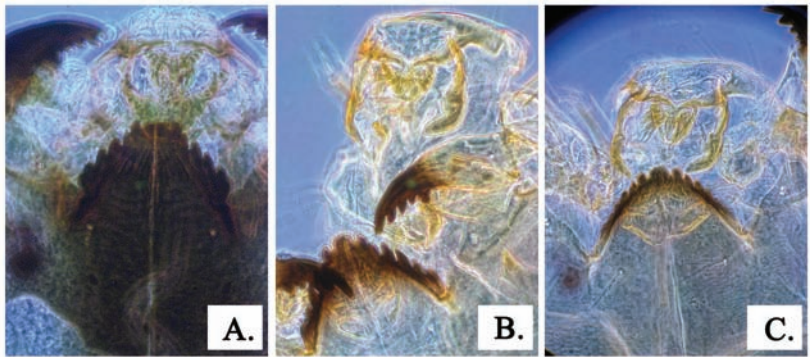

Figure 3. Mentum. A, *Oliveiriella*; B, *Cricotopus*; C, *Orthocladius*.

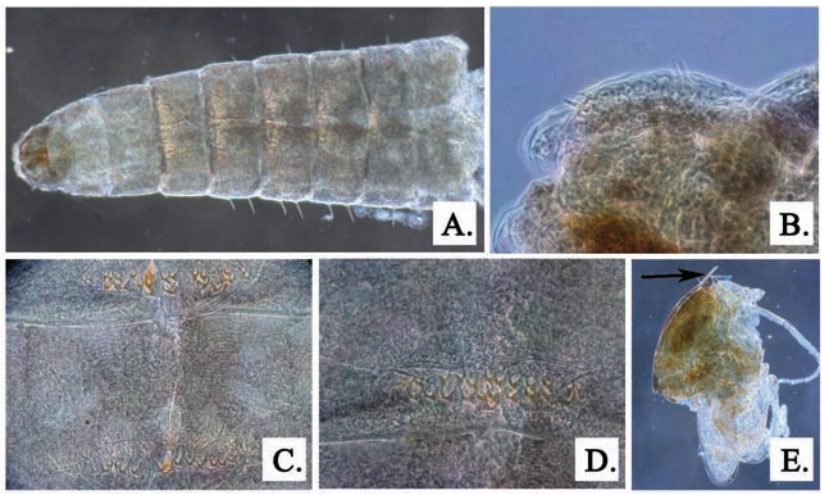

Figure 4. *Oliveiriella* pupal features. A, abdomen; B, anal lobe; C, tergites III – IV; D, tergite II; E, thorax. Arrow indicates thoracic horn.

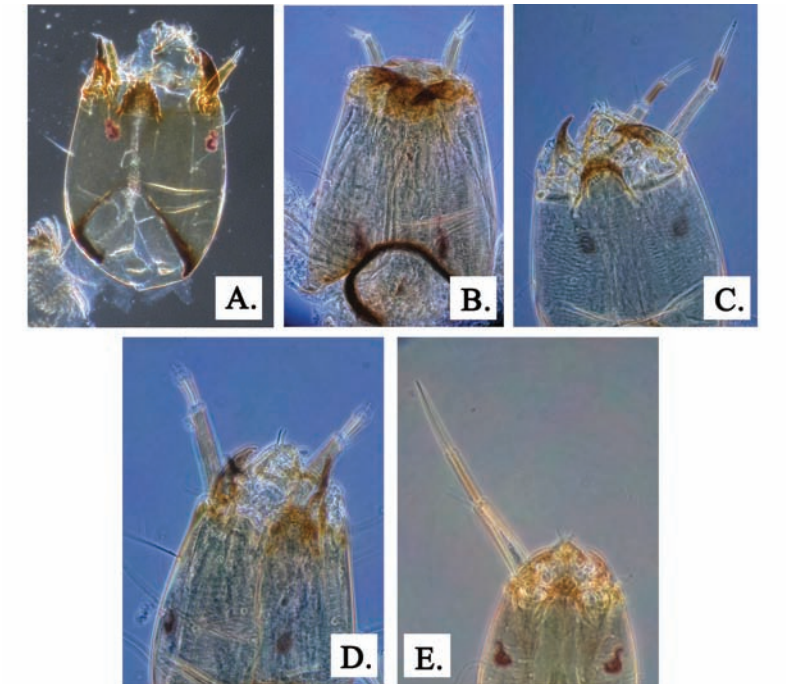

Figure 5. Larval head and antennae. A, *Tempisquitoneura*; B, *Onconeura*; C–D, *Thienemanniella*; E, *Corynoneura*.

