

NEW SPECIES, SUBSPECIES, AND STAGE DESCRIPTIONS OF
 TEXAS BAETIDAE (EPHEMEROPTERA)

W. P. McCAFFERTY AND A. V. PROVONSHA

Department of Entomology, Purdue University, West Lafayette, Indiana 47907.

Abstract. — *Baetodes bibranchius*, new species, is described from larvae and male and female adults. It is common in the central hill country of Texas where larvae develop in moderate currents in small to medium sized streams. *Baetodes alleni*, new species, is described from larvae from the Guadalupe River. Congeners are discussed, and a key to the *Baetodes* species of the United States is provided. *Procloeon texanum*, new species, is described from distinctive male adults reared from larvae from the Navasota River. It is the first nominal North American species of *Procloeon* lacking hindwings known outside northern regions of the United States and Canada. *Callibaetis montanus punctilusus*, new subspecies, is a distinct lowland geographic variant differing in color and punctuation from the primarily Mexican and Central American mountainous subspecies *C. montanus montanus* Eaton, new status. *Camelobaetidius mexicanus* (Traver and Edmunds), a relatively common Texas mayfly, is described in the adult stage for the first time based on reared adults associated with the distinctive larvae.

Key Words: Mayflies, Baetidae, Texas, new descriptions, new records

Small minnow mayflies (family Baetidae) are arguably the most taxonomically difficult and challenging group of mayflies in North America and other parts of the world due in large degree to their small size, relatively extensive adaptive radiation, and proclivity for convergent evolution with respect to reduction of size, wings, etc. Recent revisionary work (e.g. McCafferty and Waltz 1990) has begun to remedy this situation, however, considerable additional research is needed, not the least of which will be the description and documentation of species and species variability. Such descriptive works (e.g. Mayo 1972, Morihara and McCafferty 1979a, Waltz and McCafferty 1987, Lowen and Flannagan 1991) are obvious prerequisites to determining phylogenetic relationships and appropriate generic limits within the family [e.g. the

progressive resolution of *Heterocloeon* (Müller-Liebenau 1974, McCafferty and Provonsha 1975, Morihara and McCafferty 1979b)].

During a recent survey of the family Baetidae in Texas, a number of new species or variants of species were discovered. In addition, we reared adults of one previously described and common species for which that stage has been unknown. Descriptions of these new taxa and the adult stage follow. With regard to the other variant populations we discovered in Texas, we defer describing them as new taxa at this time because of the possibility that they actually represent undescribed stages of previously described species. In most instances, only associations of larvae and adults through rearing will resolve whether or not these undescribed populations represent new taxa.

***Baetodes bibranchius* McCafferty and
Provonsha, NEW SPECIES**

Figs. 1-5

Mature larva (in alcohol).—Body length excluding cerci: 4.2–4.6 mm; cerci 5.0 mm. *Head*: Vertex generally pale with medium brown shading in areas dorsal to antennal bases and area surrounding median ocellus. Labrum (Fig. 1) slightly narrower than inter-antennal distance, emarginate medially and with sclerotized cleft line at midpoint of apical emargination. *Thorax*: Nota pilose, pale with brown shading in some, most noticeable on pronotum. Sterna pale. Legs pale except for dark line at sclerotized and rounded apices of femora. Claws with five or more denticles. Fingerlike coxal gills double and slightly longer than median length of trochanters. Pronotum (Fig. 2) with medioposterior hump most apparent in lateral view. Mesonotum with very poorly developed posterior tubercle in form of two very small nodules. Metanotum (Fig. 2) with well-developed and erect tubercle, and reddish brown in anterior half as in abdominal terga 1–2 or 1–3. *Abdomen*: Terga (Fig. 3) generally pale, with reddish brown shading mostly in anterior half of segments 1–3, sometimes most evident in 1–2; other segments entirely pale or at most suffused with thin light brown shading anterolaterally and sometimes anteromedially. Dorsal median tubercles (Fig. 2) on segments 1–9, well developed and erect (but progressively less erect) on 1–5, well developed and moderately angled posteriorly on 6–7, well developed and strongly angled posteriorly on 8, and poorly developed and nearly flat on 9. Sterna pale but in some appearing suffused with granular pale brown, sometimes more intense anterolaterally in ganglionic areas. Gills pale. Cerci pale.

