

Contribution to the Taxonomy of *Callibaetis* (Ephemeroptera: Baetidae) in Southwestern North America and Middle America

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Callibaetis distinctus, sp. n., is described from female adults from Sonora, Mexico. The larvae of *C. montanus* Eaton and *C. pictus* (Eaton) are described, and the range of *C. pictus* extended to include Costa Rica. *Callibaetis completa* Banks is shown to be a junior synonym of *C. floridanus* Banks, and new records of this species are provided from Cuba and St. Croix.

Keywords: Ephemeroptera, Baetidae, *Callibaetis*, new species, new synonym, new records, new stage descriptions.

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INTRODUCTION

The Panamerican mayfly genus *Callibaetis* (Baetidae) was erected by Eaton (1881) for *Baetis pictus* Eaton. Since then, numerous species have been proposed in *Callibaetis*, mostly by Banks (1900, 1914, 1930). Recently, McCafferty and Waltz (1990) provided a list of the known species of *Callibaetis* in North and Middle America, along with 11 new synonyms and broad distributional data. They recognized 14 nominal species and indicated that additional synonyms may be present because many previously described species had proved to be simple geographic variants. Lugo-Ortiz and McCafferty (1994) showed *C. montanus punctilusus* McCafferty and Provonsha to be a distinct species, thus raising the number of species of *Callibaetis* in North and Middle America to 15. *Callibaetis* is one of two Panamerican genera whose biogeographic affinities remain unclear (McCafferty et al., 1992).

The following species of *Callibaetis* are recognized from southwestern North America (Mexico south to the Tropic of Cancer and the bordering states of the USA) and Middle America (Mexico south of the Tropic of Cancer, Central America, and the Antilles) [see also Lugo-Ortiz and McCafferty (1995) and McCafferty and Lugo-Ortiz (1995)]: *C. americanus* Banks, *C. californicus* Banks, *C. distinctus* Lugo-Ortiz and McCafferty, sp. n., *C. floridanus* Banks [= *C. completa* Banks, syn. n.], *C. fluctuans* (Walsh), *C. montanus* Eaton, *C. paulinus* (Navás), *C. pictus*

(Eaton), *C. pretiosus* Banks, *C. punctilusus* McCafferty and Provonsha, and *C. undatus* (Pictet).

Although *Callibaetis* can be readily distinguished from other baetids in both the larval and adult stage (see, e. g., Edmunds et al., 1976), no reliable keys have been published to identify species. Traver's (1935) species key for male adults can only be used with extreme caution and consideration of the synonyms indicated by McCafferty and Waltz (1990).

Here we describe a new species of *Callibaetis* based on female adults from northern Mexico. We also provide the first published comprehensive descriptions of the larvae of *C. montanus* and *C. pictus*. New distributional records for species in Middle America are also given and a new specific synonym is indicated. The material examined for this study is housed in the Purdue Entomological Research Collection (PERC), West Lafayette, Indiana, the United States National Museum (USNM), Washington, D. C., and the collection of Florida A & M University (FAMU), Tallahassee.

Callibaetis distinctus Lugo-Ortiz and McCafferty, sp. n. (Fig. 1)

Female adult. Body length: 6.0-7.0 mm; forewing length: 6.0-6.5 mm; hindwing length: 1.1-1.3 mm; caudal filaments: unknown. Head: Coloration medium brown. Antennae yellow-brown; scapes and basal portion of pedicels light brown or creamy; distal portion of pedicels light brown to brown.

Thorax brown to yellow-brown, with no distinct pattern. Legs yellow-brown, with no punctation. Forewings with distinctly patterned coloration (Fig. 1); costa serrated, serration more conspicuous on basal portion; subcosta with very weak,

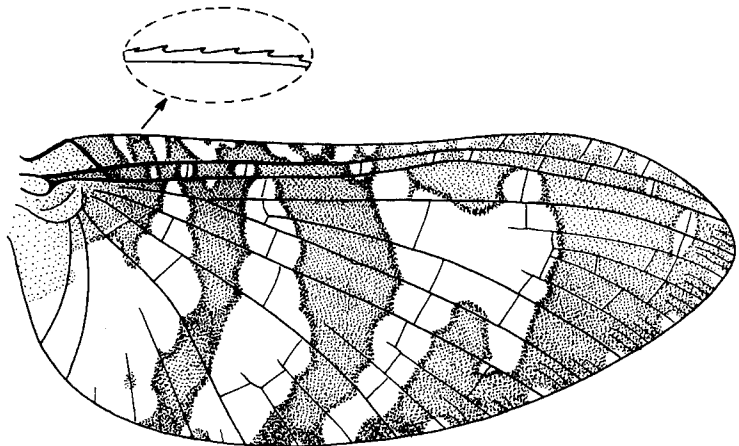


Fig. 1. *Callibaetis distinctus*, n. sp., female adult, forewing.

pink basal pigmentation; four to five slanting crossveins in stigmatic area; double marginal intercalaries present. Hindwings somewhat elongate, with basal and distal portions yellow-brown.

