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CHIRONOMIDAE (DIPTERA) OF THE COLORADO RIVER,
GRAND CANYON, ARIZONA, USA,
I: SYSTEMATICS AND ECOLOGY

James E. Sublette, Lawrence E. Stevens, and Joseph P. Shannon

ABSTRACT.—We describe the chironomid midge fauna of the Colorado River between Glen Canyon Dam and Lake Mead, Arizona. This depauperate fauna, consisting of 38 species, is dominated by euryecious Nearctic or Holarctic orthoclade taxa. In addition, a small Neotropical faunal component is represented by Polypedilum obelos Sublette & Sasa and Rheotanytarsus hamatus Sublette & Sasa.

The following new synonyms are given: Protentrites riparius Malloch 1915 with Tanypus bellus Loew 1866 [= Procladius (Psilotanytarsus) bellus (Loew)]; Cricotopus olivetus Boeckel 1983 with Cricotopus (Cricotopus) annulatus (Goetghebuer) 1927; Cricotopus edurus Sublette & Sublette 1971 with Orthocladius infuscatus Malloch 1915 [= Cricotopus (Cricotopus) infuscatus (Malloch)]; Cricotopus subfuscus Sublette & Sublette 1971 with Orthocladius infuscatus Malloch 1915 [= Cricotopus (Cricotopus) infuscatus (Malloch)]. The following new species are described: Cricotopus (Cricotopus) blinni Sublette, Cricotopus (Cricotopus) herrmanni Sublette, Metriocnemus stvensi Sublette, and Cladotanytarsus marki Sublette. We discuss the distribution and ecology of each chironomid species collected in this large, regulated, aridland river.

Key words: Chironomidae, Colorado River, distribution, euryecious species, Glen Canyon Dam, Grand Canyon, midges, new species, synonymies.

Although chironomid midges are often numerically dominant aquatic macroinvertebrates in large river ecosystems, relatively few taxonomic studies have been conducted in the American West. The known distributions of chironomids in western North America are principally based on individual species records in various works and on comprehensive studies by Sublette (1960, 1964) and Sublette and Sublette (1979). Sublette and Sublette (1979) report on material from headwater reaches of the Colorado River in the upper San Juan and Gila drainages of New Mexico. Cowley (1995) examines the chironomid fauna of the upper Rio Grande, and Ruse et al. (unpublished data) identify several chironomid species in the headwaters of the Arkansas River in Colorado; both studies report species that also occur in the Colorado River. Wolf and Shiozawa (1995) identify chironomid genera of the upper Green River in low-velocity habitats at the Ouray National Wildlife Refuge, Utah, and relate flow...
velocity to assemblage structure. Spindler (1996) reports on chironomid distribution in 10 tributaries in Grand Canyon. Also, Pearson (1967) and Rader and Ward (1988) describe the invertebrate fauna of the Green River near Flaming Gorge Dam and in the upper Colorado River, respectively.

Chironomid midges are abundant in the Colorado River in Grand Canyon (Leibfried and Blinn 1986, Blinn et al. 1992, Stevens et al. 1997). This is the largest river in the American Southwest, flowing 2250 km from the Rocky Mountains to the Sea of Cortez, and it is heavily regulated by numerous diversions and impoundments (Hirsch et al. 1990). However, no study of chironomid taxonomy has been conducted in Grand Canyon.

In this paper we describe and review the taxonomy and ecology of chironomid species in the Colorado River between Glen Canyon Dam and Lake Mead, including the entire Grand Canyon section of the river. Because our collections are primarily from the mainstream corridor, additional collecting in tributary streams, springs, and seeps will greatly increase the number of species recognized in Grand Canyon (cf. Spindler 1996).

METHODS AND MATERIALS

Study Area

The Colorado River flows 475 km from the base of Glen Canyon Dam (975 m elevation) to Lake Mead (350 m elevation) through Sonoran and Mojave Desert terrain, through lower Glen Canyon and all of Grand Canyon (Turner and Karpiscak 1980; Fig. 1). By convention, locations along the Colorado River are designated in river miles from Lees Ferry. The river passes through 13 bedrock-defined geomorphic reaches, and the Paria (km 1) and Little Colorado (km 98) rivers create 3 turbidity segments (Schmidt and Graf 1990, Stevens et al. 1997).

Field Methods

Adult and pharate aquatic Chironomidae were collected throughout the year in 1976–77 and 1990–91 by sweep-netting riparian vegetation (mostly Salix exigua Nutt., Tamarix ramosissima Loureiro, and Baccharis spp.), white and UV light-trapping, dip-netting, and larval rearing from benthic spot and quantitative samples (Stevens et al. 1997).

Taxonomy

Taxonomic determinations and descriptions were made by J.E. Sublette. Specimens from Grand Canyon which are new to science, and which also occur in other river systems, have been included in the type series of the new species described here. Some adult specimens that had been collected by sweep-netting may be associated with tributaries or springs; however, many individual larvae collected from the river were reared to emergence for identification.

Most of the morphological terminology used here follows Sæther (1980); however, in the Orthocladiinae the genitalia appendages were named by position rather than homology inferred by Sæther (1980). We term the superior volsella the basimedian gonocoxite lobe, and the inferior volsella is here referred to as the basidorsal and basiventral gonocoxite lobes. We followed Sæther’s terminology for Chironominae genitalia. The terms bacatiform papillae and nasiform tubercles for structures on the pupal wing sheath are employed for perlen and nasen, respectively (Sublette and Sasa 1994).

The basal palpomere of adult chironomids is weakly chitinized and frequently partially collapsed; consequently, only measurements for the apical 4 palpomeres are given. The term temporal setae here includes both the postorbital and outer vertical setae. If the frontal setae are continuous with temporals, they are also included. The length ratio of the gonocoxite to the gonostylus is given as Gc/Gs; gonocoxite length is measured along the ventral midline of the gonocoxite. In the pupa the anal lobe ratio (ALR; Soponis 1977) is the length of the longest anal macroseta divided by the anal lobe length. Ventral head length of the larva is measured from the medial apex of the mentum to the outer edge of the occipital ring.

In descriptions of new species, morphometric and meristic features of the holotype male are listed first, with the range of variation for paratypes and the number upon which the statistic is based provided parenthetically unless the holotype was unique. In other species descriptions the range is given with the number of specimens upon which the statistic is based, listed in parentheses immediately following.

The original citation is given in each species description, along with references to subsequent studies of that species. If a species has
been reviewed or revised, literature listed in that study is not included.

Deposition of type material is indicated by the following abbreviations: California Academy of Science, CAS; United States National Museum of Natural History, USNM; Academy of Natural Sciences of Philadelphia, ANSP; Illinois Natural History Survey, INHS; American Entomological Institute, AEI; University of California–Riverside, UCR; University of Colorado, U of C; University of Minnesota, UMN; Brigham Young University, BYU; James E. Sublette collection, JES; Scott J. Herrmann collection, SJH. Non-type material collected in Grand Canyon, unless otherwise indicated, is retained at Northern Arizona University.

Ecology

We review existing information on the ecology of North American Chironomidae and provide some additional data from our collections. In those cases where a species has a Holarctic distribution, selected reference to the European literature is made. Two regional biotic indices have been developed in North America, based on water quality and chironomid distribution. The North Carolina biotic index (NCBI; Lenat 1983) references Hilsenhoff’s Wisconsin biotic index (Hilsenhoff 1977, 1982, 1987, 1988); therefore, only the NCBI is cited here. The NCBI, based on larvae from macrobenthic samples, lists only species groups because the taxonomy of non-adult chironomids is less definitive. The NCBI is based on a range of 0–10, with 0 being the most intolerant to pollution and 10 the most tolerant. As Lenat (1993) indicates, comparisons between different geographic regions may be uncertain; nevertheless, because citation of ecological tolerances from other regions may have value for broad-ranging species, it is provided here.

TAXONOMIC DESCRIPTIONS

Subfamily Tanypodinae

Procladius (Psilotanypus) bellus (Loew)

Tanypus bellus Loew 1866:4; type locality, D.C.
Protanypus riparius Malloch 1915:389; type locality, Thompson’s Lake, Havana, IL. New synonym.

Procladius riparius (Malloch); Roback 1971:167, holotype male.

Procladius bellus (Loew); Kowalyk 1985:88, larval morphology.

Procladius (Psilotanypus) bellus (Loew); Roback 1971:162, revision, synonymy, adults; 1980:31, larva and pupa; Sublette and Sublette 1979:61, in Ist; Parkin and Stahl 1981:122 and Stahl 1986:70, ecology; Hudson et al. 1990:5.
DIAGNOSIS.—Adults: Keyed from other members of the Nearctic fauna by Roback (1971); larva and pupa keyed by Roback (1980). Adults range from almost black (early season collections or at higher elevations or latitudes) to pale yellow with pale orange-brown vittae.

DISCUSSION.—Procladius riparius, here synonymized with P. bellus, is a typical dark form except for genitalia (Roback 1971). Examination of specimens from within the range of Malloch’s original material suggests that pinned specimens and genitalia mounts were mixed, with the genitalia nominally associated with the pinned holotype of P. riparius actually being that of Coelotanypus concinnus (Coquillett). Both species occur in central U.S. and, presumably, the specimens were inadvertently switched when slides from the collection were mounted. Malloch’s presumptive holotype P. riparius genitalia were illustrated by Roback (1971: Figs. 254, 255) with a double megaseta, a condition that has been observed frequently in C. concinnus but not in species of Procladius (Psilotanypus). Roback (1971) synonymized the paratypes of P. riparius but not the holotype, because of the peculiar genitalia.

ECOLOGY.—Typically, P. bellus occurs in the littoral zone of lakes and reservoirs (Sublette 1957, Rosenberg et al. 1984) or other shallow lentic water (Wrubleski 1987, Wrubleski and Rosenberg 1990), in slow-moving streams, and along backwater areas of faster moving streams. It was uncommon in a Laurentian stream system, occurring in quiet water on finer sediments with vegetation (Cloutier and Harper 1978), and rare, comprising only 0.4% of Tanypodinae males/m²/yr in a brown-water stream in Alberta (Boerger 1981). Ferrington and Crisp (1989) reported that this species is characteristic of the recovery region below enrichment zones produced by wastewater treatment plant effluents in 2 small streams in Kansas. In the upper Arkansas River, Colorado, adults were taken at 1444–1618 m elevation (Ruse et al. unpublished data). The single Grand Canyon specimen was collected near the inflow into Lake Mead during high lake level.

DISTRIBUTION.—Wide distribution in North America.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River; 1 ♂, river mi 269.5, 365 m elev.
The species is rare in Grand Canyon, probably due to the lack of suitable substrata throughout much of the canyon.

**DISTRIBUTION.**—Alaska to Minnesota, south to California and New Mexico.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 specimen from river mi 61.0, 840 m elev. Reared material from New Mexico and Colorado was also examined.
**SUBFAMILY ORTHOCLODAINAE**

*Cardioculius platypus* (Coquillett)  
(Figs. 6-9)

*Orthoculius platypus* Coquillett 1902:33; type locality, Flagstaff, AZ.  
*Cardioculius platypus* (Coquillett); Sublette 1966:557, review; Oliver et al. 1990:21, catalog.

Because the original description by Coquillett (1902) and redescription by Sublette (1966) were based on an imperfect pinned holotype, the following data are provided to augment these descriptions.

**Male.**—**Coloration:** Almost entirely blackish brown; numeral and pleural areas very slightly paler.

**Head:** Antenna with 13 flagellomeres. Antennal ratio 1.51-1.63 (3). Palpal proportions 86:156:187:250 (1) µm. Eyes reniform, with a slightly angular medial margin. Ocular ratio 0.56-0.60 (4). Clypeus rectangular, distinctly wider than high, about as wide as the antennal pedicle; clyp/ped ratio 0.96-1.20 (4); with 26-28 (4) setae. Temporal setae 8-12 (4), in a slightly staggered single row, reaching to 0.68 of the distance from the eye to midline of the head.

**Thorax:** Antepronotum almost parallel-sided, not produced at the dorsal apex (Fig. 6). Thoracic chaetotaxy: lateral antepronotals 7-10 (4); dorsocentrals 14-23 (5), anteriorly in a partial double row; acrostichials 13-21 (4); prealars 5-7 (5); supra-alaris lacking; scutellars 30-32 (5), in a strewn pattern.

**Wing:** Membrane with microtrichia visible at 125X. Costa not produced beyond R₄₊₅; which ends distal to M₃₊₄ at 0.22 of the distance between apex of M₃₊₄ and M₄₊₂, R₂₊₃ evanescent at apex. Venarum ratio 1.02-1.09 (3). Wing length 1.90-2.58 (3) mm. Squama with 31-52 (4) marginal setae, which are 3-4X at base, becoming 2X, then 1X near the alula. Wing vein setae: R 9-14 (4), R₁ 1-4 (4), other veins without setae.

**Legs:** Foretibial spur length 62-74 µm (3); middle tibial spur lengths 52-68/24-40 µm (4); hind tibial spur lengths 80-102/26-40 µm (4). Pulvilli absent. Leg ratios: P I 0.68-0.69 (3); P II 0.43-0.49 (4); P III 0.52-0.55 (3). P III comb setae 9-14 (4). P III sensilla chaetica 3-6 (2).

**Genitalia** (Fig. 7): Ninth tergum with 18 (2) setae. Gc/Gs ratio 1.50-1.81 (2).

**Pupa** (Male).—Cephalothorax pale brown becoming dark brown posteriorly with a blackish spot over the base of each wing sheath. Abdomen yellowish brown becoming darker over the bases of the posterior tergal spine clusters; abdomen length 2.46-2.89 mm (3).

**Cephalothorax:** Setae absent on the frontal apotome, similar to that illustrated by Coffmann et al. (1986: Fig. 9.9A). Thoracic horn lacking. Median suture with strong tubercles on about middle 1/3 on either side; posteriorly the cephalothorax becomes rugose, then at extreme posterior end of the suture, fine, dark tubercles occur (Fig. 8). Precoarneal setal cluster with 1 long (139 µm), 1 smaller (77 µm), and 1 very fine seta (62 µm). Dorso-ventrals: DC₁ coarse; DC₂ smaller than, above, and slightly behind DC₁; DC₃ almost in a line with DC₁ and about the same size; DC₄ almost directly above DC₃ and about the same size as DC₂. Wing sheaths without bacatiform papillae or nasiform tubercles.

**Abdomen:** Shagreen pattern and chaetotaxy (Fig. 9); tergum I with an anterior and posterior band of spines; terga II-VIII with bands of spinulae and spines similar to that illustrated for tergum V, but virtually devoid of shagreen between median spinulae band and posterior band of spines; anterior to the median band on T II-VIII, each tergum is covered with weak shagreen. Anal macrosetae with the anterior 1 well separated from the posterior 2 and either simple and spinelike or with weak apical or subapical bifurcations (Fig. 9); length 148 µm; length of longer posterior macroseta 149 µm; ALR 0.73-1.15; sternum VIII (Fig. 9).

**DIAGNOSIS AND DISCUSSION.**—The dark coloration and features of the male genitalia (Fig. 7) differentiate *C. platypus* from other Nearctic species of *Cardioculius*. *Cardioculius obscurus* (Johannsen) has similar coloration and genitalia; however, the basidorsal gonocoxite lobe of that species (Sublette 1967; Fig 7) is more rounded, costa slightly extended, and scutellum pale. The pupa of *Cardioculius obscurus* has been illustrated by Johannsen (1937) and Coffman et al. (1986: Fig. 9.9A, B) as C. cf. *obscuripes* (Johannsen) (sic! = *obscurus*). It differs from *C. platypus*, described herein, in 2 noticeable features: the apical spines on terga I-VIII are longer and more numerous, and shagreen is virtually lacking on terga II-VII between median and posterior bands of denticles. Further, the L-setae of T VIII are heavier than in the species illustrated by Coffmann et al. (1986).
Pupae of the Palearctic species *C. fuscus* Kieffer and *C. capucinus* (Zetterstedt) differ among the features described and illustrated by Langton (1991).