Male adult (in alcohol).—Body length: 5.0–5.5 mm; wing: 5.0 mm; cerci: unknown. *Head*: Face medium brown. Flagellum of antennae pale; scape and pedicel light brown. Compound eyes black, except turbinate portion pale. *Thorax*: Nota me-

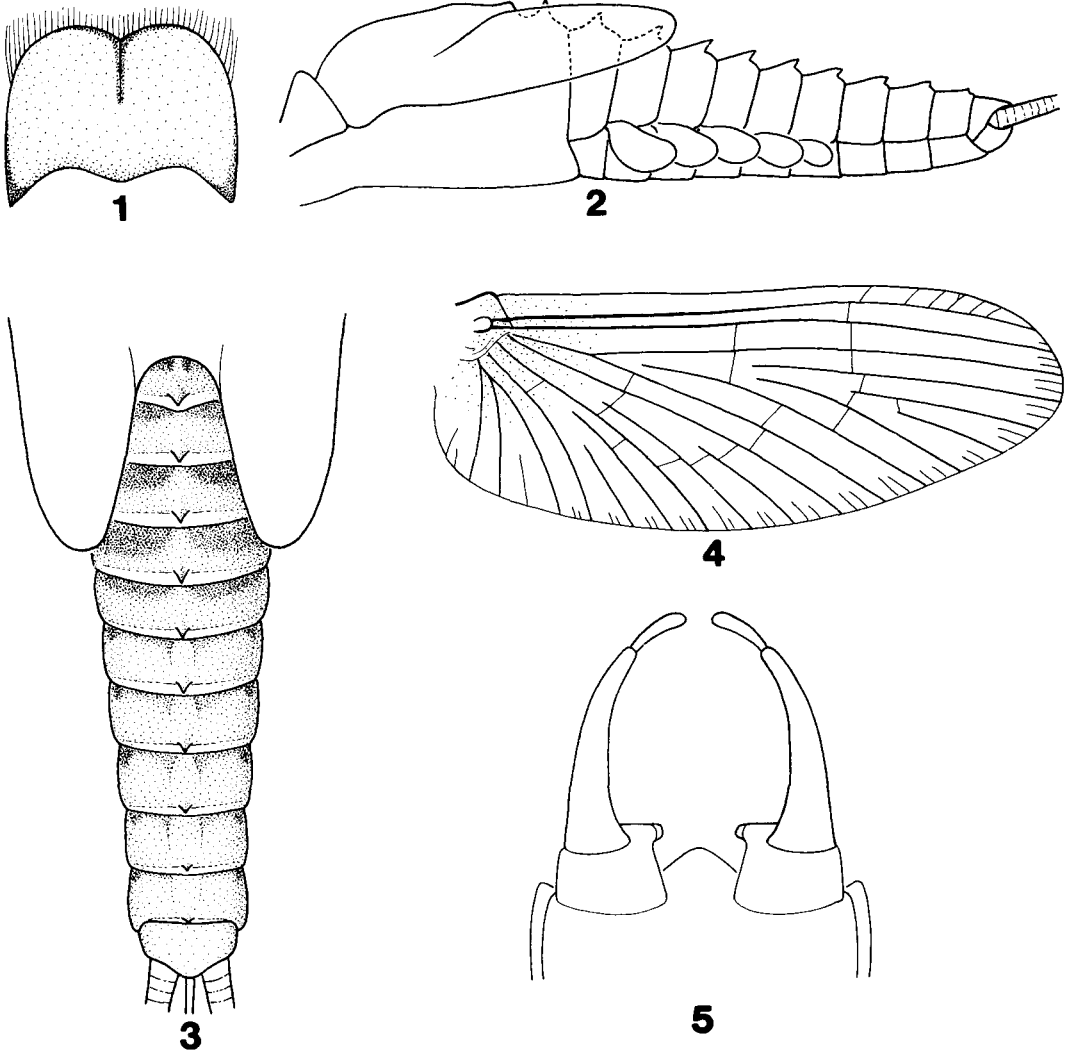
dium brown with few pale markings, prominent only as posterolateral and medial markings on mesonotum. Sterna medium brown, paler medially. Legs pale. Wings (Fig. 4) tinged with golden brown basally especially extreme basal posterior region of costal area; otherwise membrane and veins hyaline; venation as in Fig. 4. *Abdomen*: Terga generally pale except dark brown shading in at least anterior halves of terga 1 and 2, and light brown coloration of terga 7–10; remnants of dorsal abdominal tubercles of larva not evident. Sterna pale, slightly suffused with tan. Minute gill remnants present or not present on abdominal segments 1 and 2, absent from other segments. Genitalia as in Fig. 5, with well-developed inner lobes on basal segments of forceps and with well-developed basal convexity on subgenital plate between bases of forceps.

Female adult (in alcohol).—Body length: 4.0 mm; wing 5.0 mm; cerci 9.0 mm. Body similar to that of male except shorter and more robust (wing length similar). Color pattern similar to male except thorax lighter shade of brown; basal tinge of wings less intense; and abdominal terga sometimes with brown segmental overlap areas, and terga 3–7 sometimes with some faint dark shading anterolaterally. Cerci pale, slightly tan at base.

Holotype.—Mature male larva, Texas, Kendall Co., Guadalupe River 1 mi S of Sisterdale at Ranch Road 1376, V-7-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara, deposited in the Purdue Entomological Research Collection (PERC), West Lafayette, Indiana.

Paratypes.—One male larva and one female larva, same data and deposition as holotype.