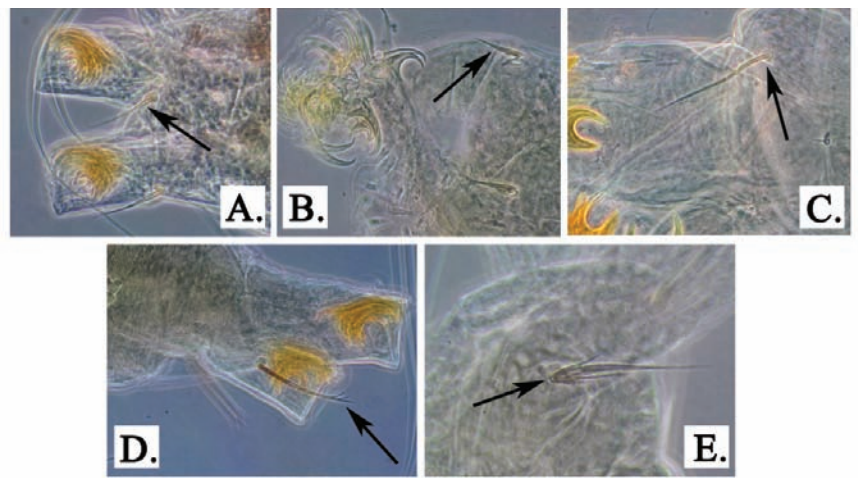

Figure 6. Posterior parapod sub-basal setae. A–B, *Thienemanniella*; C, *Tempisquitoneura*; D, *Onconeura*; E, *Corynoneura*. Arrows indicated sub-basal setae.

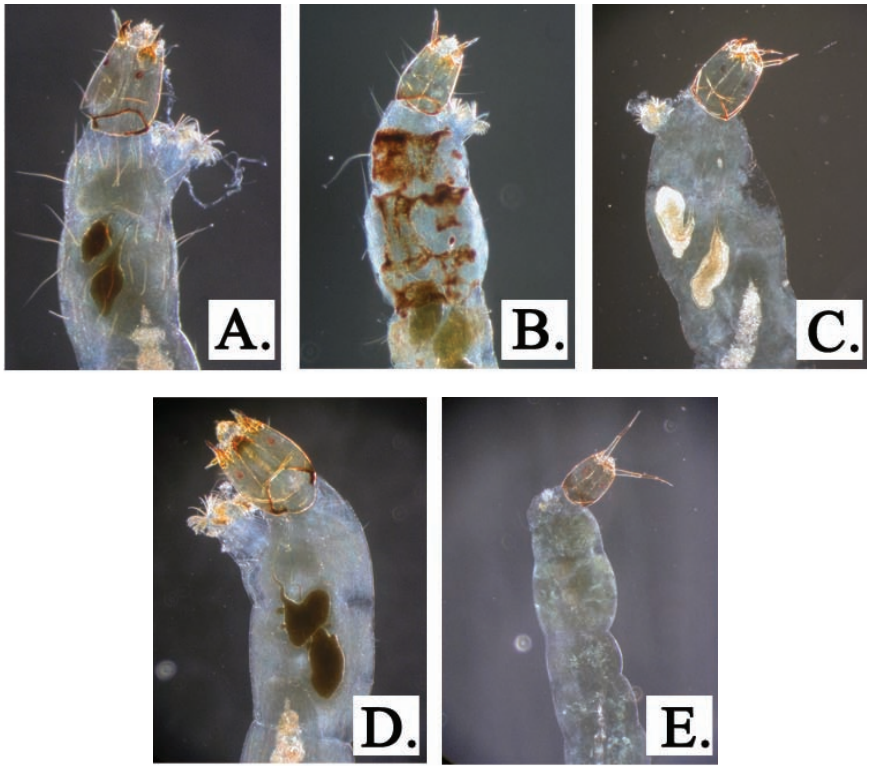

Figure 7. Larval body setation. A, *Onconeura*; B–C, *Thienemanniella*; D, *Tempisquitoneura*; E, *Corynoneura*.