**Ecology.**—*Cardiocladius platypus* is an obligate, stenothermal rheophile that occurs throughout much of the upper Arkansas River in Colorado, with adults taken from 1497 to 3042 m elevation (Ruse et al. unpublished data). It has been taken in northern New Mexico (Sublette and Sublette 1979; unpublished records) in the Canadian, Rio Grande, and San Juan drainages. It occurs at stations with substrata ranging from rubble-gravel to gravel-sand.

**Distribution.**—California to Colorado and New Mexico; Quebec (Oliver et al. 1990).
Figs. 9–10. Cardiocladius platypus. Pupa: 9, abdominal shagreen and chaetotaxy, terga I, V, VIII, anal lobe, and sternum VIII. Cricotopus (Cricotopus) annulator. Male: 10, coloration, semidiagrammatic.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1♀, river mi 0.0, 947 m elev; 1♂, river mi 72.0, 796 m elev; 1♂, river mi 108.0, 699 m elev; 1♂, 1 Pex, river mi 151.2, 556 m elev; 1♂, river mi 153.0, 549 m elev; 1♂, river mi 157.0, 555 m elev; 1♂, river mi 202.0, 457 m elev; 1♀ Pex, river mi 205.7, 451 m elev. Additional specimens examined from California, Colorado, and New Mexico.

Cricotopus (Cricotopus) annulator Goetghebuer
(Figs. 10–12)

Cricotopus annulator Goetghebuer 1927:52; type locality, Belgium.
Cricotopus irwinii Sublette and Sublette 1971:97; type locality, California; male.
Cricotopus (Cricotopus) irwinii Sublette & Sublette 1979:70; distribution, subgeneric position.
Cricotopus (Cricotopus) annulator Goetzheuer; Hirvenoja 1973:202, adults, immatures, distribution, synonymy; Laville 1979:160 and Rossaro 1987:333, ecology; LeSage and Harrison 1980a:73, adults, distribution, synonymy; 1980b:376, ecology; 1980c:2, biology of parasites; Simpson et al. 1983:4, adults, immatures, in key (after Hirvenoja 1973); Hudson et al. 1990:9, in list; Oliver et al. 1990:23; in catalog, synonymy; Langton 1991:219, pupa.
Cricotopus obvitus Boesel 1983:88; type locality, Ohio; male. New synonym.

The adult male and pupa differ slightly in some features from the description of Hirvenoja (1973). They are redescribed here to assist future comparisons.
MALE.—Coloration (Fig. 10): Head, fused thoracic vittae, preepisternum, and postnotum blackish brown; anterpronotum and scutellum brown but usually paler than postnotum; humeral and pleural areas yellowish; legs dark with paler fasciae; abdomen fasciate, with dark brown bands interspersed with yellowish bands; genitalia yellowish at apex, somewhat infuscate basally.

Head: Antenna with 13 flagellomeres. Antennal ratio 1.11–1.30 (4). Palpal proportions 55–70 (3):94–101 (3):117–133 (3):195–203 μm (3). Eyes with dorsal extension short and wedge-shaped. Ocular ratio 0.44–0.48 (3). Clypeus at base 0.86 of width of antennal pedicel; with 11–12 (4) setae. Temporal setae 7–10 (4), in a single row, reaching to near the midline of the head.

Thoracic chaetotaxy: Lateral anterpronotal 5–8 (3); dorsocentra1s 14–21 (7), in a partial double row; acrostichals 16–22 (7), mostly in 2 rows; prealars 5 (3); supra-alar lacking; scutellars 7–8 (3).

Wing: Membrane with microtrichia visible at 300X. Costa extended 56–60 μm (3) beyond R4+5, which ends distal to M3+4 at 0.16 of the distance between apex of M3+4 and M1+2. R2+3 ends at 0.42–0.51 (3) of the distance between apex of R1 and R4+5. Venarum ratio 1.09–1.14 (3). Wing length 1.80–1.97 mm (3). Squama with 8–9 (3) marginal setae. Wing vein setae R5–9 (3); other veins without setae.

Legs: Foretibial spur length 44 μm (3). Middle tibial spur lengths 22–24/18–20 μm (3); hind tibial spur lengths 46–52/16–22 μm (3). Apical tarsomere, claws, empodium, and hyaline lamellae; pulvilli absent. Leg ratios: P I 0.59–0.65 (7); P II 0.47–0.50 (3); P III 0.56–0.59 (3). P III sensilla chaetica 6–7 (3).

Abdomen: Abdominal tergal setae: III, medi­ans 5 (2), laterals 12–13 (2); IV, medians 5–7 (3), laterals 13–15 (2).

Genitalia (Fig. 11): Ninth tergum with 6–14 (3) setae. Gc/Gs ratio 2.48–2.69 (3).

PUPA.—Exuviae pale brown on posterior part of cephalothorax and darker brown on terg II–VI. Abdomen length 2.20–3.04 mm.

Cephalothorax: Frontal setae absent on the frontal apotome. Thoracic horn variable in shape (Fig. 12), length 120–161 μm. Median suture with weak rugosity anteriorly on either side. Preconneal setae are of about equal length but with 1 slightly heavier. Dorsocentra1s are small, almost in a straight line. Wing sheaths are without baciform papillae or nasiform tubercles.

Abdomen: Shagreen pattern and chaetotaxy similar to that figured in Hirvenoja (1973: Fig. 122–12). Tergum II hooks 43–65, in 2 rows; T II with a posterior row of fine shagreen just in front of hook row and in some specimens also a median band of very weak shagreen. Pedes spurii B (PSB) present on T II and T III, the latter being somewhat smaller and less projecting. Tergum VI with an oval to almost round median shagreen patch of which the L/W is 0.43–0.67. Anal macrosetae length 118–148 μm; anal lobe length 195–234 μm; ALR 0.61–0.63.

DIAGNOSIS AND DISCUSSION.—Abdominal and leg color patterns and genitalia of Nearctic specimens are so similar to the Palearctic species C. (Cricotopus) annulator that various authors have considered the 2 populations to be conspecific. Excellent reared material from Grand Canyon National Park and elsewhere clearly demonstrates some slight differences in the pupa from that described by Hirvenoja (1973) and Langton (1991). Most notable is the posterior shagreen band on T II as well as the presence of PSB on both T II and T III. The PSB on T III is, however, smaller than that on T II and, on some specimens, difficult to discern. A reexamination of the adults shows a slight difference in color bands of the foretibia as well as a genitalic difference in the basidorsal gonocoxite lobe, which is usually downturned at the apex.

ECOLOGY.—Cricotopus annulator inhabits flowing water systems ranging from spring runs to large rivers on a variety of substrata and under wide-ranging environmental conditions. Larvae usually concentrate in areas of moderate current with continuous adult emergence, but with spring and fall emergences accounting for about 90% of emergences at temperatures of 15–16°C. Adult males swarm at stream banks at less than 1 m height above clumps of grass (LeSage and Harrison 1980). In Italy the species has been taken from Typha latifolia L. along the margin of a stream (Rossaro 1987). In England it was associated with Sparganium sp. and fine sediments in the River Pang (Ruse 1992), and Myriophyllum spicatum L. in a small stream, the River Tud (Tokeshi and Townsend 1987). Cobo and González (1991) found it in relatively low numbers at 2 of 5
organically polluted sites on the River Sar in Spain. Schmid (1993) reported it in Austria in relatively low numbers among surface and gravel interstitial-dwelling larvae in a coldwater, gravel-bottomed stream. Similarly, Kownacki (1982) reported it to be relatively uncommon in a small pastureland stream in Poland. Anderwald et al. (1991) reported it from the Danube, a large river. In Germany, Kownacki and Margreiter-Kownacka (1993) found C. annulator in the soft sediments of the Alz River below a lake outflow as well as the firmer sediments of the lower stretches of the stream. Laville and Lavandier (1977) found this species at higher elevations in colder water over boulder-gravel substrata which had some moss and detritus in the French Pyrenees. In the Ossau Valley this species occurred at 500-2000 m elevation at maximum temperatures of 12-15°C (Laville and Vinçon 1991). In Lebanon, Moubayed and Laville (1983) reported C. annulator from the Beirut River at 700 m elevation, in slow to very slow summertime water flows, at a station with mosses in the current and macrophytes on the stream margins. Sublette and Sublette (1979) reported this species as being widely distributed in northern New Mexico streams, including the San Juan River, an upper tributary of the Colorado River. In the upper Arkansas River of Colorado it was taken at 1497-2743 m elevation on substrata that varied from boulder-cobble to gravel-sand (Ruse et al. unpublished data).

**Distribution.**—This Holarctic species is widely distributed in the Nearctic region from California to Labrador.

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 256 Φ (some reared), 16 Φ Φ (some reared), 18 PP throughout the river corridor from river mile 0.0, 947 m elev, to river mile 269.5, 356 m elev.

**Cricotopus (Cricotopus) blini**

Sublette, new species

(Figs. 13–20, 54, 55)

**Holotype Male.**—Grand Canyon National Park, Coconino Co., AZ, Colorado River mile 144.0, 570 m elev, 25-X-90, J.S., slide no. P0014 (CAS).

**Coloration** (Fig. 13): Head, thoracic vittae, scutellum, preepisternum, and postnotum blackish brown; antepronotum, humeral and pleural areas yellowish; legs dark with only trochanters and extreme base of all femora paler; abdomen fasciata, wing T IV entirely yellowish and the genitalia dark.

**Head** (Fig. 54a): Antenna with 12 flagellomeres. Antennal ratio 1.02 (0.96–1.16; 11). Palpal proportions 47:86:117:148 μm (42–55:86–90: 109–117:148–157 μm; 6). Eyes with dorsal extension short and wedge-shaped; ocular ratio 0.43 (0.41–0.50; 6). Clypeus trapezoidal, about as wide as base as width of antennal pedicel; with 16 (8–16; 6) setae. Temporal setae 6 (6–8; 6), of which 2 (2–3; 6) are inner verticals near midline of the head, clearly separated from the 4 (4–6; 6) postoculars.

**Thorax** (Fig. 54a): Antepronotum almost parallel-sided near the dorsal apex. Thoracic chaetotaxy: lateral antepronotals 5 (5–9; 6); dorsocentrals 17 (11–25; 6), in a partial double row; acrostichals 18 (15–20; 6), mostly in 2 rows; prealar 4 (3–5; 6); supra-alar lacking; scutellars 17 (13–20; 6), in a strewn pattern.

**Wing:** Membrane with microtrichia visible at 300X. Costa extended 52 (13–56; 6) μm beyond R4+5, which ends distal to M3+4 at 0.22 of the distance between apex of M3+4 and M1+2. R2+3 ends at 0.48 (0.51–0.59; 6) of the distance between apex of R1 and R4+5. Venarum ratio 1.14 (1.11–1.21; 6). Wing length 1.94 (1.54–1.97; 6) mm. Squama with 5 (2–5; 6) marginal setae. Wing vein setae: R4 (2–4; 5), R4+5 0 (0–1; 6); other veins without setae.

**Legs:** Foretibial spur length 42 (36–44; 5) μm; middle tibial spur lengths 22/20 (24–26/22–26; 5) μm; hind tibial spur lengths 56/24 (46–60/20–28; 5) μm. Apex of tarsomere 5, claws, hyaline lamellae, empodium and ungutractor (Fig. 54e), pulvilli vestigial. Leg ratios: P I 0.59 (0.58–0.62; 5); P II 0.44 (0.45–0.48; 5); P III 0.57 (0.53–0.58; 5). P III comb setae 14 (12–17; 5). P III sensilla chaetica 6 (5–9; 5).

**Abdomen:** Tergal setal pattern T II–T IV (Fig. 14); setae: III, medians 4 (4–7; 5), laterals 13 (9–13; 5); IV, medians 4 (4–6; 5), laterals 11 (7–19; 5).

**Genitalia** (Figs. 15, 54c): Ninth tergum with 13 (10–14; 5) setae. Ge/Gs ratio 2.0 (2.03–2.24; 5). Slide mounts of this (and other) species show much variation in the gonostylus, depending on the orientation; Figures 54f–h show the appearance of the gonostylus in various rotational positions. Apex of basidorsal gonocoite lobe without dorsal microtrichia (Fig. 54e).
Figs. 13–15. *Cricotopus* (*Cricotopus*) *blinni*. Male: 13, coloration, semidiagrammatic; 14, terga II–IV, chaetotaxy; 15, genitalia.
Pupa.—Abdomen length 2.04–2.65; 2.36 mm (6). Cephalothorax: Cephalothorax pale brown. Frontal setae present on the frontal apotome (Fig. 17); frontal setal length 86–152 μm (2). Thoracic horn variation (Fig. 16), length 170–226; 189 μm (6). Median suture of cephalothorax with strong rugosity on either side; lateral surface of cephalothorax with weak, scale-like tubercles. Precoenial setae subequal in length with 1 very slightly weaker than the
other 2. Dorsocentrals small, almost in a line. Wing sheaths without bacatiform papillae or nasiform tubercles.

**Abdomen.** Abdominal terga I–VI pale brown. Shagreen pattern and chaetotaxy (Fig. 18); details of shagreen on tergum III (Fig. 54b). Tergum II hooks 59–84; 66 (7), in 2 rows (Fig. 54d). Pedes spurii B present on terga II and III. Anal lobe 198–201 μm (4); anal macrosetae length 130–155; 145 μm (4). ALR 0.73–0.80; 0.77 (4).

**Larva.**—Ventral head length 164–187 μm (3). Head entirely pale except for darkened occipital ring, tips of the mandible, and mentum.

**Antenna.** (Fig. 19): Blade shorter than flagellum; larva born organs large, extending to apex of 3rd segment; ring organ at 0.23 from the base.

**Epipharyngeal region** (Fig. 55b): S I apically bifurcate; pecten epipharyngis of 3 unequal blades which are apparently fused (Fig. 55b); chaetae 5; spinulae about 3; chaetae laterales 7, variable in size and shape; chaetae basales 2, weakly dissected apically. Ungula V-shaped with the basal sclerite quadrangular. Premandible with 1 apical tooth and a slight subapical shelf; brush lacking.

**Maxilla** (Fig. 55c): Lacinial chaetae 5; antaxial seta shorter than lacinial chaetae; paraxial seta shorter than antaxial seta; palpus with 13 sensillar structures (Fig. 55d).

**Mandible** (Fig. 55a): Apical tooth shorter than combined width of the 3 inner teeth; seta subdentalis apically pointed; seta interna (not shown) with 3 main branches which are simple; outer margin moderately crenulate; mola smooth.

**Mentum** (Fig. 20): Median tooth <2X width of 1st laterals; 2nd lateral slightly shorter than 1st and 3rd. Anterior parapods pectinate (Fig. 55c), with claws progressively diminishing in size posteroventrally.

**Diagnosis and Discussion.**—The genitalia and chaetotaxy resemble those of the *festivalus*-group (Hirvenoja 1973), but members of that group have P II sensilla chaetica which are lacking in this species; also the abdominal color pattern of this species is distinctively different. It also closely resembles *C. (Cricotopus) herrmanni* Sublette, new species, in genitalic features and abdominal chaetotaxy, but that species has a significantly lower antennal ratio and a strikingly different color pattern. The larva is also similar to members of the *festivalus*-group, but the central tooth of the mentum is much narrower than in known members of that group. The pupa is similar to the Paleartic species *C. albiforceps* Kieffer (Hirvenoja 1973: Fig. 140), but that species has pedes spurii B only on tergum II, while this species has both PSB II and III. Also, the thoracic horn appears to be less spinose. The pupa is very similar to that of *C. (Cricotopus) herrmanni* Sublette; however, the length of the thoracic horn is usually less than that of *C. herrmanni*, and the anal macrosetae are shorter than 125 μm.