Additional material examined.—Two larvae, Texas, Blanco Co., Blanco River 6 mi W Blanco, V-6-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara, deposited in PERC; two larvae, Texas, Blanco Co., Blanco River 6 mi W Blanco, V-7-1977, W. P. McCafferty, A. V. Provonsha, D. Mori-



Figs. 1-5. *Baetodes bibranchius*: 1. Labrum, larva. 2. Lateral profile of body, larva. 3. Dorsal abdominal color pattern, larva. 4. Wing, male adult. 5. Ventral genitalia, male adult.

hara, in PERC; one immature larva, Texas, Guadalupe Co., Geronimo Creek from mi 20 N Seguin, VI-29-1988, J. R. Davis, deposited in the J. R. Davis private collection, Austin, TX; two male and six female adults, Texas, Kerr Co., Guadalupe River at Kerrville, at light, V-5-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara, in PERC.

Etymology.—The specific epithet is an arbitrary combination of letters incorporating “bi” for double, and “branchius,” Greek for

gill. It thus alludes to the distinctive double coxal gills of the larvae.

Discussion.—This new species is evidently common in many streams in the central hill country of Texas, as would be indicated by the collecting records given above. Larvae have been found only in moderate current and often in association with somewhat silty substrates (specimens are often partially covered with silt held by the pilose thoracic nota). More precise eco-

logical data are not available at this time. Adults, which have been associated with the larvae on the basis of the matching unique color patterns, were taken only at lights on signs adjacent to the Guadalupe River at Kerrville. Subimagos, however, were not taken.

The larvae of *B. bibranchius* are distinctive and can be compared with other known larval *Baetodes* on the basis of the published summary of Cohen and Allen (1978). A larval diagnosis is presented below via a key to the species known to occur in the United States. Unfortunately, relationships within the genus are unknown, and little can be surmised with confidence regarding the relationships of *B. bibranchius*.

Cohen and Allen (1978) indicated that details of size and mouthpart structure were of little use in the taxonomy of this group due to variability they had seen. They instead emphasized characters of tubercle placement, coloration, and, in some cases, characters of the coxal gills; they did not deal with adult characterization. On the basis of tubercle development and placement in *B. bibranchius*, the species may be related to the Central American species *B. noventus*, however, it differs in other important respects from *B. noventus*. On the basis of color patterns, *B. bibranchius* is unique but could perhaps be envisioned as having the same dorsal abdominal tendencies as the Mexican and Honduran species *B. pallidus* Cohen and Allen, but developed to a much lesser degree. It is questionable, however, if color patterns per se in mayflies are indicative of relationship. Finally, according to Cohen and Allen (1978), there are only two other species with double coxal gills. The length of such gills may be similar in *B. bibranchius* and the Mexican species *B. longus* Mayo, but the length of the double gills of the Mexican and Panamanian species *B. adustus* was not given.

Adults of *A. bibranchius* can easily be distinguished from the two other North American species of *Baetodes* that are presently

known as adults (*B. edmundsi* Koss and *B. arizonensis* Koss). Key differences (see Koss 1972) are that the sterna of *A. bibranchius* are entirely pale, and no remnants of dorsal larval tubercles are present. The sterna of *B. arizonensis* are dark reddish brown in the anterior half or third, and faint postero-medial remnants of tubercles are present on some abdominal segments in *B. edmundsi*, among other differences. The most diagnostic feature of adults of *B. bibranchius* is perhaps the presence of the heavily pigmented abdominal terga 1-3, which contrast the remainder of the abdomen.

Adult generic characteristics of *Baetodes* are poorly known, the delineating characters given by Koss (1972) and Edmunds et al. (1976) being tenuous. While the number of known adults prohibits any meaningful evaluation of relationships based on this life stage, Flowers (1987) was able to correlate adults of four additional species of Neotropical species of *Baetodes*. On that basis, he was able to establish which characters might be consistent and which might be variable among species of the genus. All known adults have some degree of medial cuticular development on the basal segments of the male forceps, but the degree and kind of development appear to differ among species. In this respect the genitalia of *B. bibranchius* (Fig. 5) are much like that of the Panamanian species *B. velmae* Cohen and Allen. Flowers (1987) also pointed out that the wing shape character given by Edmunds et al. (1976) regarding the hind margin is not consistent in the genus. In any case, it has been particularly difficult for workers to interpret. The shape of the wing of *B. bibranchius* (Fig. 4) is typical of most known adults, however, having a hind margin more-or-less subparallel to the costa. We agree with Flowers (1987) that the character of the distance between marginal intercalaries (interspaces) being subequal to their length is not generic. We have found both the interspace size mentioned above and relatively smaller interspaces in a single wing

of specimens of *B. bibranchius*. Therefore, the character is even of doubtful specific importance.