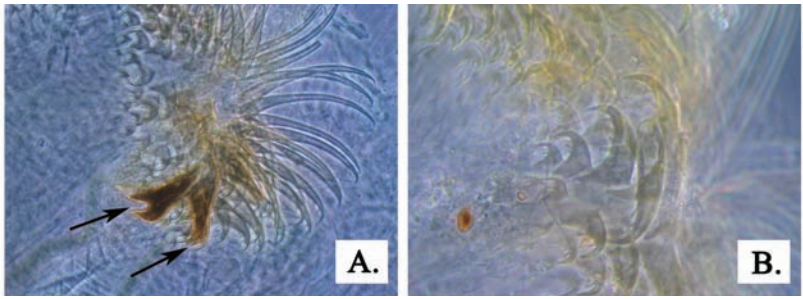

Figure 8. Anterior parapod claws. A, *Tempisquitoneura*; B, *Onconeura*. Arrows indicated sclerotized claws.

The pupae of *Onconeura* and *Tempisquitoneura* differ from *Corynoneura* and *Thienemanniella* by having tergal conjunctives with large recurved hooklets (Fig. 9) and an anal lobe fringe confined to the posterior third with only 1 pair of weak anal macrosetae for *Onconeura* and no anal macrosetae for *Tempisquitoneura* (Fig. 10). The lack of abdominal taeniate setae for *Onconeura* and *Tempisquitoneura* also distinguishes them from *Corynoneura* and *Thienemanniella*. Additionally, the pupae of *Onconeura*, *Tempisquitoneura*, and *Corynoneura* have wing sheaths with pearl rows (weak in *Onconeura* and *Tempisquitoneura*), whereas *Thienemanniella* does not (Fig. 11). For a more detailed comparison of the characters for these genera please see Epler and de la Rosa (1995), and Andersen and Sæther (2005).

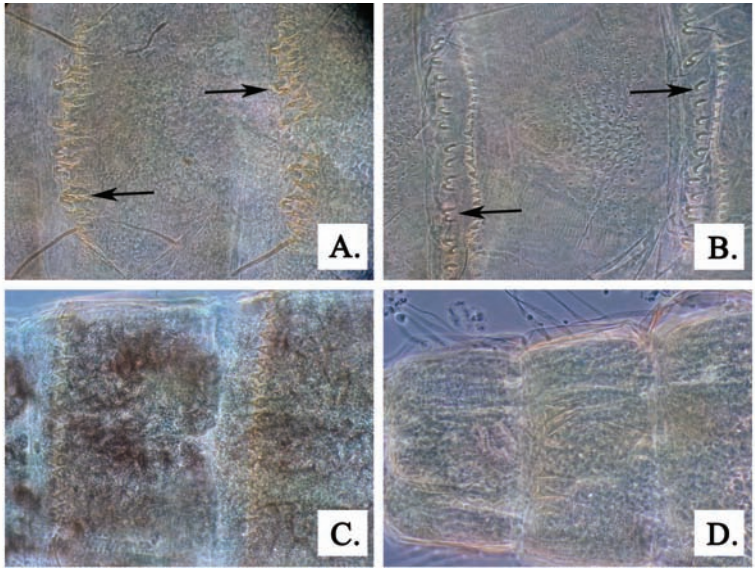

Figure 9. Pupal tergites. A, *Onconeura*; B, *Tempisquitoneura*; C, *Thienemanniella*; D, *Corynoneura*. Arrows indicate recurved hooklets.