**Ecology.**—This species is widely distributed in the cold, swift Colorado River corridor, with specimens collected from Lees Ferry to mile 166.5. Adults were collected from July to February.

**Distribution.**—California to Colorado and New Mexico.

**Paratypes.**—AZ: 2 ♂♂, collected with the holotype (NAU). Mohave Co., 1 ♂, Colorado R, Bullhead City, 5-IX-73, M.S. Mullar (UCR). Cococino Co., 1 L, Colorado R, Grand Canyon National Park, river mi 0.5, 950 m elev; 2 ♂♂, river mi 133.0, 597 m elev; 1 ♂, river mi 133.5, 600 m elev; 1 ♂, river mi 144.0, 572 m elev; 1 ♂, river mi 166.5, 532 m elev.

CA: Riverside Co., 3 ♂♂, Laffin Ranch, between Thermal and Mecca, 15-V-70, 17-VII-74, M.S. Mullar (UCR, JES). CO: Lake Co., 1 ♂, 4 ♀♀, E fork of Arkansas R, 3042 m elev, 20–21-IX-84, S.J. Herrmann. Pueblo Co., 69 ♂♂, Arkansas R, Pueblo Blvd Br, 1431 m elev, 31-X-1-XI-84, 4-XI-84, S.J. Herrmann; 9 ♂♂, 22-VIII-83, P. Sanchez; 70 ♂♂, Stilting Basin Br, below Pueblo Res, 1444 m elev, 10-VI-85, 15-VII-85, 18-IX-85, 17-VII-87, S.J. Herrmann; 6 ♂♂, Hobson Ranch, 1504 m elev, 19-IX-85, 17-VII-87, S.J. Herrmann. Fremont Co., 10 ♂♂, Portland Br, 1535 m elev, 21-III-85, 19-IX-85 (SJB, JES, UC, KU, ANSP, CAS, AEI, CNC, USNM, INHS, UMN, BYU).

NM: Santa Fe Co., 22 ♂♂, Rio Grande, Otowai Br, near San Ildefonso Pueblo, 8-IX-74, 5-X-74, 16-VII-76, malaise trap, sweep net, M. Beard (JES). Socorro Co., 1 ♂, Rio Grande, nr San Marcial, 11-VII-76, sweep net, M. Beard. Dona Ana Co., 6 ♂♂, Rio Grande, at Texas state line, 15-XI-74, M. Beard. Catron Co., 8 ♂♂, 1 ♀, San Francisco R, south of Pleasanton, nr Frisco Hot Spgs, 10-VII-74, 17-IX-74, malaise
GRAND CANYON CHIRONOMID TAXONOMY

This species is dedicated to Dr. Dean W. Blinn, limnologist at Northern Arizona University, Flagstaff, for his assistance in bringing this project to fruition.

**Cricotopus (Cricotopus) globistylus** Roback

(Figs. 21-33, 56)

*Cricotopus globistylus* Roback 1957:10, male and female, type locality, Heber-Midway bridge, Wasatch Co., Utah; Sublette and Sublette 1979:69, in list; Oliver et al. 1990:25, catalog.

The male has been very briefly described and inadequately illustrated (Roback 1957). The following is a more complete description of the male together with descriptions of the pupa and larva.

**MALE.**—**Coloration** (Fig. 21): Head, thoracic vittae, preepisternum, and postnotum blackish brown; antepronatum and scutellum paler than postnotum; humeral and pleural areas yellowish; legs dark; abdomen fasciate, with dark brown bands interspersed with yellowish bands; genitalia dark.

*Head:* Antenna with 13 flagellomeres. Antennal ratio 0.63–1.17; 0.82 (17). Palpal proportions 39–78:86–140:86–117:125–164 μm. Eyes with dorsal extension short, wedge-shaped. Ocular ratio 0.44–0.53 (3). Clypeus quadrangular, slightly wider at base than width of antennal pedicel; with 6–19 (15) setae. Temporal setae 10–13 (6), in a slightly staggered single row, reaching near midline of head.

*Thorax:* Antennopronotum moderately produced at dorsal apex (Figs. 22, 56a). Thoracic chaetotaxy: lateral antepronotals 8–14; 11 (5); dorsocentra1s rather coarse, 17–25 (6), in a partial double row (Fig. 56a); acrostichals 10–18 (6), mostly in 2 rows; prealars 3–7 (6); supra-alar setae absent; scutellars 21–38 (6), in a strewn pattern.

*Wing:* Membrane with microtrichia visible at 300X. Costa extended 28–50 μm beyond R₁+₁, which ends distal to M₃+₄ at 0.39 of the distance between apex of M₃+₄ and M₁+₂. R₂+₃ ends at 0.34–0.45 (6) of the distance between apex of R₁ and R₄+₅. Venarum ratio 1.0–1.05 (6). Wing length 1.47–2.23 (6) mm.

*Squama* with 4–10 (6) marginal setae. Wing vein setae: R 6–14 (6); other veins without setae.

*Legs:* Foretibial spur length 48–71 (6) μm; middle tibial spur lengths 31–37/20–30 (6) μm; hind tibial spur lengths 56–74/22–36 (6) μm. Pulvilli absent. Leg ratios: P I 0.53–0.57 (6); P II 0.37–0.44 (6); P III 0.46–0.53 (6). P III comb setae 7–13 (6). P III sensilla chaetica 5–10 (6).

**Abdomen:** Abdominal tergal setae (Fig. 23): T III, medians 5–13 (6), laterals 11–22 (6); T IV, medians 8–13 (6), laterals 12–27 (6).

*Genitalia* (Fig. 24): Ninth tergum with 5–16 (6) setae. Cc/Cs ratio 2.31–2.48 (6).

*Pupa:* Exuviae pale brown except for darker brown shagreen patches. Abdomen length 2.65–3.08 mm (5).

*Cephalothorax:* Frontal setae present but frequently lost. Thoracic horn (Fig. 25), length 88–108 μm (5). Median suture with weak rugosity on either side. Precorneal setae with 1 long and 2 slightly smaller setae. Dorsal antepronotal seta much longer than ventral. Dorsocentra1s small, almost in a line. Wing sheath with out bacatiform papillae or nasiform tubercles.

**Abdomen:** Shagreen pattern and chaetotaxy (Figs. 26, 56b–d). Tergum II hooks 57–72 (5), in 2 rows (Figs. 26, 56e, f); anterior to the hook row is a weak band of fine shagreen, which is occasionally absent. Pedes spurii B present on tergum II, broad and poorly defined. Pedes spurii A present on terga III–VI. Anal macrosetae length 125–127 (5) μm, heavy and only weakly curved at the tip, occasionally bifurcate; ALR 0.43–0.59 (5). Tergum VIII with 5 L-setae or occasionally with 4 only (as shown in Fig. 26).

**LARVA.**—Ventral head length 257 μm. Head pale brown with posterolateral margin dark, as are the occipital ring and tips of the mandible and mentum.

*Antenna:* With 5 segments (Fig. 27); length 99 μm; blade shorter than the flagellum, extending to level of 3rd segment; lauterborn organs moderately large but not reaching apex of 3rd segment; ring organ at 0.29 from base of 1st segment.

*Epipharyngeal structures* (Fig. 28): S I apically bifurcate; pecten epipharyngis of 3 unequal blades; chaetae 8; spinulae 5; chaetae laterales 6; chaetae basales 2, weakly fimbriate apically; ungula V-shaped with basal sclerite quadrangular. Premandible with 1 apical tooth; brush lacking.
Figs. 21–24. *Cricotopus* (*C ricotopus*) *globistylus*. Male: 21, coloration, semidiagrammatic; 22, antepronotum, lateral view; 23, terga II–V chaetotaxy; 24, genitalia (left, dorsal; middle, internal skeleton; right, 2 views of gonostylar apex).
Mandible: Apical tooth shorter than combined width of 3 inner teeth; seta subdentalis apically notched; seta interna not discernible; outer margin strongly crenulate; mola smooth.

Mentum (Fig. 29): One median tooth which is <2X 1st laterals that are larger than remainder, which diminish in size laterally.

Maxilla (Fig. 30): Lacinial chaetae with 6 large anterior and about 4 smaller posterior blades; palpi slightly longer than wide.
**Body:** With abdominal hair clusters of 1–4 setae up to 189 μm long; procercus dark brown, about as wide as high, with 1 long and 1 short setae on posterior face and 6 long terminal setae; each posterior parapod with about 13 yellowish brown claws.

**Diagnosis and Discussion:** The abdominal chaetotaxy, massive gonostylus, and fused basiventral and basidorsal lobes of the gonocoxite distinguish the male of this species from all other Holarctic *Cricotopus*. In Hirvenoja (1973) *C. globistylus* keys to the *fuscus*-group;
however, in that group the basidorsal and basiventral lobes are more or less separated and no species has such a massive gonostylus. The pupa, which lacks frontal setae, a scarcely discernible PSB on T II, a small, weakly spinose thoracic horn, shagreen patches on T III-VI well separated, and a weak L-seta on T VIII, does not fit any of Hirvenoja’s groups. The larva, which has a central tooth of the mentum that is less than twice the width of the 1st laterals, also does not fit any of Hirvenoja’s groups.

**ECOLOGY.**—This species occurs most often in cold streams with gravel bottoms. In Grand Canyon it is most common in the uppermost, clearwater reach above the Paria River confluence.

**DISTRIBUTION.**—Known from California north to Oregon and east to Montana and New Mexico.

**MATERIAL EXAMINED:** AZ: Coconino Co., Grand Canyon National Park, Colorado River, 74♂♀ (some reared), 27 Pex, river mi 0.0, 947 m elev, to river mi 109.0, 710 m elev. UT: Paratype ♂, Wasatch Co., Heber-Midway Br, 26-XI-54, Gerald D. Brooks (ANSP). Also, specimens, including reared material, from California, Oregon, Idaho, Montana, and New Mexico (CAS, USNM, JES).

**Cricotopus (Cricotopus) herrmanni**

Sublette, new species

(Figs. 33-35, 57)

**HOLOTYPE MALE.**—Arkansas River, Fremont Co., CO, Canyon City, 9th street bridge, T85S, R70W, S33, 1618 m elev, 19-IX-85, S.J. Herrmann (CAS).

**Coloration** (Fig. 31): Head, thoracic vittae, preepisternum, scutellum, and postnotum blackish brown; antepronotum, humeral and pleural areas yellowish; legs dark with paler fasciae; abdomen fasciate, with dark brown bands interspersed with yellowish bands; genitalic yellowish at apex, somewhat infuscate basally.

**Head:** Antenna with 13 flagellomeres. Antennal ratio 0.58 (0.40-0.62; 12). Palpal proportions 47 (47-62; 6):86 (78-94; 6):109 (101-117; 6):[terminal palpmere on holotype shriveled] (156-211; 6) μm. Eyes with dorsal extension short and wedge-shaped. Ocular ratio 0.43 (0.40-0.46; 6). Clypeus quadrangular, slightly narrower at base than width of the anterior pedicel; with 8 (7-11; 6) setae. Temporal setae 9 (6-9; 6), of which 4 are inner vertically near the midline of the head widely separated from the remainder.

**Thorax:** Antepronotum almost parallel-sided in apical half (Fig. 32). Thoracic chaetotaxy: lateral antepronotals 6 (3-6; 6); dorsocentrales 18 (13-19; 6), in a partial double row, with the posterior setae distinctly coarser than the anterior; acrostichals 15 (14-21; 6), partially in 2 rows; prealars 4 (3-5; 6); supra-alarss lacking; scutellars 15 (16-21; 6), irregularly biseriately laterally becoming uniserial towards the middle, but with a median gap.

**Wing:** Membrane with microtrichia visible at 300X. Costa extended 60 (48-70; 6) μm beyond R₄₊₅, which ends distal to M₃₊₄ at 0.26 of the distance between apex of M₄₊₅ and M₁₊₂. R₂₊₃ ends at 0.56 of the distance between apex of R₁ and R₄₊₅. Venarum ratio 1.24 (1.14-1.20; 6). Wing length 1.68 (1.52-1.90; 6) mm. Squama with 4 (3-5; 6) marginal setae. Wing vein setae: R 3 (3-5; 6), other veins without setae.

**Legs:** Foretibial spur length 44 (32-50; 6) μm; middle tibial spur lengths 26/24 (20-28/14-24; 6) μm; hind tibial spur lengths 58/26 (44-60/20-30; 6) μm. Pulvillus vestigial but hyaline lamella and empodium well developed. Leg ratios: PI 0.59 (0.58-0.64; 6); P II 0.47 (0.44-0.47; 6); P III 0.58 (0.51-0.59; 6). P III comb setae 13 (12-16; 6), with tips of the comb setae forming an arc. P III sensilla chaetica 7 (6-10; 7).

**Abdomen:** Abdominal tergal setae: T III, medians 6 (4-8; 6), laterals 10 (8-12; 6); T IV, medians 4 (4-7; 6), laterals 10 (5-13; 6); setal pattern similar to C. blinni, n. sp.

**Genitalia** (Figs. 33, 57a): Ninth tergum with 10 (11-22; 6) setae. Ge/Gs ratio 2.22 (2.04-2.40; 6). As in other species of Cricotopus, the gonostylus shows considerable variation in appearance due to position at the time of slide mounting; Figures 57b-d illustrate some of the variation observed at various angles due to slide-mounting differences.

**Pupa.—Exuviae.** Almost entirely pale brown; tergum VI still darker brown.

**Cephalothorax:** Frontal setae 60-70 μm (2). Thoracic horn (Fig. 34), length 214–275; 252 μm (7). Median suture with moderate rugosity on either side; lateral surface with weak, scale-like tubercles. Precoanal setae, 2 large, 1 slightly smaller. Dorsocentrales small, almost in
Figs. 33–36. *Cricotopus (Cricotopus) herrmanni*. Male: 33, genitalia. Pupa: 34, thoracic horn variation; 35, abdominal shagreen and chaetotaxy. *Eukiefferiella ilkleyensis*. Male: 36, genitalia.
a straight row. Wing sheath without bacilliform papillae or nasiform tubercles.

**Abdomen:** Abdomen length 2.42–2.89 mm (5). Shagreen pattern and chaetotaxy (Fig. 35). Tergum II with 67–82; 71 (5) hooks in 2 very regular rows. Pedes spuri B present on terga II and III, with the PSB on II large and projecting and that on III smaller and rounded. Width of medial shagreen band on T III less than posterior. Medial shagreen of T VI L/W 0.31–0.37 (3). Anal lobe length 195–234; 214 µm (7). Anal macrosetae length 156–172; 162 µm (7). ALR 0.69–0.83; 0.76 (7).

**DIAGNOSIS AND DISCUSSION.**—The adult can be clearly differentiated from *C. blinni* by the distinctively different coloration (cf. Figs. 13, 31). The genitalia are very similar to those of *C. blinni* as well as members of the *cylindraceus*-group and *festivellus*-group (Hirvenoja 1973); however, these 2 groups differ in color. The pupa is very similar to that of *C. blinni*, but it has a slightly longer thoracic horn and longer anal macrosetae.