***Baetodes alleni* McCafferty and Provonsha,**

NEW SPECIES

Figs. 6–7

Mature male larva (in alcohol).—Relatively large with somewhat atypical elongate body 6.0 mm in length excluding cerci; cerci: 6.2 mm. *Head*: Vertex generally light brown, with slightly darker, faint, longitudinal stripes between compound eyes. Labrum narrow and emarginate but without sclerotized cleft line. *Thorax*: Notae with scattered and sparse, short hairs; color medium brown with pale markings prominent on mesonotum. Sterna pale but with pair of dark, sublateral lines on mesosternum. Legs generally pale except thin light brown shading along dorsal third of anterior facing surface of femora, and dark brown apices of femora. Claws with three prominent apical denticles and three or four less prominent basal denticles. Coxal gills absent. Pronotum (Fig. 6) with medioposterior elevation. Mesonotum without tubercle, but with pale median and pair of submedian longitudinal stripes. Metanotum (Fig. 6) with small tubercle. *Abdomen*: Terga (Fig. 7) light brown with darker anterior marginal areas progressively less developed in posterior segments; moderately developed tubercles on terga 1–7 (Fig. 6); tubercle on terga 8 barely discernible. Sterna pale with thin, poorly developed darker areas at segmentation margins. Gills pale. Cerci pale.

Holotype.—Mature male larva, Texas, Kendall Co., Guadalupe River 1 mi S of Sisterdale at Ranch Road 1376, V-7-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara, deposited in PERC.

Etymology.—This species is named after the entomologist Richard K. Allen, in honor of his extensive contributions to our taxonomic knowledge of the mayflies of Mesoamerica and the southwestern United States.

Discussion.—We are aware of the tentative nature of any species whose description is based on limited materials. However, we decided to describe *A. alleni* at this time because it was distinct from any variations known of any other described species, and was easily distinguished from congeners, particularly those from the southwestern United States. Its diagnosis is given in the partial key below.

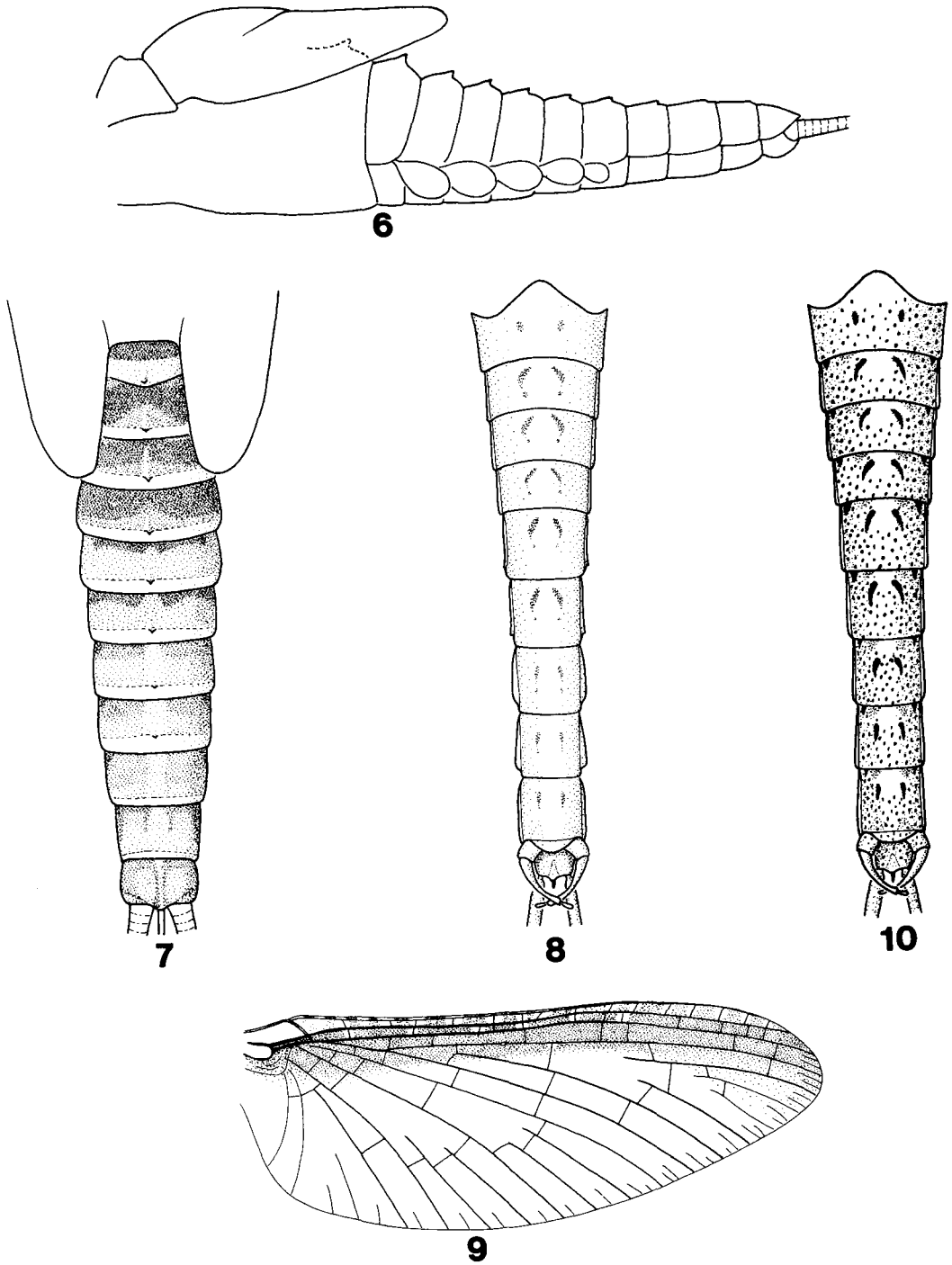
In terms of size, Cohen and Allen (1987) noted only four Mexican and Central American species known to be as large as *B. alleni* larvae: *B. adustus* Cohen and Allen; *B. pictus* Cohen and Allen, *B. tritus* Cohen and Allen, and *B. velmae*. In terms of coxal gills, seven species were noted to have at least some individuals devoid of such gills, as in *B. alleni*: *B. arizonensis*, *B. fuscipes* Cohen and Allen, *B. inermis* Cohen and Allen, *B. pallidus*, *B. pictus* Cohen and Allen, *B. tritus* Cohen and Allen, and *B. velmae*. In terms of dorsal tubercle distribution and development, *B. alleni* appears to be most like *B. adustus* Cohen and Allen, but *B. inermis*, *B. longus*, and *B. pallidus* are somewhat similar. The color pattern of *B. alleni* is difficult to relate to any others. Little, if anything, can be deduced about relationships from the above larval comparisons. This underscores the necessity of revisionary studies of this genus as was suggested by McCafferty and Waltz (1990).