Ecology and Distribution

In the United States, *Oliveiriella* was found only within the Salt River drainage of Arizona and the Gila River drainage of New Mexico. It occurs in relatively silt-free streams with riffle percent fines (<2mm) of approximately 10% or less and tolerates moderate water temperatures with neutral to alkaline pH and high conductivity.

Onconeura appears to be more widely distributed, found in 13 streams and several river basins, in Arizona and New Mexico. It appears to occur over a wide range of environmental conditions, mostly at lower elevations (<1524 meters) considered warm-water in Arizona. *Onconeura* appears tolerant of high temperatures, neutral to alkaline pH, elevated conductivity, and high levels of hardness and total dissolved solids. In addition, it appears to tolerate a high percentage (up to 67%) of fine sediments in riffle substrates.

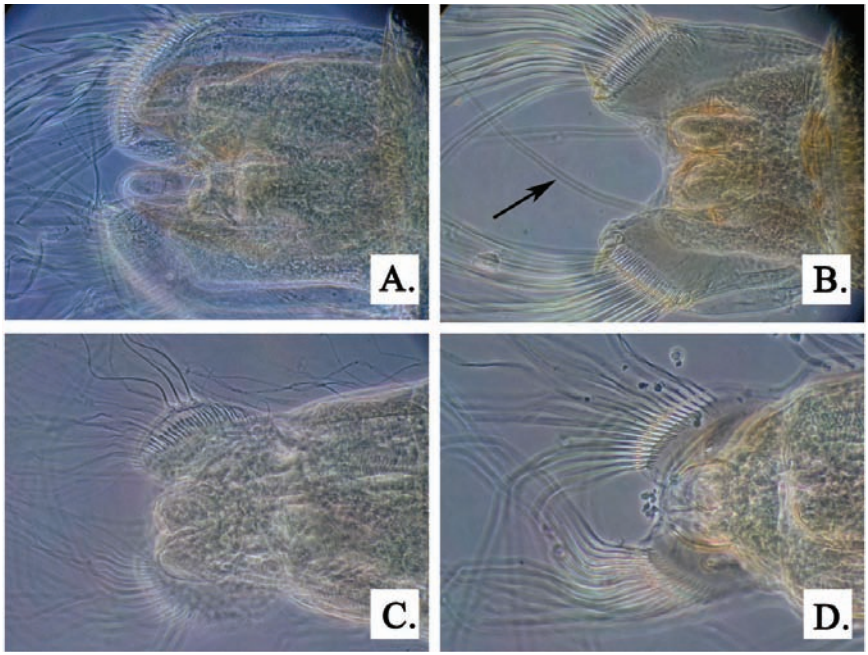

Figure 10. Pupal anal lobes. A, *Tempisquitoneura*; B, *Onconeura*; C, *Thienemanniella*; D, *Corynoneura*. Arrow indicates median anal marcoseta.