**ECOLOGY.**—This species has been collected most frequently from coldwater streams with gravel-sand substrata.

**DISTRIBUTION.**—California to Colorado and New Mexico.

**PARATYPES AND MATERIAL EXAMINED.**—AZ: Coconino Co., 1 δ, Grand Canyon National Park, Colorado R, river mi 31.0, 876 m elev; 4 δ, 2 ε, river mi 31.8, 876 m elev; 2 δ, δ, river mi 133.0, 597 m elev. Cochise Co., 1 δ, Southern Research Station, 1646 m elev, V. Roth (UCR).

CA: 1 δ, Davis, R.O. Schuster (UCD); 1 δ, Hopeland, E.P. Van Duzee (CAS); 1 δ, Oakland, E.S. Rosa (CAS); 1 δ, Tule R, Springville, W.W. Wirth (USNM); 1 δ, Whitewater, A.L. Melander (USNM). Alameda Co., 1 δ, Sunol, W.W. Wirth (USNM). Inyo Co., 1 ε, Surprise Canyon, R.O. Schuster (CIS). Nevada Co., 1 δ, Sagehen Cr, nr Hobart Mills, C.N. Slodochikoff (CAS). Riverside Co., 3 δ, δ, R.L. Boyd Desert Research Center, Saul I. Frommer, L. LePre; 1 δ, Horsethief Cr, 10 mi S Palm Desert, L. LaPre; 1 δ, Desert Hot Springs (UCR); 1 δ, 1000 Palms Canyon, P.A. Rausch (UCR). San Bernardino Co., 1 δ, Mill Cr, Thurman Flats, P.A. Rausch (UCR), Santa Clara Co., 2 δ, Coyote Creek, R. Whitset (JES). Shasta Co., 118 δ, Fall River Mills; 1 ε, Hat Creek, Pitt R, C. Apperson (BYU, CAS, INHS, KU, JES, UCR, USNM). Sonoma Co., 1 δ, Triniti, N.W. Frazier (CAS), Tenama Co., 2 δ, Red Bluff (CAS). Tulare Co., 1 δ, F. Success Res, TW. Fisher (UCR).

CO: Chaffee Co., 18 δ, Arkansas R, Rd 301, Fisherman’s Br, 2338 m elev, T1S5, R78W, S3; 40 δ, δ, 6 6, Sand Lake Br, Salida, 2143 m elev, T50N, R9E, S31, Chalk Cr; 1 δ, Hwy 285, 2338 m elev, T1S5, R77W, S14. Fremont Co., 12 δ, 1 P & δ, Arkansas R, Howard Br, 2033 m elev; 22 δ, δ, Parkdale Siding Br, 1747 m elev, T1S5, R72W, S13; 17 δ, δ, Hwy 115, 9th St Br, Canyon City, 1618 m elev, T85S, R70W, S33; 9 δ, Texas Cr Br, 1879 m elev, T19S, R73W, S7; 21 δ, δ, Portland Br, 1535 m elev, T19S, R68W, S17/20. Lake Co., 1 δ, Arkansas R, upstream from Lake Cr inflow, 2745 m elev, T11S, R50W, S24. Pueblo Co., 1 δ, Arkansas R, Hobson Ranch, 1504 m elev, T20S, R67W, S6; 6 δ, δ, Stilling Basin Br, 1444 masl, T20S, R66W, S36, all (except as indicated) collected by S.J. Herrmann (AEI, CAS, JES, UMMN, USNM).

NM: Rio Arriba Co., 1 δ, Chama R, 2 mi S Chama, Doles and Milensky; 1 δ, Chama R below El Vado Dam, Doles and Milensky (JES). This species is dedicated to Dr. Scott J. Herrmann, University of Southern Colorado, who collected a significant part of the type series from the Arkansas River in Colorado.

**Cricotopus (Cricotopus) infuscatus** (Malloch)

*Orthocladius infuscatus* Malloch 1915:517; type locality, Peoria, Il.

*Cricotopus (Cricotopus) infuscatus* (Malloch); Sublette and Sublette 1979:69, distribution, synonymy; LeSage and Harrison 1980a:81 and Fig. 10, adults, immatures, distribution; 1980b:376, ecology; 1980c:2, biology of parasites; Oliver et al. 1990:23, catalog, synonymy.

*Cricotopus edwardsii* Sublette & Sublette 1971:85; type locality, FL, Boyd Desert Research Center, near Palm Desert, Riverside Co., CA. *New synonym.*

*Cricotopus subfuscus* Sublette & Sublette 1971:98; type locality, Hat Creek, Fall River Mills, Shasta Co., CA. *New synonym.*

*Cricotopus infuscatus* (Malloch); Boesel 1983:83, distribution, synonymy.

**DIAGNOSIS.**—The sharply defined basidorsal and basiventral lobes of the gonocoxite which are about of equal length, the basidorsal lobe which bears about 6–9 main setae (Sublette and Sublette 1971: Figs. 6, 35; LeSage and Harrison 1980a: Fig. 10), and the abdominal chaetotaxy (Sublette and Sublette 1971: Figs. 5, 34), together with the color pattern (Sublette and Sublette 1971: Figs. 1, 2), separate
this species from other Nearctic Cricotopus. The larva and pupa have been characterized by LeSage and Harrison (1980a:84); both stages are similar to those of C. (Cricotopus) annulatort (Goetgebuer), described above. The pupa differs in usually lacking the apical shagreen band on T II and having a higher number of recurved hooks on T II (63-112). The number of recurved hooks on T II is quite variable, with eastern populations generally having a higher number. The larva has a strongly crenulate mandible, which is in contrast to that of C. annulator with its virtually smooth outer mandibular margin.

**DISCUSSION.**—Additional material of C. infuscatustricatoricates a much broader range of color variation and chaetotaxy than was previously known, hence the synonymies given above.

**ECOLOGY.**—Lenat and Folley (1983) demonstrated a bimodal pattern of adult emergence for adults in the infuscatustrictus-group. LeSage and Harrison (1980b) reported that C. infuscatustricatoricould tolerate pollution, 80% of the populations occurred in riffles, most emergences were at temperatures of 16-21°C, and swarming occurred over grass clumps or the ground at less than 1 m in height at 7-11 m from the stream margin. Ruse et al. (unpublished data) collected adults from the upper Arkansas River in Colorado at elevations ranging from 1431 to 2748 m.

**DISTRIBUTION.**—Widely dispersed throughout lower elevations and latitudes of North America.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River; 3 \( \delta \), river mi 61.5, 826 m elev; 1 \( \delta \), river mi 63.7, 818 m elev; 1 \( \delta \), river mi 164.5, 533 m elev; 2 \( \delta \), river mi 166.5, 532 m elev. Other material: Adults have been examined from throughout most of the range of this species in North America, including extensive reared series from South Dakota and New Mexico.

*Cricotopus (Cricotopus) trifascia* Edwards

*Cricotopus trifascia* Edwards 1929:328, male. Type locality, England; Boesel 1983:84, distribution.

*Cricotopus trifascia* Edwards; Hirvenoja 1973:244, adults, pupa, larva, review, distribution; Sublette and Sublette 1978:70, synonymy, distribution; Laville 1979:160 and Wilson 1987:391, ecology; LeSage and Harrison 1980a:102, distribution, synonymy; 1980b:378, ecology; 1980c:2, biology of parasites; Lenat and Folley 1983:152, phenology, distribution; Mason and Lehmkuhl 1983:196, 1985:877, distribution, phenology; Simpson et al. 1983:4, distribution, adults, pupa, larva, in key (after Hirvenoja 1973); Hudson et al. 1980:9, in list, distribution; Oliver et al. 1990:24, distribution, synonymy; Langton 1991:208, pupa.

**DIAGNOSIS AND DISCUSSION.**—This is the only Nearctic species of *Cricotopus* that lacks a basidorsal gonocoxite lobe. The pupa has the distinctive features of heavy shagreen on terga VII and VIII as well as 2 large and 1 small macrosetae on the anal lobe.

**ECOLOGY.**—*Cricotopus trifascia* is usually in rapidly flowing waters ranging from 1st-order streams to large rivers (Simpson and Bode 1980). In small streams in England it has been taken on gravel or *Ranunculus* (Pinder 1980, Pinder and Farr 1987). Mason and Lehmkuhl (1983) reported 3 peaks of adult emergence upstream from an impoundment: spring, midsummer, and fall. However, highest numbers were found 23 km downstream from the impoundment and with a unimodal, midsummer emergence about a month after the upstream populations. In Germany, Kownacki and Margreiter-Kownacka (1993) reported *C. trifascia* as occurring more commonly in the lower stretches of the Alz River rather than immediately below a lake outflow; in the Fulda, Lehmann (1971) found this species rather widely distributed, occurring in the metarhithral to the potomaral regions in moderately strong current. The species was the dominant form in a small, heavily polluted stream in southern Ontario, absent from another polluted stream, but clearly rheophilous with at least 80% of the populations in riffles of cobble and pebbles densely covered by diatoms and filamentous algae; adult emergences occurred at water temperatures of 16-21°C, with adult male swarms 2-3 m aboveground where tree branches were used as lateral swarm markers (LeSage and Harrison 1980b). In an organically enriched small chalk stream in southern England this species occurred in low numbers only at an unpolluted station (Pinder and Farr 1987). The larval tubes of *C. trifascia* are constructed largely of detritus and filamentous algae or filamentous algae alone, and the stream in which stones occurred had a thin aufwuchs film except during summer, at which time large areas of stones had a Cladophora blanket (Brennan and McLachlan 1979). The species has been reported from periphyton in a large stream, the Danube, associated primarily with Cladophora (Janković 1973). It has been taken in
low numbers from 2 of 5 stations receiving organic enrichment in the River Sar in Spain (Cobo and González 1991). In Lebanon, *C. trifascia* occurred at 800-1200 m at several different stream sites, most of which had mosses or macrophytes; 1 station was polluted (Moubayed and Laville 1983). A population in a 3rd-order trout stream consisted of 2 cohorts that made up 9.7% of total secondary production of midges (Berg and Hellenthal 1992a, 1992b). The species, collected at a station with medium levels of zinc, was considered to be tolerant according to the pollution tolerance codes developed by Wilson and McGill (1982) (Armitage and Blackburn 1985). In New Mexico, *C. trifascia* was an uncommon species, occurring in the San Juan River; an upper tributary of the Colorado River, and in the upper Río Grande (Sublette and Sublette 1979). Adults have been taken from the upper Arkansas River in Colorado at elevations ranging from 1431 to 2021 m elevation (Ruse et al. unpublished data).

**DISTRIBUTION.**—Saskatchewan to Ontario and New York, south to California, New Mexico, and North Carolina.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 P, river mi 124.61., 625 m elev, 26-XI-91. Other material examined: reared specimens from California, Colorado, and New Mexico.

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**Eudactylocladius dubitatus** (Johannsen)

*Orthocladius* (*Dactylocladius*) *dubitatus* Johannsen 1942:72; type locality, NY.

*Hydrobaenius dubitatus* (Johannsen); Roback 1957:76, immature stages.

*Orthocladius* (*Eudactylocladius*) *dubitatus* Johannsen; Sublette 1967:507, review; Hudson et al. 1990:11, in list, distribution; Oliver et al. 1990:31, in catalog.

*Eudactylocladius dubitatus* (Johannsen); Sublette and Sublette 1979:73, generic position, distribution.

**DIAGNOSIS AND DISCUSSION.**—The males of this genus can be separated from the closely related *Orthocladius* (s.s.) by the greatly reduced basidorsal and basiventral gonocoxite lobes. The pupa has distinctive paired spinulalae patches on terga II or III-VI, lacks recurved hooks on tergum II, and has a short, smooth, saclike thoracic horn that arises from a short stalk. The male of *E. dubitatus* can be separated from other Holarctic species by its short anal point, basimedian gonocoxite lobes that are not produced, and an apically tapered gonostylus with a scarcely discernible dorsodistal carina (cf. Sublette 1967:505, Fig. 17). The pupa has been redescribed by Roback (1957:81: Figs. 194–196). Our material suggests that this species is more variable in the pupal stage than heretofore known: the weak, paired shagreen patches of tergum II may be reduced to just a few points, or even completely absent; the apical spinulalae row on tergum VIII, in like manner, may be well developed, reduced to a few points, or even absent. A unique feature appears to be the presence of well-developed pedes spurii on terga I, II, and III.

**ECOLOGY.**—*Eudactylocladius dubitatus* is probably madicolous since the pupae are sometimes taken in streams. The madicolous biotope occurs as a thin film of water on any solid substratum such as seeps on vertical rock faces, splash zones of rapids and waterfalls, water interface of emergent vegetation, and at stream margins. Spring runs provide a stable environment and will usually include members of this assemblage. The species, while rare in this system, has been collected on the upper Arkansas River of Colorado at elevations ranging from 1444 to 2143 m (Ruse et al. unpublished data). Species of this genus occur in lakes, temporary ponds, swamps, and in madicolous assemblages on rock faces and in moist soil (Cranston et al. 1989).

**DISTRIBUTION.**—California to New Mexico east to New York and Pennsylvania.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River; 2 P, river mi 124.61L, 625 m elev, 26-XI-91. Other material examined: reared specimens from California, Colorado, and New Mexico.

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**Eukiefferiella claripennis** (Lundbeck)

*Chironomus claripennis* Lundbeck 1899:281; type locality, Greenland.

**Eukiefferiella claripennis** (Lundbeck); Oliver 1970: 102, lectotype; Lehmann 1972:359, adult, pupa, synonymy; Pinder 1974:198, Laville 1976:160, Wilson 1987:391 and 1989:373, ecology; Halvorsen 1981:34, review, female; Hudson et al. 1990:9, Oliver et al. 1990:26, catalog, distribution, synonymy; Langton 1991:125, pupa.

**DIAGNOSIS AND DISCUSSION.**—The adult male is characterized by having bare eyes, an absence
of $R_2+R_3$, a moderately extended costa that ends slightly proximal to apex of $M_3+4$ (Lehmann 1972: Fig.7), and, above all, the features of the male genitalia (Lehmann 1972: Fig.6). The pupa has a distinctive thoracic horn and abdominal chaetotaxy (Lehmann 1972: Figs. 8, 9). The adult is very similar to *E. brevinervis* (Malloch) (Sublette 1970:71) but differs in having a lower antennal ratio (0.75–1.30; *E. brevinervis*, 2.0–2.4).