KEY TO THE UNITED STATES

SPECIES OF *BAETODES*

The following larval key is an extension of the key of Cohen and Allen (1978: 255), which includes Latin American species.

1. Coxal gills double; abdomen (Fig. 3) with terga 1–3 reddish brown in anterior halves, not markedly patterned otherwise; metanotal tubercle well developed (Fig. 2) *bibranchius*
- Coxal gills absent, or present and single; dorsal abdomen not patterned and colored as in Fig. 3; metanotal tubercle present or absent 2
2. Abdominal tubercles present on terga 1–7; abdominal terga with dark bands anteriorly, progressively more developed medially and often



Figs. 6-10. 6-7. *Baetodes alleni* larva: 6. Lateral body profile. 7. Dorsal abdomen. 8-9. *Callibaetis montanus punctilusus* adult: 8. Ventral abdomen, male. 9. Forewing, female. 10. *Callibaetis montanus montanus* male adult abdomen.

forming broad somewhat triangular patterns in middle and posterior segments [fig. 15: Cohen and Allen (1978)]; coxal gills present and single

- Abdominal tubercles present on terga 1-8 (Fig. 6) or 1-9 [e.g. fig. 12: Koss (1972)], although posterior tubercles difficult to discern in some; abdominal terga not as above [if all terga have anterior portions darkened, then darkening not more developed medially (Fig. 7) and coxal gills absent]; single coxal gills present or absent *inermis*
- 3. Dorsal tubercles present on pro-, meso-, and metanotum as well as abdominal terga 1-9, well developed on thorax and abdominal terga 1-7 or 1-8 [fig. 12: Koss (1972)]; single coxal gills present *edmundsi*
- Dorsal tubercles present or absent on thorax [if present then not well developed and not present on all thoracic segments (e.g. pronotal hump more common)]; tubercles present on abdominal terga 1-8 and difficult to discern on 8 (Fig. 6), or present on terga 1-9 and difficult to discern on 7-9; coxal gills absent 4
- 4. Abdominal terga (Fig. 7) light brown with darker anterior areas up to one third or one half of tergum; sterna pale with darker lines evident; abdominal tubercles on 1-8 and difficult to discern on 8 *alleni*
- Abdominal terga dark reddish brown with some pale markings; abdominal sterna pale with reddish brown markings; abdominal tubercles on 1-9 and difficult to discern on 7-9 ... *arizonensis*

Callibaetis montanus punctilusus

McCafferty and Provonsha,

NEW SUBSPECIES

Figs. 8-9

This new subspecies differs from typical *Callibaetis montanus* [= *Callibaetis montanus montanus* Eaton, new status] as follows:

Male adult (in alcohol).—*Head*: Entire surface of pedicel and medial surface of scape of antennae light to medium brown, contrasting pale face and flagellum. *Thorax*: Surface lacking dark and conspicuous punctate spots, with only hint of pale punctation in some, or at most sparse and relatively few punctate spots and most apparent basad of leg origins. All legs pale; all femora lacking series of punctate spots (if any spots present then indistinct). Scales of blunt claws numbering over 40 in basal area. Wings not

stained with pigment, except extreme base of forewings; longitudinal veins pale except extreme base of subcosta of forewings. Forewings with costal and subcostal area hyaline (rarely in distal half of wing only); marginal intercalaries single posterior to radial triad. *Abdomen*: Terga lacking any prominent markings, punctate spots when present sparse and inconspicuous (some individuals with pale macula in extreme lateral area). Sterna (Fig. 8) without punctate spots. Median lobe of basal segment of forceps not darkened. Cerci entirely pale.