Abdomen yellow-brown, with no distinct pattern or punctuation, but with black dashes usually visible along pleura.

Material examined. Holotype: Female adult, Mexico, Sonora Sta., Esperanza, VIII-15-1955, O. and R. Flint, deposited at PERC. Paratypes: Two female adults deposited at PERC and USNM.

Etymology. The specific epithet is a Latin word meaning different. It is in reference to the unusual forewing color pattern of the species.

Remarks. *Callibaetis distinctus* shows a striking forewing color pattern (Fig. 1) that will readily separate it from adults of other species of *Callibaetis*. The species is most similar to *C. ferrugineus* (Walsh), and preliminarily appears to be related to that species.

Callibaetis floridanus Banks

Callibaetis floridanus Banks, 1900: 249.

Callibaetis completa Banks, 1930: 187. Syn. n.

Material examined. Costa Rica, Puntarenas Prov., Peninsula de Osa, Río Rincón at end of Playa Blanca Rd, III-3-1969, W. P. McCafferty, larvae, deposited at PERC; Cuba, Matanzas Prov., Ciénaga de Zapala, Buenaventura, X-17-1964, deposited at FAMU; Virgin Islands, St. Croix, Harden gut pond, II-6-1984, P. A. Godwin, larvae, deposited at PERC.

Remarks. Banks (1900) described *C. floridanus* from a series of female adults from southern Florida. Later, Berner (1940) described the larva and male adult. Banks (1930) described *C. completa* from a single female adult from Cuba, and recently Kluge (1991) described the larva and male adult from Cuba. Comparison of the descriptions and figures provided by Berner (1940) and Kluge (1991) indicated that *C. completa* and *C. floridanus* are not morphologically distinct. Moreover, examination of extensive material of *C. floridanus* from the study area, as well as from southern United States, did not indicate any variability in the mouthparts, tergal armature, leg setation, and paraproct spination that might have been expected if there were two species represented.

Callibaetis floridanus ranges from the southeastern United States west through Texas (Berner and Pescador, 1988; McCafferty and Waltz, 1990; McCafferty and Davis, 1992), and south to Costa Rica and the Antilles (Kluge, 1991), including Cuba and St. Croix. Although we have not seen the material, Traver's (1938) report of *C. completa* from Puerto Rico may be assumed to be referable to *C. floridanus*.

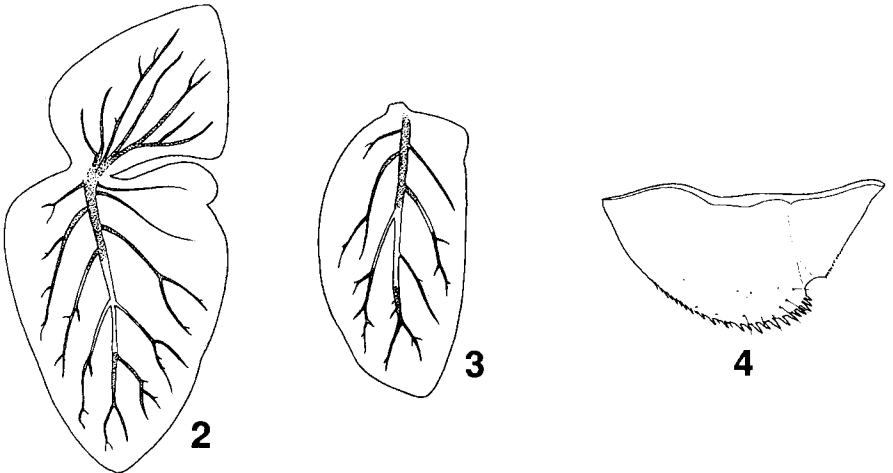
The species has one of the widest ranges of habitat tolerance of any mayfly. It develops in temporary ponds, roadside ditches, small pools in abandoned rock pits, artificial fish ponds, and estuaries (Trost and Berner, 1963; Berner and Pescador, 1988). This extreme tolerance might explain the extensive distribution of the species.

Callibaetis montanus Eaton (Figs. 2-4)

Callibaetis montanus Eaton, 1885: 196.