**ECOLOGY.**—*Eukiefferiella claripennis* is widely distributed in lower and medium elevation streams. It is eurythermal and rheobiontic (Lehmann 1972). Pinder (1980), Pinder and Farr (1987), and Pinder et al. (1987) collected it most often on *Ranunculus* and gravel substrates, while Ringe (1974), Halvorsen (1981), and Nolte (1991) reported it as an inhabitant of aquatic mosaics. Halvorsen (1981) also found it on the surface of rocks in swiftly flowing water at 500 m elevation, and Millet et al. (1987) reported it from rocks with *Cladophora*. *E. claripennis* tolerates low to medium levels of zinc and is considered to be relatively tolerant according to the pollution codes of Wilson and McGill (1982) (Armitage and Blackburn 1985). Gower et al. (1994) reported this to be one of the most abundant and tolerant chironomids, occurring at stream stations with high levels of copper and aluminum. Pinder and Farr (1987) collected it from stations with elevated levels of organic enrichment in a small chalk stream in southern England, but not in numbers greater than at clean water stations. It has been taken from a calcareous stream with elevated levels of zinc but not from acid streams with higher levels of zinc (Wilson 1988), and is considered to be a moderately pollution-tolerant species (Bazerque et al. 1989). In Lebanon, Moubayed and Laville (1983) reported this species from a seasonal limnocrene in eddies at the outflow, with water temperatures ranging from 14°C to 16°C; elevation was 850 m. Oliver and Sinclair (1989) regarded it as a member of the madicolous assemblage. According to Bode (1983), the *claripennis*-group is the most tolerant member of the genus, occurring from high-altitude streams to larger, warmer rivers. In the brown-water stream system studied by Boerger (1981) in Alberta, *E. claripennis* constituted only 0.5% of the Orthocladiinae males/m²/yr. It is one of the predominant chironomids that emerged in the spring from the River Pang in England (Ruse 1992). Ringe (1974) observed 4 adult emergence periods from a small stream in central Germany, with most individuals emerging during the interval from June to August. In Austria, Schmid (1993) found low larval densities of this midge from a coldwater, gravel-bottomed stream. In Germany it has been reported from the Danube, a large river (Anderwald et al. 1991), as well as a regulated, primary tributary, the lower Inn River (Reiss and Kohmann 1982); in the Alz River this species avoids the soft sediments immediately below a lake outflow but is common further downstream (Kownacki and Margeiret-Kownacka 1993). In the French Pyrenees the streams of the Ossau Valley support moderate numbers of *E. claripennis* at elevations from 500 to 800 m, in slow- to fast-moving water; maximum temperatures range from 15°C to 18°C (Laville and Vincion 1991). Ruse et al. (unpublished data) collected adults of this species at elevations ranging from 1431 to 2969 m in the upper Arkansas River in Colorado, from areas where substrata range from boulder-cobble to gravel-sand. In New Mexico *E. claripennis* occurs in all northern and western drainages in cold to cool waters where substrata are predominantly gravel-sand (Sublette and Sublette 1979).

Steep rock faces at or near the water's edge in Grand Canyon, together with the occasional patches of cobble-gravel, provide considerable madicolous habitat and are the probable preferred habitat.

**DISTRIBUTION.**—Holartic; widely distributed in the Nearctic region; introduced into Hawaii (Oliver et al. 1990).

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 4 $\delta$, river mi 0.0, 947 m elev; 1 $\delta$, Pex, river mi 3.4, 945 m elev; 4 $\delta$, river mi 31.5, 876 m elev; 1 $\delta$, river mi 31.8, 876 m elev; 1 $\delta$, Pex, river mi 34.1, 872 m elev; 1 $\delta$, river mi 43.2, 861 m elev; 1 $\delta$, river mi 61.5, 826 m elev; 2 $\delta$, river mi 65.3, 805 m elev; 1 $\delta$, river mi 98.0, 706 m elev; 2 $\delta$, river mi 108.5, 664 m elev; 3 $\delta$, river mi 133.0, 597 m elev; 1 $\delta$, river mi 150.0, 556 m elev; 1 $\delta$, river mi 172.0, 521 m elev; 1 $\delta$, river mi 204.0, 454 m elev; 1 $\delta$, 1 $\delta$, Pex, river mi 205.7, 451 m elev.

*Eukiefferiella coerulescens* (Kieffer)

*Trichocladius coerulescens* Kieffer, in Zavrel 1926:279. *Spaniotoma* (*Eukiefferiella*) *coerulescens* (Kieffer); Edwards 1929:354, generic (subgeneric) position, review, distribution.
Eukiefferiella coerulescens (Kieffer); Brundin 1956:87, male, in key, generic position, distribution; Lehmann 1972:369, male, pupa; Hudson et al. 1990:9, in list, distribution; Langton 1991:184, pupa.

**DIAGNOSIS.**—In the adult the presence of distinct microtrichia between the eye facets and a bare squama are unique features among Nearctic Eukiefferiella. The pupa has a distinctive chaetotaxy as well as very short anal macrosetae, of which 1 is distinctly shorter than the other 2 (cf. Langton 1991: Figs. 51a–c).

**DISCUSSION.**—Nearctic material of adults and pupae agrees well with the descriptions given by Lehmann (1972:369) except that the antennal ratio of the male is intermediate between that given for this species and E. boeovrens Brundin. Langton (1991:124) has redescribed the pupa (in a correction sheet he has added that the pupa has a small, thin-walled, saclike thoracic horn; this is very frequently lost and thus in earlier descriptions was described as lacking). Our material agrees well with his description.

**ECOLOGY.**—Listed as a member of the madicolous assemblage by Oliver and Sinclair (1989) (see Euctactylocladius dubitatus, above), E. coerulescens has also been taken from aquatic mosses (Ringe 1974, Laville and Lavandier 1977, Nolte 1991) and has been found in streams with organic enrichment (Cobo and Gonzáles 1991). Bode (1983) reported the coerulescens-group as apparently widespread in North America, occurring mostly in small to medium-sized, unpolluted streams. Schmid (1993) collected it in low numbers from the surface and gravel interstices of a coldwater, gravel-bottomed stream in Austria. In Germany, Ringe (1974) observed that adult emergence in 2 small streams was essentially bivoltine but that the peaks of emergence were out of phase between the 2 streams, with the warmer stream having the main peaks of emergence almost a month before the stream with the colder, more uniform temperatures. In the Fulda, Lehmann (1971) found this species only in strongly flowing water in moss or on stones of the krenal to hyporithral regions. Kownacki (1982) found this species at only a single station in a small upland stream in Poland, occurring in an area of low current. Mouyabed and Laville (1983) reported this species in Lebanon from 3 stream systems at elevations above 1100 m, usually on moss- or algal-covered rubble. In the Ossau Valley of the French Pyrenees, E. coerulescens is one of the more abundant species, occurring most often in fast to very fast streams from 500 to 2100 m elevation; maximum temperatures range from 10° to 15°C (Laville and Vinçon 1991). One of the most unusual occurrences of E. coerulescens was reported in an underground stream of a cave system in Rumania some 8000 m from its epigean source (Albu and Stergar 1971). Adults have been taken in the Arkansas River of Colorado at elevations ranging from 1431 to 1618 m, primarily from gravel-sand substrata (Ruse et al. unpublished data). In New Mexico E. coerulescens is found mostly in the cool to cold northern and western streams where gravel-sand substrata predominate; a record from the warm-water, lower Pecos River was from a gravel substratum (Sublette unpublished data).

**DISTRIBUTION.**—Holartic; this species is probably more widely distributed in the Nearctic region than records indicate.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River; 1 ♂ P. river mi 0.0, 947 m elev; 1 ♂ , river mi 3.4, 941 m elev; 1 ♂ , river mi 31.5, 876 m elev; 2 ♂ , river mi 43.2, 861 m elev; 1 ♂ , river mi 68.0, 808 m elev. In addition, we have reared material from Arizona, Colorado, and New Mexico.

Eukiefferiella ilkleyensis (Edwards)

(Figs. 36–39)

Spaniotoma ilkleyensis Edwards 1929:349; type locality, Ilkley, Yorkshire, England.
Eukiefferiella ilkleyensis (Edwards); Lehmann 1972:372, revision, adult, pupa; Pinder 1974:198 and Laville 1979:161, ecology; Storey 1987:339, developmental ecology; Hudson et al. 1990:9, in list, distribution.

Nearctic males and pupae, which are considered here as conspecific with Palearctic populations, differ in some slight details. The following descriptions define the Nearctic material.

**MALE.**—**Coloration:** Almost entirely blackish brown; scutellum, humeral and pleural areas yellowish; legs dark; abdomen blackish brown with the narrow apices of T VII and VIII somewhat paler; genitalia dark. Antenna with 13 flagellomeres. Antennal ratio 0.85–1.05 (10). Palpal proportions 62:101:101:164 μm. Eyes reniform, without dorsal extensions; ocular ratio 0.68–0.73 (4). Clypeus rectangular, much wider than long, slightly narrower at
Figs. 37-39. *Eukiefferiella ilkeyensis*. Pupa: 37, thoracic horn; 38, abdominal shagreen and chaetotaxy. *Metriocnemus stevensi*. Male: 39, genitalia (dorsal view below, internal skeleton above).
base than width of the antennal pedicel; clyp/ped ratio 0.87-0.93 (9); clypeus with 6-8 (12) setae. Temporal setae 2-5 (12), usually in a small clump behind dorsal apex of the eye (with 1-2 very fine inner verticals observed in 2 specimens).

**Thorax:** Antepenultimate slightly and almost evenly tapered to the apex, collarlike. Thoracic chaetotaxy: lateral antepronotals 2-5 (5); dorsocentrals 8-12 (5), set in paler alveoli, in a single row; acrostichials 7-13 (5), mostly in 2 rows; prealars 3 (5); supra-alarls lacking; scutellars 7-11 (5), mostly in a staggered single row.

**Wing:** Membrane with very fine microtrichia barely visible at phase 500X. Costa extended 30-55 (6) μm beyond R4+5, which ends distinctly proximal to tip of M3+4. R3+4 ends at 0.29-0.35 (5) of the distance between apex of R1 and R4+5. Venarum ratio 1.09-1.17 (5). Wing length 1.90-2.37 (9) mm. Squama with 6-13 (11) marginal setae. Wing vein setae: R 1-4 (5), R1 0-1 (5), other veins without setae.

**Legs:** All legs with a single tibial spur; foretibial spur length 48-58 (5) μm; middle tibial spur length 38-46 (5) μm; hind tibial spur length 54-70 (5) μm. Pulvilli absent. Leg ratios: P I 0.60-0.66 (10); P II 0.48-0.55 (5); P III 0.57-0.61 (5). P III comb setae 12-14 (5). P II and P III sensilla chaetica lacking.

**Abdomen:** Setae on terga II-IV broadly strewed over most of each tergum except for a posteromedian concave area devoid of setae; terga V-VIII with setae strewed over most of each tergum except for a narrow apical transverse band.

**Genitalia** (Fig. 36): Ninth tergum with 2-3 (10) setae. Virga absent. Gc/Gs ratio 1.80-2.06 (5).

**Pupa.—Exuviae:** Exuviae almost entirely brown.

**Cephalothorax:** Frontal setae absent. Thoracic horn (Fig. 37), length 122-152 μm; apical denticles on the basal enlargement very weak or perhaps absent in some specimens. Cephalothorax almost smooth on either side of median suture. Precorneal setae with 1 long and 2 smaller setae. Dorsocentrals small, almost in a line, Dc1,3 larger, Dc2,4 smaller. Wing sheaths without bacatiform papillae or nasiform tubercles.

**Abdomen:** Abdomen length 1.59-1.90 mm. Shagreen pattern and chaetotaxy (Fig. 38). Pedes spurii B lacking. Terga II-VIII with posterior spines; T III-V with a continuous row of recurved hooks behind the spine row; hook number: III 17-24, IV 18-24, V 12-18. Sterna VI and VII with inconspicuous apical denticles. Tergum VIII with L1,2,4 very fine; L3 larger and heavier but not spinose. Anal macrosetae of unequal length, with the medial 1 smaller than the lateral 2; lateral macrosetal length 124-150 μm.

**Diagnosis and Discussion.—**Despite some minor differences, this population is considered to be conspecific with the Palearctic *E. ilkleyensis* (Edwards) and is very similar to the Holarctic *E. devonica* (Edwards) in adult and pupal stages. The adult differs in having the ventral junction of the gonocoxites irregularly papilllose and the apex of the phallopodeme weakly digitate (not always clearly visible, being dependent upon the orientation of the genitalia on the slide), while both Palearctic *E. ilkleyensis* and *E. devonica* have a smoothly rounded medial junction and the phallopodeme is not illustrated as digitate (cf. Lehmann 1972: Figs. 30, 34). Further, the temporal setae of this population are usually restricted to behind the dorsal apex of the eye while Palearctic *E. ilkleyensis* has a group of 3-4 setae near the midline in addition to the group behind the dorsal apex of the eye (cf. Lehmann 1972: Fig. 36). The antennal ratio is much higher than in *E. devonica*.

The pupa of this species can best be distinguished by the different thoracic horn. In Palearctic *E. ilkleyensis* the filament is short (cf. Lehmann 1972: Fig. 37) to very short (cf. Langton 1991: Fig. 51d), while in this population the filament is distinctly longer; further, the fine denticles at the base of the filament are usually distinct in *E. ilkleyensis*, whereas in this population the denticles are very sparse (visible only at phase 500X) or entirely absent. Although the thoracic horn is nearer to that illustrated for *E. devonica* (Lehmann 1972: Fig. 32), the filament, which is shorter than in that species, and the absence of apical hooks on sternum VIII clearly distinguish this species from *E. devonica*.

**Ecology.—** *Eukiefferiella ilkleyensis* is a member of the *devonica*-group, which is associated with mosses and algae in small to large rivers (Bode 1983). It has been found most often on *Ranunculus* (Pinder 1980), *Ranunculus* and gravel (Pinder et al. 1987), or aquatic mosses (Ringe 1974, Nolte 1991). Armitage and Blackburn (1985) reported the species at
stream sites with low zinc concentrations and considered it to be intolerant in the pollution tolerance codes of Wilson and McGill (1982). However, Cobo and Gonzales (1991) collected it on the Sar River in Spain at 1 station of 5 that received organic enrichment. Pinder and Farr (1987) also reported it in low numbers from a small chalk stream in southern England at a station with elevated levels of organic enrichment. In Poland in the River San, Kownacki (1989) found this species to be one of the dominants above a sewage outfall, but it diminished or disappeared at downstream stations. Storey (1987) considered E. ilkleyensis to be a scraper/herbivore that selectively feeds on aufwuchs, especially epiphytic diatoms. Tokeshi and Townsend (1987) described aspects of the ecology of a population living epiphytically on Myriophyllum spicatum L. in a small river in eastern England. It was collected by Schmid (1993) from a coldwater, gravel-bottomed stream in Austria; larval densities were low. Kownacki and Kownacka (1971) and Kownacki (1982) found this species at several stations on small upland streams in Poland; however, greatest numbers were reported over stony bottoms. Kownacki and Zosidze (1980) also reported it from medium to large, stony streams from the Little Caucasus Mountains of Georgia (Adzhari) and the Caucasus Mountains of Azerbaijan. In the Alz River of Germany, Kownacki and Margreiter-Kownacka (1993) reported that this species avoids slower currents and softer bottoms below a lake outflow but occurs commonly in lower stretches of the stream. In Lebanon, Moubayed and Laville (1983) reported E. ilkleyensis at only 1 station on the Assi River, in fast current, on rubble partially covered with mosses. In the Ossau Valley of the French Pyrenees, this is a rare species occurring in fast to slow streams at elevations of 450-500 m; maximum temperature is 15°C (Laville and Vinçon 1991). Ruse et al. (unpublished data) found it at only a single location in the upper Arkansas River of Colorado at an elevation of 1431 m.

**DIAGNOSIS, DISCUSSION, AND ECOLOGY.**—The adult is scarcely distinguishable from that of E. ilkleyensis in genitalic features; however, the tip of the antenna is broken off (antennal ratio estimated to be about 1.0). The pupa is readily distinguishable by its distinctive thoracic horn, which is more like that of E. devonica (Edwards) (Lehmann 1972: Fig. 32). Unfortunately, the presence of small hooks at the apex of S VII (Lehmann 1972: Fig. 33) cannot be ascertained, as the apex of the associated pupal exuviae is missing beyond segment V.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 ♂, Pex, river mi 63.7, 818 m elev; 1 ♀, river mi 74.3, 792 m elev; 1 ♂, river mi 75.3, 785 m elev; 1 ♂, river mi 52.7, 846 m elev; 2 ♂♂, river mi 71.0, 808 m elev; 2 ♂♂, river mi 72.0, 796 m elev; 1 ♂, river mi 87.5, 740 m elev; 1 ♂, river mi 88.0, 739 m elev; 1 ♂, river mi 89.0, 736 m elev (CAS, USNM, CNC, INHS, JES).

*Eukiefferiella* sp.