Female adult (in alcohol).—Body punctation fine (with spots small), somewhat sparse, and distinctly bright pink (specimens in 70% ETOH for 15 years). *Thorax*: Mesoscutellum usually with pair of diffuse pink patches. Forewings (Fig. 9) with vitta extending to R₂; some crossveins in small clear areas in basal half of subcostal area bright pink in some individuals, and some of these individuals with additional pink crossvein in midregion of R₁ area. Hindwings not stained. *Abdomen*: Punctate spots sparse ventrally. Cerci entirely pale.

Holotype.—Male adult, Texas, Victoria Co., Guadalupe R. at Victoria at light, V-8-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara, deposited in PERC.

Paratypes.—Three male and two female adults, same data and deposition as holotype; one female adult same deposition as holotype, deposited at the United States National Museum, Washington, D.C.

Additional material examined.—One female adult and two male subimagos, same data and deposition as holotype.

Etymology.—The specific epithet is derived from “punctum,” Latin for spot, and “lusus,” Latin for the quality of being different. It thus is an allusion to the very different size, color, and distribution of punctate spots on the body of the adults.

Discussion.—In existing keys [e.g. Traver (1935)], this new subspecies should be identifiable as *C. montanus*, but perhaps with some difficulty because of the atypical variation it shows. As described above, the males

do not exhibit the prominent maculation and punctation of *C. montanus montanus*, and the females also differ in degree with respect to color, vitta, and punctation. It remains to be seen if claw scaling differences and possible differences in marginal intercalaries are significant.

Traver (1935) gave a rather tenuous report of *C. montanus* in Texas, indicating that she had seen many males from Weslaco with typical venation but, "with wholly pale legs, the femora not at all stippled . . ." These were likely to have been *C. montanus punctilulus*. Henry (1986) reported *C. montanus* from the Concho River, with no other specific data. This material may also prove to be the new subspecies.

Callibaetis montanus has had a somewhat confused taxonomic history; it is primarily a Central American and Mexican species and many erroneous records have been based on misidentifications of *C. fluctuans* (Walsh) (G. F. Edmunds, Jr., personal communication). Therefore, in the United States, *C. montanus* appears to be restricted to extreme southwestern areas. The subspecies *C. montanus montanus* occurs in mountainous areas extending from Nicaragua to southern Arizona (Eaton 1885, 1892, Traver 1935, McCafferty and Lugo-Ortiz 1992). The subspecies *C. montanus punctilulus* is not known from mountainous regions and thus far is known only from Texas. It appears to represent a variant that has been isolated long enough to have undergone genetic change, especially with respect to coloration and punctation. If the two variants are eventually found not to be geographically isolated, the new subspecies may in fact represent a new sister species to *C. montanus*.

Camelobaetidius mexicanus
(Traver and Edmunds)
Figs. 11–12

This species has remained unknown in the adult stage since it was originally de-

scribed as larvae only. We are able to provide an adult description based on male adults we reared from larvae.

Male adults (in alcohol).—Body length excluding cerci: 4.8–5.2 mm; forewings: 4.8 mm; hindwings 0.7 mm; cerci 8.8–9.0 mm. Body yellowish tan, darkest at head and thorax and slightly so at abdominal terga 7–10. *Head*: Turbinate portion of compound eyes yellow, semi-elliptical, slightly separated, and slightly divergent. *Thorax*: Pronotum with pair of brown lateral patches. Legs pale. Wing veins hyaline. Hindwing as in Fig. 11. *Abdomen*: Terga and sterna similarly pale and without maculations or color pattern. Genitalia as in Fig. 12, with forceps distinctly curved. Cerci entirely pale.

Material examined.—Four male adults and four male subimagos, all reared (with larval exuviae retained), Texas, Blanco Co., Blanco R. 6 mi W Blanco, V-6-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara, deposited in PERC.

Discussion.—Traver and Edmunds (1968) originally described this species from larvae from Tamaulipas Province in Mexico. In the same paper they described adults taken from the same locality as *Dactylobaetis* sp. A, and stated that they were possibly the adults of *C. mexicanus*. Material we have reared from Texas are in partial agreement with that adult description. The male genitalia of *C. mexicanus* appear different than that described for *D.* sp. A; however, the intraspecific variation is not known with regard to this character in this genus. Perhaps more importantly, descriptions agree with regard to the pale abdomen being unmarked, and this according to Traver and Edmunds (1968) is unique for those species of the genus having pale mid abdominal segments. Except for the unicolorous abdomen, however, *C. mexicanus* appears more like *C. chiapas* (Traver and Edmunds), described from adults only from Chiapas Province, Mexico. The forceps are definitely more similar. The forewing size

of *C. mexicanus* appears intermediate to what Traver and Edmunds (1968) reported for *C. chiapas* and sp A.

From the above, it is possible that *C. mexicanus* is a junior synonym of *C. chiapas* (page priority) if, indeed, the slight differences in adult coloration and wing size prove to be intraspecifically variable. We have chosen to maintain *C. mexicanus* for the time being, until additional evidence about variability in the genus *Camelobaetidius* can be garnered.