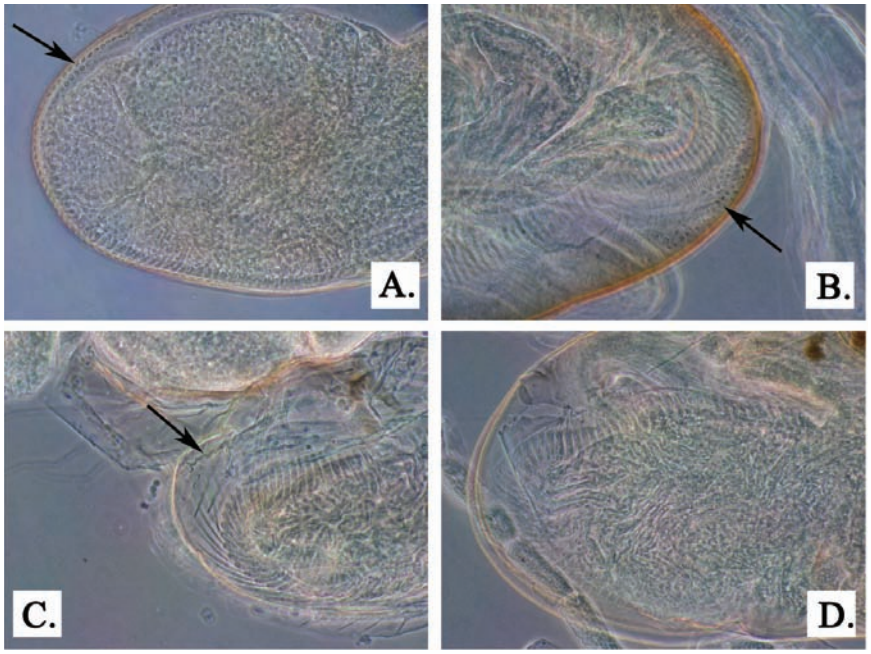

Figure 11. Pupal wing sheaths. A, *Onconeura*; B, *Tempisquitoneura*; C, *Corynoneura*; D, *Thienemanniella*. Arrows indicate pearl rows.

Tempisquitoneura occurs in the southwestern states of Arizona, Nevada and Utah. In Arizona, this taxon is found primarily within the Gila River drainage. *Tempisquitoneura* occurs at lower elevations considered warm-water in Arizona, with relatively clean substrate (<25% fines in riffle substrates). It tolerates relatively high temperatures, conductivity, elevated pH and hardness.

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Table 3. Physical and chemical data for *Tempisquitoneura merrillorum* sites								
Waterbody	Beaver Creek	North Creek	Bonita Creek	Gila River	Hot Springs Canyon	San Francisco River	Sycamore Creek	West Clear Creek
State in the U.S.A.	Nevada	Utah	Arizona	Arizona	Arizona	Arizona	Arizona	Arizona
County	Lincoln	Washington	Graham	Graham	Cochise	Greenlee	Yavapai	Yavapai
Government Agency	NVDEP	EPA	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ	AZDEQ
Collection date	2 June 05	22 Sept. 04	18 Sept. 97	18 Sept. 97	29 Apr. 97	18 Sept. 97	29 Apr. 98	1 Sept. 97
No. of larvae collected	1	16	1	1	1	1	1	1
No. of pupae collected	0	0	0	0	0	0	0	0
Elevation (m)	1560	1277	960	975	1167	1097	1247	1009
Water temperature (^{o}C)	19.4	n/a	27.9	28	17.5	21	20.1	26.4
Dissolved oxygen (mg/L)	9.5	n/a	7.35	6.7	6.96	6.67	8.31	6.92
Conductivity (uS/cm)	280	314	346	900	284	526	475	326
pH	8.2	8.5	8.59	8.32	8.11	8.22	8.3	8.52
Alkalinity (mg/L)	130	n/a	n/a	n/a	180	150	230	180
Hardness (mg/L) ($CaCO_3$)	112	n/a	170	350	100	150	210	170
Total dissolved solids (mg/L)	207	n/a	n/a	576	250	320	200	190
Percent fine sediment (%)	n/a	n/a	n/a	n/a	25	n/a	7	7
Total phosphorus (mg/L)	0.04	0	n/a	n/a	0.058	n/a	0.049	n/a
Total Kjehldal nitrogen (mg/L)	0.3	0.88	n/a	n/a	0.22	n/a	0.37	0.16

TABLE 4. Larval and pupal characters that are helpful in separating closely related genera of the Corynoneurini.

NOTE: This table was inadvertently omitted from the published paper. It will be included as an erratum in a later number of *Entomological News*

Characters	Taxa			
	Thienemanniella sp.	*Corynoneura* sp.	*Tempisquitoneura merrillorum*	*Onconeura semifimbriata*
Larval				
Darkened antennal segments	2nd or none	usually 2nd and 3rd	none	none
Length of antennae to head	about 1/2	greater than or equal	about 1/4	about 1/3
2 dark anterior parapod claws	no	no	yes	no
Sub-basal setae of anal parapods	simple	basally spinose	simple	apically trifid
Strong body setation	yes or no	no	moderate	yes
Pupal				
Pearl rows on wing sheaths	no	yes	yes	yes
Hooklets on conjunctives	no	no	yes	yes
Macrosetae on caudal lobes	3	3	none	1 weak
Anal lobe fringe	entire	nearly entire	apical 1/3	apical 1/3

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