**DIAGNOSIS AND DISCUSSION.**—A single male was taken, but during slide preparation the genitalia were badly crushed, hence the lack of a specific determination.

**ECOLOGY.**—The genus *Limnophyes* occurs in numerous ecotopes, ranging from aquatic (particularly madicolous) to semiterrestrial habitats.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 ♂, river mi 133.5, 600 m elev, 9-11-90.

*Metriocnemus stet'see* Sublette, new species

**HOLOTYPEx MALE.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, Vaseys Paradise, river mi 31.8, 876 m elev, J.S. (CAS).

**Coloration:** Head, thoracic vittae, preepisternum, and postnotum blackish brown; anter­pronotum and scutellum paler than postnotum; humeral and pleural areas yellowish; legs and abdomen dark brown.

**Head:** Antenna with 13 flagellomeres; fully plumed. Antennal ratio 0.93. Palpal proportions 47:195:172:211 μm. Eyes with dorsal extension short and wedge-shaped. Ocular ratio
0.45. Clypeus quadrangular; slightly wider at base than width of the antennal pedicel (1.07); with 22 (23; 1) setae. Temporal setae 23 (31; 1), those in the postocular series coarse and in a single row, while those lying medial to the eye finer, multiserial, and reaching to near midline of the head.

Thorax: Antepronotum rather broad and collarlike, almost parallel-sided in the apical half. Thoracic chaetotaxy: lateral anteranotals 7 (9; 1); dorsocentrals 53 (42; 1) (including 15 [16; 1] humerals), in 3 staggered rows posteriorly, with the humerals becoming multiserial anteriorly; acrostichials about 35 (37; 1), partially in 2 rows; prealars 18 (23; 1); supra-alar 2 (2; 1); scutellars 32 (32; 1), in a single row laterally, becoming 3–4 rows medially; preepisternals 9 (5; 1).

Wing: Membrane with fine macrotrichia over most of the membrane. Costa extended 170 (126; 1) µm beyond R4+5, which ends slightly distal to M3+4 at 0.21 of the distance between apex of M3+4 and M1+2. R2+3 almost parallel to R1, ending at 0.14 of the distance between its apex and apex of R4+5. Venarum ratio 1.24 (1.23; 1). Wing length 2.25 (1.92; 1) mm. Square with 17 (19; 1) marginal setae. Wing vein setae: R 75, r-m 7, R1 67, R4+5 128, M 24, M1+2 104, M3+4 24, Cu3 32, Cu1 18, remigium 6.

Legs: Foretibial spur of holotype broken at tip (54; 1) µm; middle tibial spur lengths 31/31 (34/28; 1) µm (tip of longer spur on holotype broken); hind tibial spur lengths 53/28 (72/34; 1) µm (tip of longer spur on holotype broken). Pulvilli vestigial. Tarsal pseudospurs present on T3-1 of P II and P III (P III tarsi missing on holotype). Leg ratios: P I 0.63; P II 0.43 (0.40; 1); P III 0.44 (1) (P III lacking on holotype). P III comb setae 11 (12; 1). P II and P III sensilla chaetica lacking (P III tarsi missing on holotype).

Abdomen: Abdominal terga with scattered setae; T IV with about 93 setae; sternum III-VI with a midventral row of setae, that of S III unserial, S IV 2X with S V-VI multiserial; S II-VI with multiserial laterals; S VII-VIII with medial and lateral setal bands fused.

Genitalia (Fig. 39): Ninth tergum with 24 (21; 1) setae. Small virga present; length 24 µm. Ge/Gs ratio 1.78.

DIAGNOSIS AND DISCUSSION.—The combination of heavily haired wings, presence of preepisternal setae, and extremely short anal point is unique among Nearctic Metriocnemus.

ECOLOGY.—The genus Metriocnemus occurs in a wide variety of habitats, from madicolous to semiterrestrial habitats.

MATERIAL EXAMINED.—Paratype (and holotype) ♂, Coconino Co., Grand Canyon National Park, Colorado River, mi 31.8, 876 m elev, LES (CAS).

This species is dedicated to Dr. Lawrence E. Stevens who initiated and coordinated this study.

Orthocladius (Euorthocladius) luteipes Goetghebuer

Orthocladius luteipes Goetghebuer 1938:457; type locality, Austria.

Orthocladius (Euorthocladius) luteipes Goetghebuer; Soponis 1990:23, revision, adults and immatures, distribution.

DIAGNOSIS AND DISCUSSION.—The adult male and immatures have been separated in key by Soponis (1990). Males are similar to those of Orthocladius (Euorthocladius) rivicola Kieffer but may be recognized by the more square-shaped basidorsal gonocoxite lobe below which the basiventral gonocoxite lobe is more weakly projecting than in O. rivicola; however, the pupae are more distinctive than the adults. It is probable that some males identified in the literature as O. rivicola are actually O. luteipes.

DISTRIBUTION.—Palearctic; Oregon to New York, south to Arizona and Georgia.

ECOLOGY.—Orthocladius luteipes occurs in creak and riverine habitats, spinning gelatinous cases on stones. This species' distribution broadly overlaps that of O. rivicola.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 ♂, river mi 3.4, 941 m elev, 24-VII-71.

Orthocladius (Euorthocladius) rivicola Kieffer

Orthocladius rivicola Kieffer 1911:181; type locality, Germany.

Orthocladius (Euorthocladius) rivicola Kieffer; Laville 1979:161, ecology; Soponis 1990:26, revision, all stages, distribution: Hudson et al. 1990:11, in list, distribution; Oliver et al. 1990:31, catalog, distribution.

DIAGNOSIS AND DISCUSSION.—Soponis (1990) has differentiated the adult and pupa of this species from other Holarctic members of the subgenus.

ECOLOGY.—Orthocladius rivicola has been categorized as "less pollution resistant" (Bazerque et al. 1989), although Cobo and Gonzales
(1991) reported it at 3 of 5 stations receiving organic enrichment on the River Sar in Spain. In the high arctic Hayes and Murray (1987) found this to be one of the numerically dominant forms that exhibited a bimodal emergence during a 24-h study, with emergence continuing over the entire 6-wk study period. Laville and Lavandier (1977) also reported this as a numerically dominant species all along the length of a torrential brook in the Valon d’Es­taraigne in the French Pyrenees. In the Ossau Valley of the French Pyrenees this was one of the “frequent or abundant” species in fast to very fast waters at elevations of 500–1500 m; maximum water temperatures were 12–15°C (Laville and Vinçon 1991). It has been reported from aquatic mosses (Kownacki 1971, Nolte 1991) and from Cladophora in the aufwuchs assemblage (Janković 1973). Mason and Lehmkuhl (1983) observed that numbers of this species were not diminished downstream from a dam when compared with upstream populations. In Austria, Schmid (1993) collected larvae in low numbers from the surface and gravel interstices in a coldwater stream, while Ander­wald et al. (1991) took it from the Danube, a large river. It has also been reported from the lower Danube in the former Yugoslavia (Janković 1973). Ringe (1974) illustrated an emergence period from April to August in a small stream in central Germany, with 1 major peak of emergence occurring in early May; in the Fulda, Lehmann (1971) reported the highest abundance of this species in the strongly flowing currents of the rhithral regions. Kownacki (1982) found it to be most abundant in Poland at a station on stony bottoms in an upper-elevation Carpathian pastureland stream, while in the high Tatraus it was most often encountered in rapid current in the montane forest zone (700–1500 m elevation), being the dominant species there (Kownacki 1971, Kownacki and Kownacka 1971). Kownacka and Kownacki (1972) clarified the dominant status to those stations with a granite substratum below 1550 m elevation. In the medium to large stony streams of the Little Caucasus Mountains of Georgia (Adzhar) and the Caucasus Mountains of Azerbaijan, this species was among the dominant chironomids (Kownacki and Zosidze 1980, Kownacki 1985). In Bybi Potok, a polluted stream in Poland, Kownacki (1989) found that O. rivicola increased in abundance as organic enrichment decreased. In Germany, Kownacki and Margreiter-Kownacka (1993) collected it in the Alz River at all stations including the soft-bottomed, slower-flowing section immediately below a lake outflow; Reiss and Kohmann (1982) collected it from the banks of the lower Inn River, a large, regulated, primary tributary of the Danube. Fáby (1975) found highest numbers in low to intermediate flows in a low-nutrient, stony stream in Ireland. This is one of the more abundant orthoclads in the Colorado River as well as the upper Arkansas River in Colorado (Herrmann et al. unpublished), and the upper Canadian, Rio Grande, San Juan, and Gila drainages in New Mexico; it occurs on a variety of substrata ranging from boulder-gravel to sand-silt (Sublette unpublished). Ruse et al. (unpublished data) collected adults in the upper Arkansas River at elevations ranging from 1431 to 3042 m.

DISTRIBUTION.—Holarctic; widely distributed throughout much of North America from the high arctic to the lower temperate zones.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River; 4 δ, 2 P, 1 Pex, river mi 0.0, 947 m elev; 1 δ, river mi 2.0, 945 m elev; 3 δ, Pex, river mi 3.4, 941 m elev; 1 δ, river mi 20.4, 911 m elev; 1 δ, river mi 31.0, 876 m elev; river mi 31.5, 876 m elev; 1 δ, river mi 43.2, 861 m elev; 2 δ, river mi 52.7, 846 m elev; 2 δ, river mi 53.0, 846 m elev; 1 δ, river mi 56.0, 835 m elev; 2 δ, river mi 61.0, 826 m elev; 2 δ, river mi 63.7, 823 m elev; 2 δ, river mi 65.3, 815 m elev; 1 δ, river mi 88.0, 739 m elev; 1 δ, river mi 89.0, 736 m elev; 2 δ, river mi 108.0, 699 m elev; 1 δ, river mi 124.0, 625 m elev.

Orthocladius (Orthocladius) frigidus (Zetterstedt)

Chironomus frigidus Zetterstedt 1838:812; type locality, Greenland.

Orthocladius (Orthocladius) frigidus (Zetterstedt); Soponis 1987:123, subgeneric position, review, synonymy; 1990:53, morphology; Oliver et al. 1990:32, in catalog.

DIAGNOSIS AND DISCUSSION.—Soponis (1987) has characterized all life history stages. The male genitalia are similar to those of some members of the subgenus Euorthocladius (Soponis 1990) in which O. frigidus was, until recently, included. However, the anal point is usually distinctly broader and the dorsal extension of the eye is longer than in members of that subgenus (Soponis 1990: Fig. 12).
ECOLOGY.—Orthocladius frigidus inhabits cool to cold streams, constructing detritus-encrusted silken tubes in moss or algae. It has been reported on stones but seldom on moss and algae in a small stream in central Germany (Ringe 1974), on aquatic mosses (Nolte 1991), from "springs, streams and rivers" (Aagaard et al. 1987), and in an islandic lake, primarily in the littoral splash zone but occasionally as deep as 30 m (Lindegaard 1980). Armitage and Blackburn (1985) found O. frigidus in streams with moderate levels of zinc, but it is considered pollution intolerant in the classification of Wilson and McGill (1982). Serra-Tosio (1977) took it from a stream with considerable anthropogenic enrichment, while Cobo and González (1991) reported it from 1 of 5 stations receiving organic enrichment on the River Sar in Spain. In a Pyrenean torrent, d'Estaragne, Laville and Lavandier (1977) found this species in small numbers above 2150 m elevation, occurring on boulder-gravel substrata or on moss. In the Ossau Valley in the French Pyrenees, this species had the highest frequency of occurrence, occupying streams at elevations of 500–2000 m; water temperatures ranged from 9° to 16°C (Laville and Vingon 1991). Schmid (1992) observed this species at significantly higher densities in the main current channel than in the marginal area of a gravel stream, the Oberer Seebach, in Austria; he further reported a tendency towards bivoltinism. Ringe (1974) illustrated 2 major peaks of adult emergence from a small stream in central Germany, 1 in May and the other in November. Fahy (1975) collected this species most often in intermediate flows in a stony, low-nutrient stream system in Ireland. In the high Tatras of Poland it occupied stony bottoms in rapid current (Kownacki 1971, Kownacki and Kownacka 1971); in the Little Caucasus Mountains of Georgia (Adzhar) and in the high Caucasus Mountains of Azerbaijan it was taken from several stations in medium to large, stony-bottomed streams (Kownacki and Zosidze 1980, Kownacki 1985). In Germany, Kownacki and Margreiter-Kownacka (1993) found this species in the Alz River most often some distance below a lake outflow; Lehmann (1971) reported it from the Fulda in areas with strong currents; and Reiss and Kohmann (1982) collected it from the banks of the lower Inn River, a regulated, primary tributary of the Danube. In Lebanon, Moubayed and Laville (1983) reported O. frigidus from several stream systems with variable current and substrata, but usually at stations with mosses or macrophytes. It has been taken at elevations from 1746 to 3042 m on gravel/cobble substrates in the Arkansas River of Colorado (Ruse et al. unpublished data). The rarity of O. frigidus in the Colorado River is possibly due to the almost constant scouring action of the river in the canyon, which disturbs the preferred gravel and removes algal clumps.

DISTRIBUTION.—Holarctic; in North America this species occurs from California to New Mexico and Colorado, Pennsylvania, and Greenland.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 L, river mi 0.0.

Orthocladius (Orthocladius) mallochi Kieffer

Orthocladius lacteipennis Malloch 1915:524, male; type locality, South Haven, MI. Orthocladius mallochi Kieffer 1919:191, nomen novum for Orthocladius lacteipennis Malloch 1915, non Lundstrom 1910. Orthocladius (Orthocladius) mallochi Kieffer; Soponis 1977:63, revision, adults, immatures, distribution; Savage and Soponis 1983:302, adult morphology; Hudson et al. 1990:11, in list, distribution; Oliver et al. 1990:32, in catalog, distribution.

DIAGNOSIS AND DISCUSSION.—Adults and immatures have been keyed by Soponis (1977).

ECOLOGY.—Orthocladius mallochi was one of the rarest Orthocladiinae in a brown-water stream in Alberta, with only 0.03 of 1.0% males/m²/yr collected (Boerger 1981). It is common in the upper Arkansas River of Colorado where it occurs at elevations of 1431–2905 m (Ruse et al. unpublished data). It occurs in most stream systems in New Mexico (Sublette unpublished).

DISTRIBUTION.—This species has an unusual distribution, with specimens taken from Alberta south to California and New Mexico in western North America and from Northwest Territories south to Illinois and South Carolina in the East.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 ♂, river mi 204.0.

Paraeladus conversus (Walker)

Chironomus conversus Walker 1856:175; type locality, British Isles. Paraeladus conversus (Walker); Hirvenoja 1973:94, revision, adults and immatures; Sublette and Sublette 1979:
80, distribution; Oliver et al. 1990:33, in catalog, distribution.

**Diagnosis.**—The adults and pupae of the 3 known species have been separated in key by Hirvenoja (1973). Reared material from New Mexico agrees well with Hirvenoja’s descriptions as does the single male taken in Grand Canyon.

**Ecology.**—*Parakiefferiella* *subaterrima* is most frequently collected from lakes but is also known from slow-moving streams (Hirvenoja 1973). In Germany, Reiss and Kohmann (1982) collected it from stream margins of the lower Inn River, a large, regulated, primary tributary of the Danube; in the Fulda, Lehmann (1971) reported it from the Potamal region (“Barben-region”). In the Nida River in Poland, Kow-nacki (1989) found this species to be generally distributed but occurring in greater abundance in the recovery zone below a sewer outfall. It is known from a zine-contaminated stream where it constituted <0.5% of the sample (Wilson 1988). It has been statistically associated with *Myriophyllum* in the River Pang in England (Ruse 1992). In the Ossau Valley of the French Pyrenees this was a rare species, occurring in medium to slow streams at 800–850 m elevation; maximum water temperatures were 16° to 18°C (Laville and Vinçon 1991). In small, interrupted stream systems of Lebanon this species was found at 3 stations with macrophytes (Moubayed and Laville 1983). In New Mexico it was often taken near stream margins (Sublette and Sublette unpublished data).