***Procloeon texanum* McCafferty and
Provonsha, NEW SPECIES**

Figs. 13–14

Male adults (in alcohol).—Body length: 4.0 mm; wing: 3.4 mm; cerci unknown. *Head*: Face light brown. Antennae entirely pale. Turbinate portion of compound eyes entirely pale. *Thorax*: Nota light golden brown. Pleura and sterna entirely pale. Legs pale. Forewings without staining; with single marginal intercalaries beginning after R_2 . *Abdomen*: All segments pale and colorless (segments 1–6 semi-hyaline, 7–10 opaque) except segments 2–7 with thin, purple, longitudinal dashes laterally in anterior half of segments (Fig. 13). Genitalia as in Fig. 14.

Holotype.—Male adult, Texas, Brazos Co., Navasota R. at Hwy. 6, VIII-10-1969, C. D. Bjork, deposited in PERC.

Additional material examined.—Female subimago, same data and deposition as holotype.

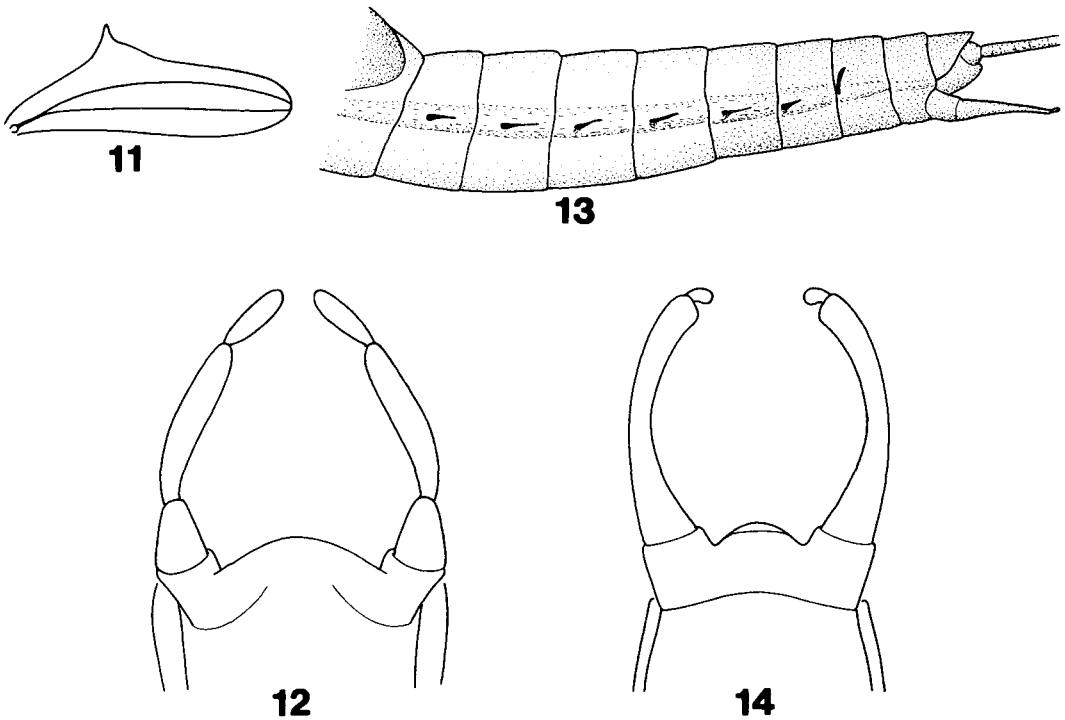
Discussion.—According to the labels accompanying the above specimens, they had been reared from larvae in the laboratory. It is most unfortunate, however, that the larval skins have evidently been lost.

Unlike several of the genera of Baetidae in North America, the taxonomy of this particular group of species, as defined by McCafferty and Waltz (1990) is based almost entirely on adult morphology rather than the larval stage, as, for example, in *Baetodes* and *Camelobaetidius* (treated

above). For comparative descriptions of the adults in North America, see Traver's (1935) treatment of what she considered *Cloeon* at that time (essentially those baetids without hindwings and with single marginal intercalaries in the forewings). On the basis of adult morphology, this new species is distinct from any thus far known. The golden thoracic nota and the almost entirely pale abdomen with purple lateral dashes on segments 2–7 appear to be unique characteristics.

Of those *Procloeon* in North America that lack hindwings, *P. minor* (McDunnough) and *P. rubropictum* (McDunnough) are the only ones with about the same body and wing size. *Procloeon inanum* (McDunnough) and *P. minor* are known to have some lateral purplish blotches on the abdomen, but they are nothing like the thin dashes seen in *P. texanum*, and these former species have considerable coloration not shown in *P. texanum*. Like *P. texanum*, *P. minor* also has a more-or-less hyaline abdomen, but unlike *P. texanum*, *P. minor* possesses both dorsal and ventral markings on the abdomen and its head and thorax are deep blackish brown. From all of this, it is impossible at this time to determine any specific relationships of *P. texanum*.