**Distribution.**—Arizona to New Mexico and Colorado; Pennsylvania. It is possible that some records of *P. alpica* (Zetterstedt) from the Nearctic region are actually this species.

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 2 ♂♂, river mi 246L, 365 m elev, 13-XI-1975. *Parakiefferiella subaterrima* (Malloch); Oliver et al. 1990:33, in catalog, distribution.

**Parakiefferiella subaterrima** (Malloch); Oliver et al. 1990:33, in catalog, distribution.

**Diagnosis and Discussion.**—The male can be recognized by the presence of a distinct R$_{2+3}$ which becomes evanescent apically, an antennal ratio usually about 1.0 (0.68–1.34), and, above all, the male genitalia. The genitalia (Fig. 40) have typically a bluntly acute anal point; compression due to more or less flattening by the cover glass results in considerable variation in appearance of the anal point as well as the basal dorsal and basal ventral gonocoxite lobes. Proximally, the basal dorsal gonocoxite lobe usually has visible a transverse apodeme that appears as a darkened bar. Northern specimens have a higher number of anal point setae and higher antennal ratio (based on Sæther 1969).

The pupa, based on extensive rearings from New Mexico, differs in some features from that described by Sæther (1969): the frontal apotome has small frontal setae (Fig. 41), there is a small egg-shaped thoracic horn with fine apical denticles present (Fig. 42), pedes spuri B are present on T II and III, and the shagreen pattern on the abdomen is much weaker (Fig. 43). Specimens from the Chama River in New Mexico near the Colorado state line have heavier shagreen than those taken from the Rio Grande in Doña Ana County in New Mexico near the Texas state line. Thus, the pupa described from Manitoba (Sæther 1969) with the terga almost completely covered by shagreen may represent the extreme of a north–south cline.

**Ecology.**—This is a common inhabitant of the upper Arkansas River in Colorado, found at elevations ranging from 1444 to 2771 m (Ruse et al. unpublished data).

**Distribution.**—Northwest Territory east to Quebec and south to California and Illinois.

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 ♀, river mi 89.0, 732 m elev, 8-I-91. Other material examined: California, Colorado, New Mexico, and Utah.

**Parametriocnemus lundbeckii** (Johannsen)

**Metriocnemus lundbeckii** Johannsen 1905:302, nomin novum for *Chironomus nanus* Lundbeck 1898:255, nomen novum Meigen 1818; type locality, Greenland; Oliver et al. 1990: 34, in catalog, distribution; Epler 1995:6.65, larva, distribution.
Figs. 40–43. *Parakiefferiella subeterrima*. Male: 40, genitalia. Pupa: 41, frontal apotome; 42, thoracic horn; 43, abdominal chaetotaxy and shagreen, including details of anal lobe and apex of anal lobe.

**Parametriocnemus lundbecki** (Johannsen); Sublette 1967:537, review; Sæther 1969:115, review, synonymy, distribution; Simpson and Bode 1980:56, larva, ecology; Cranston et al. 1983:261, larva; Simpson 1983:320, ecology; Coffman et al. 1986:265, pupa; Cranston et al. 1989:310, male; Hudson et al. 1990:11, in list, distribution.

**DIAGNOSIS AND DISCUSSION.**—The adults and pupae have been well characterized by Sæther (1969).

**ECOLOGY.**—The North Carolina biotic index (NCBI) value for *Parametriocnemus lundbeckii* is 3.7 (Lenat 1993), which agrees with the Simpson and Bode (1980) observation that the species is restricted to relatively clean water. It has been listed by Singh and Harrison (1984) as having 3 periods of adult emergence, but the species was not commonly taken, comprising only 1.84% of all chironomids collected; this
was similar to Boerger’s (1981) findings, which listed only 0.5 of 1.0% males/m²/yr of the total Orthocladiinae. The cohort growth is asynchronous with maximal growth in the spring (Berg and Hellenthal 1992a). Beckett (1992) collected the species in a large temperate river on artificial plate samplers in low numbers during most months except June-August. *P. lundbeckii* was more frequently taken from an acid, poorly buffered Precambrian Shield stream with a boulder-cobble bottom covered with thick growths of *Fontinalis* (Rempel and Harrison 1987). McShaffrey and Olive (1985) found only diatoms in the gut contents of larvae. In the upper Arkansas River of Colorado this is an uncommon, but rather widely distributed, species occurring at elevations ranging from 1444 to 3042 m (Ruse et al. unpublished data). In New Mexico *P. lundbeckii* is widely distributed in northern and western cool-to-coldwater streams (Sublette and Sublette 1979). Epler (1995) reported the larvae as being sensitive to organic pollution.

**DISTRIBUTION.**-Alberta east to Quebec and Greenland, south to California and Florida.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1°, river mi 133.5, 625 m elev. 17-VIII-75.

*Paraphaenocladius exagitans* (Johannsen)

*Metriocnemus exagitans* Johannsen 1905:303; type locality, New York.

*Paraphaenocladius exagitans* (Johannsen); Sublette 1967:543, review, generic position; Hudson et al. 1990:12, in list, distribution; Oliver et al. 1990:34, catalog, distribution, synonymy.

**DIAGNOSIS AND DISCUSSION.**—The hairy wings, retracted R₄₊₅ ending proximal to the apex of M₃₊₄, and features of the male genitalia (Sublette 1967: Figs. 36, 37) differentiate this species from other Nearctic congeners.

**ECOLOGY.**—Members of this genus in the Palearctic region are reported to be terrestrial, living in damp soil adjacent to water bodies (Strenzke 1950). In the Nearctic, however, “at least semiaquatic and perhaps truly aquatic species occur in streams and springs” (Cranston et al. 1983). Rosenberg et al. (1988) reported *Paraphaenocladius exagitans* emerging from a fen in western Ontario, indicating at least a semiaquatic existence for this species. Ruse et al. (unpublished data) collected this species only once along the Arkansas River in Colorado at an elevation of 2338 m; adults probably came from nearby spring seeps or marshy areas.

**DISTRIBUTION.**—South Dakota east to New York, south to Arizona and New Mexico.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1°, river mi 31.8, 876 m elev; 1°, river mi 124.0, 625 m elev.

*Pseudosmittia nanseni* (Kieffer)

*Pseudosmittia nanseni* Kieffer 1928:82; type locality, Ellesmere Island, Northwest Territories.

*Prosmittia nanseni* (Kieffer); Oliver 1963:177, generic position, in list; Sæther et al. 1984:270, review of holotype.

*Pseudosmittia nanseni* (Kieffer); Cranston and Oliver 1988:451, generic position, added description of male, distribution; Hudson et al. 1990:13, in list, distribution.

*Pseudosmittia n. sp.*; Sublette and Sublette 1979:83, misidentification, distribution.

**DIAGNOSIS.**—The male genitalia (Sæther et al. 1984: Fig. 12; Cranston and Oliver 1988: Fig. 20) are distinctive. Immature stages are unknown.

**DISCUSSION.**—This wide-ranging species shows considerable variation between northern and more southern populations (Cranston and Oliver 1988). Dr. O.A. Sæther, University of Bergen, suggests the nominal species is actually a complex of related forms (personal communication).

**ECOLOGY.**—*Pseudosmittia nanseni* is probably a madicolous species, as Wrubleski and Rosenberg (1990) reported low numbers of it from emergent vegetation where apparently the aquatic-terrestrial interface provides a habitat. Presumably, wet algal strands in the splash zone on the rock faces of the canyon wall in Grand Canyon are similar to the interface found on emergent aquatic vegetation.

**DISTRIBUTION.**—Alaska to Greenland, south to California, east to Georgia.

**MATERIAL EXAMINED.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1°, river mi 6.0, 945 m elev.

*Tvetenia vitracies* (Sæther)

*Eukiefferiella vitracies* Sæther 1969:49, male, female, and pupa.

*Tvetenia vitracies* (Sæther); Sæther and Halvorsen 1981:271, generic position; Coffman et al. 1986:293, pupa.

*Tvetenia calloscens* (Edwards); Sublette and Sublette 1979:74, review, distribution, misidentification.
Diagnosis and Discussion.—The genitalia are very similar to those of *Tevenia calvescens* (Edwards), *T. discoloripes* (Goetghebuer), and *T. bavarica* (Goetghebuer) (cf. Pinder 1978: Figs. 105 b, c; Lehmann 1972: Figs. 65, 70, 71, 77); however, the antennal ratios of *T. calvescens* (Edwards) and *T. bavarica* (Goetghebuer) are much lower (0.6–0.8 vs. 1.03–1.35). The pupal thoracic horn and abdominal chaetotaxy of *T. vitraces* have been briefly described by Seethe (1969) and figured by Coffmann et al. (1986: Fig. 9.75). It is very similar to that of *T. verralli* (Edwards) (Langton 1991), but the pupa of that species lacks the fine-pointed spines at the apex of the anal lobe. The adult male of *T. verralli* has much stronger crista dorsalis on the gonostylus (cf. Pinder 1978: Fig. 105A).

Ecology.—Larvae of the *discoloripes*-group are most frequently found in larger, warmer rivers, most often in association with *Cladophora* (Bode 1983). Ruse et al. (unpublished data) collected *T. vitraces* in the upper Arkansas River of Colorado at elevations ranging from 1497 to 1879 m.

Distribution.—Arizona, California, Colorado, New Mexico, Ontario, and Saskatchewan. Possibly, some of the North American records of *T. calvescens* are actually this species since the male genitalia appear to be virtually indistinguishable.

Material Examined.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1°0'0", river mi 61.0, 826 m elev; also, material from California, Colorado, New Mexico.

**Chironomus decorus**

Johannsen 1905:239; type locality, Ithaca, NY; adults and immature stages.

**Chironomus decorus** Johannsen; Sublette and Sublette 1979:86, review, distribution; Martin et al. 1979:131, karyotype.

Diagnosis and Discussion.—The male genitalia (Townes 1945: Fig. 136a), together with abdominal coloration consisting of saddle-shaped darker markings on terga II-V (heaviest on II–IV, occasionally evanescent on V) and a foretarsus without a beard, will differentiate the species. However, there are at least 10 Nearctic species in this complex (Martin et al. 1979), and identifications are somewhat uncertain at this time. One of the authors (JES) has examined the holotype at Cornell University, and the Grand Canyon material cannot be separated from it on adult morphology. The larva and pupa cannot be adequately separated. The most reliable separation remains through karyological examination.

Ecology.—*Chironomus decorus* is primarily lentic but occurs widely in stream systems in backwater pools and river stretches with little current. As do other members of the genus, this species lives on soft, muddy substrata, occasionally on sandy-silt. In New Mexico it occurs in every major stream system in the state (Sublette and Sublette 1979).

Distribution.—Throughout much of North America; however, many of the literature records of this and its junior synonym, *Chironomus attenuatus* Walker, are suspect. Karyological or DNA studies are needed to define the many populations.

Material Examined.—AZ: Coconino Co., Grand Canyon National Park, Colorado River,
1  ♂, river mi 259.0R, 8-V-90; 1  ♂, river mi 268.5, 21-VI-75, LES.

**Chironomus (Chironomus) decorus**

Johannsen complex

At least 2 additional species of this group occur in Grand Canyon, based on males with adequate genitalia visible in limited slide-mounted material. However, this material was not considered sufficient upon which to base new species descriptions. With additional material in hand a better appraisal will be possible. The localities for these are described below

**Chironomus** n. sp. 1

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 2  ♂, river mi 246.0L, 13-XI-75; 1 ♀, Pex, river mi 209.0L, 4-XII-91.

**Chironomus** n. sp. 2

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1  ♂, river mi 269.5, 21-VI-75.

**Chironomus (Chironomus) utahensis** Malloch

*Chironomus utahensis* Malloch 1915:438; type locality, Kayville, UT; Schuller and English 1976:300, cytology; Sublette and Sublette 1979:89, distribution; Martin et al. 1979:139, karyotype.

**Tendipes (Tendipes) utahensis** (Malloch); Townes 1945:127, review.

**Chironomus (Chironomus) utahensis** Malloch; Oliver et al. 1990:45, distribution; Wülker et al. 1991:71, review, immatures and adults, karyosystematic position.

**Diagnosis and Discussion.**—The distinctive male genitalia will serve to differentiate this species from other Nearctic species (cf. Townes 1945: Fig. 143). Immatures have been characterized by Wülker et al. (1991).

**Ecology.**—*Chironomus utahensis* is primarily lentic, inhabiting water bodies ranging from large lakes and reservoirs to shallow ponds in Manitoba and playa lakes on the Llano Estacado of New Mexico. This species is an uncommon inhabitant of pool environments with silt and substrates; it also may occur in backwaters. Similar collections of the lentic *C. decorus* complex have been taken in the Arkansas River in Colorado and Pecos River and Rio Grande in New Mexico (Sublette unpublished data).

**Distribution.**—This widely distributed western species ranges from Alberta and Manitoba south to California and New Mexico.

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1  ♂, 1 ♀ Pex, 1 Lex, river mi 53.0, 847 m elev; 1 ♀, river mi 0.0R, 11-VII-90, J.S.; 1  ♂, L, Pex, river mi 31.0R, 1-II-90, J.S.

**Cyphomella gibbera**

Sæther

*Cyphomella gibbera* Sæther 1977:103; type locality, Yankton, SD, male, pupa; Pinder and Reiss 1986:379, pupa; Oliver et al. 1990:45, distribution.

**Diagnosis and Discussion.**—The male is very near *Cyphomella cornea* Sæther in genital features but differs in having 8–11 setae on the inferior volsella while *C. cornea* has 0–1; the superior volsella lacks setae while in *C. cornea* there are usually 4 (cf. Sæther 1977: Figs. 37D, F). Immature stages have been figured by Sæther (1977: pupa, Fig. 37A, B; larva, Fig. 35; Pinder and Reiss 1983: larva, Fig. 10.13) as *Cyphomella* sp.

**Ecology.**—Ruse et al. (unpublished data) collected this species in the upper Arkansas River of Colorado at an elevation of 1497 m. In New Mexico this species occurs in a wide variety of habitats ranging from cold- to warm-water streams with substrates ranging from gravel to sand-silt (Sublette and Sublette 1979).

**Distribution.**—Saskatchewan and South Dakota south to Arizona and New Mexico.

**Material Examined.**—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 2 LL, river mi 61.0, 826 m elev; 1 L, river mi 87.5, 740 m elev; 1 L, river mi 187.5, 488 m elev, 19-IX-91, M.S.

**Phaenopsectra profusa**

(Townes)

(Figs. 44–48)

*Phaenopsectra profusa* Townes 1945:73; type locality, Reno, NV, male.

**Phaenopsectra profusa** (Townes); Grodhaus 1987:137, generic position, morphology, ecology; Oliver et al. 1990:51, distribution.

**Phaenopsectra** n. sp. 1; Sublette and Sublette 1979:103, distribution, misidentification; Martin et al. 1979:151, karyotype.

The male has been briefly described by Townes (1945). The following is given to supplement his description.
MALE.—*Coloration:* Head, thorax, and abdomen largely blackish brown; scutellum somewhat paler brown; legs with coxae dark, remainder mostly stramineous except knees, which are slightly darker; haltere knob pale; abdomen largely dark with the posterolateral margins of the terga paler brown; genitalia infuscate.