The genus *Procloeon* generally has not been known outside the northwest and northeast regions of North America (see McCafferty and Waltz 1990). Of *Procloeon* and *Centroptilum*, a genus with which the former may be confused at this time, McCafferty and Davis (1992) have found from Texas only one species in the larval stage that lacks hindwingpads. Those larvae, which superficially appear to be related to *Centroptilum alamance* (Traver), remain undescribed because larvae of these genera are poorly known and because of the previously mentioned historical emphasis on adults. For example, there remains the possibility that these undescribed larvae (*Centroptilum* sp. 1 of McCafferty and Davis)



Figs. 11-14. 11-12. *Camelobaetidius mexicanus* male adult: 11. Hindwing. 12. Ventral genitalia. 13-14. *Procloeon texanum* male adult: 13. Lateral abdomen. 14. Ventral genitalia.

will prove to be the larvae of *P. texanum* or some other previously named species of *Procloeon* or *Centroptilum*.

ACKNOWLEDGMENTS

We thank Dennis Morihara, Pukalani, Hawaii, for his participation in our field work in Texas. We also thank Jack Davis, Austin, Texas, for providing material for examination. This paper has been published as Purdue University Experiment Station Journal No. 13390.

LITERATURE CITED

- Cohen, S. D. and R. K. Allen. 1978. Generic revisions of mayfly nymphs III. *Baetodes* in North and Central America (Baetidae). *Journal of the Kansas Entomological Society* 51: 253-269.
- Eaton, A. E. 1883-88. A revisional monograph of recent Ephemeroidea or mayflies. *Transactions of the Linnean Society of London* 2nd Ser. Zool. 3: 1-352.
- . 1892. *Biologia Centrali-Americana: Insecta, Neuroptera, Ephemeroidea*. Vol. 38. Bernard Quaritch, Ltd., London.
- Edmunds, G. F., Jr., S. L. Jensen, and L. Berner. 1976. The mayflies of North and Central America. University of Minnesota Press, Minneapolis.
- Flowers, R. W. 1987. The adult stage of three Central American *Baetodes* (Ephemeroptera: Baetidae) with notes on the genus. *Aquatic Insects* 9: 1-10.
- Henry, B. C., Jr. 1986. Mayflies (Ephemeroptera) of the Concho River, Texas. *Southwestern Naturalist* 31: 15-21.
- Koss, R. W. 1972. *Baetodes*: New species and new records for North America (Ephemeroptera: Baetidae). *Entomological News* 83: 93-102.
- Lowen, R. G. and J. F. Flannagan. 1991. Four Manitoba species of *Centroptilum* Eaton (Ephemeroptera: Baetidae) with remarks on the genus, pp. 189-206. In Alba-Tercedor, J. and A. Sanchez-Ortega, eds., *Overview and Strategies of Ephemeroptera and Plecoptera*. Sandhill Crane Press, Gainesville, Florida.
- Mayo, V. K. 1972. New species of the genus *Baetodes* (Ephemeroptera: Baetidae). *Pan-Pacific Entomologist* 48: 226-241.
- McCafferty, W. P. and J. R. Davis. 1992. New and additional records of small minnow mayflies

- (Ephemeroptera: Baetidae) from Texas. Entomological News. (In press.)
- McCafferty, W. P. and C. R. Lugo-Ortiz. 1992. Registros nuevos y notas sobre los Ephemeroptera de Nicaragua. *Revista Nicaraguense de Entomología* 19: 1-7.
- McCafferty, W. P. and A. V. Provonsha. 1975. Reinstatement and biosystematics of *Heterocloeon* McDunnough (Ephemeroptera: Baetidae). *Journal of the Georgia Entomological Society* 10: 123-127.
- McCafferty, W. P. and R. D. Waltz. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. *Transactions of the American Entomological Society* 116: 769-799.
- Morihara, D. K. and W. P. McCafferty. 1979a. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). *Transactions of the American Entomological Society* 105: 139-221.
- . 1979b. The evolution of *Heterocloeon* with the first larval description of *Heterocloeon frivolutus* comb. n. (Ephemeroptera: Baetidae). *Aquatic Insects* 1: 225-231.
- Müller-Liebenau, I. 1974. *Rheobaetis*: A new genus from Georgia (Ephemeroptera: Baetidae). *Annals of the Entomological Society of America* 67: 555-567.
- Traver, J. R. 1935. Part II. Systematic, pp. 239-739. In Needham, J. G., J. R. Traver, and Y. C. Hsu, eds., *The Biology of Mayflies with a Systematic Account of North American species*. Comstock Publ., Ithaca, New York.
- Traver, J. R. and G. F. Edmunds, Jr. 1968. A revision of the Baetidae with spatulate-clawed nymphs (Ephemeroptera). *Pacific Insects* 10: 629-677.
- Waltz, R. D. and W. P. McCafferty. 1987. Revision of the genus *Cloeodes* Traver (Ephemeroptera: Baetidae). *Annals of the Entomological Society of America* 80: 191-207.