*Head:* Antenna with 13 flagellomeres. Antennal ratio 1.9–1.96. Palpal proportions 70:164: 179:289 μm. Eyes with dorsal extension long
and parallel-sided. Ocular ratio 0.19. Clypeus quadrangular, slightly longer than wide, with 21–23 setae; clyp/ped ratio 0.76. Temporal setae 14, in a single row, reaching about halfway from the dorsal apex of the eyes to the midline of the head.

Thorax: Antepronotum greatly narrowed near the dorsal apex and closely appressed to the mesonotal continuation (cf. Townes 1945: Fig. 230). Thoracic chaetotaxy: lateral antepronotals lacking; dorsocentrals 16–18, in a partial double row; acrostichals 15–16, mostly in 2 rows; prealars 7; supra-alars lacking; scutellars 23–32, in a strewed pattern.

Wing: Membrane with heavy macrotrichia distal to the apex of R1 and with sparse macrotrichia extending almost to the wing base. Costa not extended beyond R4+5, which ends considerably distal to M3+4 at 0.93 of the distance between apex of M3+4 and M1+2. R2+3 closely parallels R1, ending at about 0.2 of the distance between apex of R1 and R4+5. Venarum ratio 1.0–1.04. Wing length 2.75–2.79 mm.

Abdomen: Abdominal tergal setae scattered, becoming denser at the lateral margins.

Genitalia (Fig. 44): Ninth tergum with 12–16 setae. Ge/Gs ratio 0.95.

Pupa.—Cephalothorax: Cephalothorax brown; wing sheaths mostly pale but outlined with brownish margins. Frontal setae present on the frontal tubercles very similar to that illustrated for P. flavipes (Meigen) (cf. Pinder and Reiss 1986: Fig. 10.59A); frontal setal length 58 μm. Thoracic horn base also similar to that of P. flavipes (cf. Pinder and Reiss 1986: Fig. 10.59C). Median suture with strong tubercles on either side near the anterior end and with a smaller patch near the posterior end on either side. Precoarneal setae very weak, with 1 longer and 2 slightly shorter setae. Posterior dorsocentrals small, in a line below the posterior tubercle patch; anterior dorsocentrals not discernible. Wing sheaths without bacatiform papillae or nasiform tubercles.

Abdomen: Abdomen mostly pale but with blackish spots at the corners of conjunctiva I–II, II–III, III–IV, and IV–V; lateral margins of terga V–VIII with a narrow brown band that becomes progressively broader posteriorly. Abdomen length 4.85–5.00 mm. Shagreen pattern and chaetotaxy very similar to P. flavipes (cf. Pinder and Reiss 1986: Fig. 10.59D), but with the anterior band of shagreen not conspicuously heavier than the posterior; tergum IV (Fig. 45), tergum VI (Fig. 46), and tergum VIII (Fig. 47). Pedes spurii B on terga I and II. Tergum II hooks 69–72 in a single row. Anal lobe with 27–42 swim fringe setae.

Diagnosis and Discussion.—The male of this species is only weakly separated, based on color features, from the closely related P. obediens (Johannsen) (Townes 1945). These 2 species may prove ultimately to be conspecific when more material is available for examination. The pupa is very similar to P. flavipes but differs in having a more heavily tuberculate cephalothorax.

Ecology.—Grodhaus (1987) took Phaenopsis curvifrons from temporary pools in California and suggested that the species maintains itself in permanent waters and opportunistically invades temporary pools, since it also has been found in rice fields, reservoirs, and sewage lagoons. Ruse et al. (unpublished data) collected adults of this species in the upper Arkansas River of Colorado at elevations ranging from 1431 to 2944 m. Its rarity in the Colorado River in Grand Canyon bespeaks a paucity of lentic habitats, principally small backwater and side pools.

Distribution.—Washington to Montana south to California and New Mexico.

Material Examined.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 Lex. Pex. 5°, river mi 31.8, 876 m elev; 1 P 5°, 3 LL, river mi 33.0, 847 m elev; 2 LL, river mi 225.0, 411 m elev.

Polyhedillum (Tripodura) obelos
Sublette & Sasa
(Figs. 49–52)

Polyhedillum (Tripelos) obelos Sublette & Sasa 1994:50; type locality, Laurenos, Guatemala, male and female.

Pupa.—Total length 4.67, 5.52 mm (2).

Cephalothorax: Frontal apotome without tubercles (Fig. 48); frontal setal length 62 μm. Thoracic horn with 3 posterior branches and about 5 anterior branches, similar to that of
Figs. 49-53. *Polypedilum (Polypedilum) obelos*. Pupa: 49, terga III (above) and VI (below) shagreen and chaetotaxy; 50, posterolateral spur of tergum VIII. Larva: 51, antenna; 52, mentum and ventromental plate. *Cladotanytarsus (Cladotanytarsus) marki*. Male: 53, genitalia.
Polypedilum (Tripodura) epomis Sublette and Sasa (Sublette and Sasa 1994: Fig. 170). Premaxillary setae 2, 52 μm in length, subequal. Median suture with moderate tubercles anteriorly on either side; posteriorly becoming weakly rugose. Dorsocentral setae minute, anteriorly with DcS1 and DcS2 contiguous and posteriorly with DcS3 and DcS4 the same. Bacatiiform papillae and nasiform tubercles lacking.

Abdomen: Abdomen length 3.48, 4.15 mm (2). Tergum I with weak reticulation; PSB I and II present. T II apical hooks 54, 62 (2). PSA present on S IV-VI. Terga III-V shagreen as in Figure 49; T VI with weaker shagreen so that the anterior, medial, and posterior transverse bands are separate. Intersegmental membrane II/IV and IV/V with weak shagreen (Fig. 49). Lateral abdominal setae: II-IV with 3 filiform setae, V-VI with 3 lamellate setae, and VII-VIII with 4. Posterolateral spur of T VIII (Fig. 50). Anal lobe with 38, 42 (2) fringe setae.

Larva.—Head capsule yellowish except for tips of mandibles, mentum, and occipital ring. Ventral head length 160 μm (1).

Antenna (Fig. 51): Length 90 μm (1); AR 0.80; lastborn organs large, extending past 3rd segment.

Head and mouthparts (Fig. 52): Mentum with 16 teeth, similar to other members of the genus. Ventromental plate (Fig. 52) with 40-61 fine striae. Premandible with a conspicuous brush, 2 apical teeth, and 1 basal shelf-like tooth. Mandible length 114 μm; seta subdentalis attenuate, down-curved at tip, extending past the basal tooth, similar to that illustrated by Pinder and Reiss (1983: Fig. 10.60C); subapical tooth heavy, scarcely exceeded in length by the apical tooth; mola with 1 very weak denticle; seta interna with numerous fine branches, major branches not discernible. Pecten epipharyngis, chaetulae laterales, ungula, and basal sclerite similar to that of P. (Tripodura) gryseopunctatus (Malloch) (Soponis and Simpson 1992), but with 5 denticles in each of the lateral plates of the pecten epipharyngis and 6 chaetulae laterales on each side; S I and S II simple, fimbriate. Chaetae 5 on each side, weakly fimbriate. Spinulae 2. Lacinial chaetae of maxilla 3, the most anterior one heaviest, reaching to midline of head; 2nd about as long but narrower, and 3rd greatly reduced. Maxillary palpus slightly longer than wide, with at least 7 apical sensillae. Dorsal labral sclerites obscured.

Body: Anterior parapods separate, mostly with pectinate claws. Procerci each with 6 terminal setae and 2 anterior setae; L/W of procercus about 1.0. Claws of anal parapod yellow, simple.

Diagnosis.—This species closely resembles P. (Tripodura) pterosopilus Townes in wing features but differs from that species in having the basal dark spot in cell ReS clearly separated from the r-m crossvein and having spots along the anal margin broader and heavier (cf. Sublette and Sasa 1994: Fig. 181). Male genitalia anal point is longer and more lanceolate (cf. Sublette and Sasa 1994: Fig. 182) than in P. pterosopilus (Townes 1945: Fig. 32). The genitalia of P. (Tripodura) labeculosum (Mitchell) are more similar to this species (cf. Sublette 1960: Fig. 1C), but the wing spots of P. labeculosum are distinctively different (cf. Townes 1945: Fig. 211). Immature stages in this genus are still inadequately known. Of the known southwestern larvae this species most closely resembles P. labeculosum in having antennal segments 3-5 about equal to segment 2, ventromental plates finely striate (30–47 striae), head capsule largely pale, and posterior margin of the ventromental plate not strongly sinuate. This species differs, however, in having the anterior band of shagreen only slightly greater density than the middle and posterior bands of T II–VI. This, coupled with the heavy, somewhat divided, posterolateral spur of T VIII, presents a unique appearance among the southwestern Polypedilum.

Discussion and Ecology.—The presence of P. obelos in Grand Canyon represents the northernmost occurrence of this recently described Neotropical species. The related P. labeculosum and P. pterosopilus also represent probable Neotropical forms with range extensions into the southwestern United States.

Distribution.—Guatemala, Arizona, New Mexico.

Material Examined.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 ♀ and Pex, river mi 61.0, 663 m elev; 1 ♀ and Pex 1 Lex, river mi 166.0, 646 m elev.

Polypedilum (Tripodura) apicatum Townes

Polypedilum (Tripodura) apicatum Townes 1945:39; type locality, Las Vegas Hot Springs, NM; Boesel 1982:258, review; Oliver et al. 1990:52, catalog, distribution.
DIAGNOSIS AND DISCUSSION.—Features of the male genitalia and the characteristic spotted wing are distinctive (cf. Townes 1945: Figs. 31, 207).

ECOLOGY.—This species is found at low elevations in the Southwest and has been collected in desert springs.

DISTRIBUTION.—California to Colorado and New Mexico; Illinois.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 1 δ, river mi 164.5, 533 m elev; 1 δ, river mi 166.5, 532 m elev.

Tribe Tanytarsini

Cladotanytarsus marki

Suhlette, new species (Fig. 53)

HOLOTYPE MALE.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, river mi 174.3, 518 m elev, UV trap, LES (CAS).

Coloration: Head, antepronotum, thoracic vittae, preepisternum, a spot on the pleura, and postnotum blackish brown; humeral, prescutellar, and pleural areas and scutellum yellowish; legs and abdomen dark.

Head: Antenna with 13 flagellomeres. Antennal ratio 0.72 (0.60–0.64; 3). Palpal proportions 23:78:78:125 μm. Eyes reniform; ocular ratio 0.71 (0.64–0.72; 3). Clypeus truncate triangular, width at base 0.65 of width of antennal pedicel; with 8 (8–10; 4) setae. Temporal setae 9 (8–9; 4), in a single row, reaching to over halfway to midline of the head.

Thorax: Antepronotum triangular, evanescent dorsally. Thoracic chaetotaxy: lateral antpronotals lacking; dorsocentrals 7 (5–6; 4), in a single row; acrostichials 5 (5–6; 4), partially in 2 rows; prealars 1 (1; 4); supra-alars lacking; scutellars 2 (2–4; 3), in a single row.

Wing: Membrane with sparse macrotrichia at the tip; R4+5 ends very slightly proximal to apex of M1+2; R2+3 ends at 0.65 (0.56–0.65; 4) of the distance between apex of R1 and R4+5. Venarum ratio 1.25 (1.27–1.31; 5). Wing length 1.26 (1.18–1.45; 4) mm. Wing vein setae: R 10 (7–10; 4), R4+5 4 (1–5; 4), M1+2 15 (7–15; 4).

Legs: Foretibial spine length 12 μm; middle tibial spurs subequal, lengths 10 μm; hind tibial spur lengths 10/8 μm. Pulvilli vestigial. Leg ratios: P 1 1.58 (1.59–1.97; 3); P II 0.53 (0.53–0.56; 3); P III 0.65 (0.61–0.67; 3). Sensilla chaetica P II 2 (2; 3).

Abdomen: Genitalia (Fig. 53). Ninth tergum with 6 (3–11; 4) setae; ventral anal point setae extending slightly beyond middle of anal point (Fig. 53, inset). Ge/Gs ratio 1.43 (1.26–1.45; 4).

DIAGNOSIS AND DISCUSSION.—The medially concave inferior volsella separates this species from all described Nearctic Cladotanytarsus except C. daviesi Bilyj and C. pinnaticornis Bilyj. In those species the anal point spinulae have multiple points at the tip with the spinulae and 9th tergum setae distinctly separated in both size and shape, while C. marki has simple tips so that the spinulae grade into the 9th tergum setae.

PARATYPES.—AZ: Coconino Co., Colorado River, Grand Canyon National Park, 1 δ, river mi 108.5, 663 m elev, 26-XI-91, TCM; 4 (, collected with the holotype (, (CAS, USNM).

This species is dedicated to the son of JES, Dr. J. Mark Sublette, who has devoted many hours in the field in pursuit of elusive midges.

ECOLOGY.—This species has been collected in cold-stenothermic conditions in both steep, narrow, bedrock-constrained and wider reaches of the mainstream Colorado River.

DISTRIBUTION.—This species has been collected only in the lower half of the Colorado River corridor in Grand Canyon, Arizona.

Micropsectra sp.

DIAGNOSIS AND DISCUSSION.—A single female pupal exuvium was taken at Lees Ferry on 30 December 1990, but the lack of knowledge on female pupal morphology prevented identification to the species level.

ECOLOGY AND DISTRIBUTION.—The most common southwestern Micropsectra is M. nigripila (Johanssen), which has a very broad ecological tolerance, occurring in a variety of flowing water.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado R, 1 δ Pex, river mile 0.0, 950 m elev, 30-XII-90.

Rheotanytarsus hamatus

Sublette and Sasa

Rheotanytarsus hamatus Sublette and Sasa 1994:52; type locality, Rincon, Guatemala.

DIAGNOSIS AND DISCUSSION.—The genitalia of the males are available in rather poor condition; however, the strongly hooked gonostylus, short medial volsellas, and distinctively shaped superior volsellas are clearly visible (cf.
Fig. 54. *Cricotopus (Cricotopus) blimi*, scanning electron micrographs (clockwise from top left): (a) male, head and thorax (dorsolateral view); (b) pupa, tergum III (lateral view); (c) male, genitalia; (d) pupa, recurved hooks of tergum II; (e) male, claws and associated structures; (f) male, gonostylus (ventral); (g) gonostylus (medial); (h) gonostylus (lateral).
Fig. 55. *Cricotopus* (Cricotopus) *bini*, scanning electron micrographs (clockwise from top left). Larva: (a) mandible (3-piece collage); (b) head (ventral view); (c) anterior parapods; (d) maxillary palpus apex; (e) maxilla.
ECOLOGY AND DISTRIBUTION.—In Arizona this species has been collected in cold-stenothermic conditions in the Colorado River just below the Paria River.

MATERIAL EXAMINED.—AZ: Coconino Co., Grand Canyon National Park, Colorado River, 4 ♂, river mi 133.5, 610 m elev.

The chironomid fauna of the Colorado River in Grand Canyon is depauperate in comparison with other North American rivers. Our sample of nearly 1500 larval, pupal, and adult chironomid specimens included 38 species in 23 genera and 4 subfamilies. The fauna was dominated by 23 species in the subfamily...
Orthocladiinae, with *Cricotopus annulator* > *C. globistylus* > *Eukiefferiella claripennis* > *Orthocladius rivicola* > *Tvetenia vitraces*. *Chironomus* spp. (subfamily Chironominae) were regularly encountered in low densities in pool habitats floored with fine sediment. Twelve chironomine species were collected overall. *Procladius bellus*, *Paracladius conversus*, *Chironomus decorus*, *C. sp. 1*, and *C. sp. 2* were collected only in the headwaters of Lake Mead.
Stevens et al. (1998) present a synthesis and summary of the Colorado River chironomid assemblage from the data presented here.

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