Callibaetis montanus montanus, McCafferty and Provonsha, 1993: 65.

Larva. Body length: 9.0-12.0 mm; caudal filaments: 6.0-9.0. Head: Coloration yellow-brown, with no distinct pattern. Antennae almost three times as long as head capsule; scapes and pedicels pale brown to medium brown, with scattered fine, simple setae over surface. Labrum (as in Fig. 5) with anterior margin parallel and deep anteromedial emargination; scattered fine, simple setae dorsally and with submarginal anterior row consisting of 15-20 long, simple setae. Right mandible (as in Fig. 6) with two separate sets of incisors; distal set with three to four denticles, proximal set with two denticles and median row of very small, simple setae; prosthema very slender, spinelike. Left mandible (as in Fig. 7) similar to right mandible, except prosthema long, with two to three weakly defined denticles distally and tuft of simple setae near base of mola. Maxillae (as in Fig. 8) robust; distal denticles short and stout; one to three simple setae basally; four to five long, simple setae distally; five to six long, simple setae near base of palps; palps 2-segmented, segments subequal in length; segment 1 more robust than segment 2, with many long, simple setae over surface; segment 2 with long, simple setae over surface, not as abundant as in segment 1. Labium (as in Fig. 9) with paraglossae longer than glossae; paraglossae curved, with many long, simple setae on surface; glossae with three to four distal rows of long, simple setae; labial palps 3-segmented; palp segment 1 as long as segments 2 and 3 combined, with long, branched setae ventrally; segment 2 elongate, with 9-12 robust, simple setae proximally on median margin and 7-10 long, simple setae



Figs. 2-4. *Callibaetis montanus*, larva. 2. Gill 5. 3. Gill 7. 4. Paraproct.

ventrally; segment 3 short, weakly demarcated and indicated by constriction on median margin, and with many long, simple setae distally on median margin.

Thorax light to medium brown. Sterna light to medium brown, covered with fine, simple setae. Legs yellow-brown to medium brown; femora with few short, stout, simple setae dorsally and ventrally, dorsal margin with two to three long, simple setae distally; tibiae and tarsi dorsally bare except for scattered fine, simple setae, ventrally with short, stout simple and serrate setae; tarsal claws long, with two long rows of long, sharp denticles increasing in length distally.

Abdomen yellow-brown to medium brown, variable in pattern. Tergal surfaces with scattered fine, short, simple setae and densely covered with scales; posterior margin with long, sharp spines. Sterna yellow-brown to medium brown, covered with fine, short, simple setae and scales; posterior margin with long, sharp spines. Gills 3-6 (Fig. 2) with two subequal lamellae narrowly connected to each other; gill 7 (Fig. 3) single, sometimes with minute inner flap. Paraprocts (Fig. 4) with 8-12 large spines apically and 15-20 small spines basally. Caudal filaments yellow-brown to medium brown, with numerous fine, simple setae at joints.

Material examined. USA, Arizona, Apache Co., St. John's, open cellar hole, IX-9-1967, R. Koss and D. Argyle, larvae, deposited at PERC; Gila Co., US Hwy 60, Salt R, VI-18-1963, R. D. Anderson, larva, deposited at PERC; Mohave Co., Wikieup, Big Sandy R, VIII-24-1969, R. and D. Koss, larvae, deposited at PERC; Navajo Co., Tool Hollow Lake, Show Low, VI-19-1963, larvae, deposited at PERC; Pima Co., Organ Pipe Cactus National Monument, Quitobaquito Springs, VIII-25-1969, R. and D. Koss, larvae, deposited at PERC.

Remarks. Eaton (1885) described *C. montanus* from female adults only. Later, Spieth (1941) designated a female adult from the type series as the lectotype. The above description of the larval stage is based on material from localities where female adults have been collected either exclusively or with other species whose larvae and adults have been associated by rearing. The species is known from Arizona, New Mexico, and Texas south to Nicaragua (Eaton, 1885, 1892; Banks, 1900; Traver, 1935; McCafferty and Davis, 1992; McCafferty and Lugo-Ortiz, 1992). Reports of this species north of this area in both taxonomic and ecological publications (e. g., Edmunds, 1954; Newell, 1970; Rahel and Kolar, 1990) are in error and are instead apparently referable to *C. fluctuans*.

In the larval stage, *C. montanus* is relatively similar to *C. pictus* (see below), and the two could be confused. However, *C. montanus* larvae differ from those of *C. pictus* in that they possess narrowly connected lamellae on gills 3-6 (Fig. 2), a single lamella of gill 7 (Fig. 3), and distinct spination on the paraprocts (Fig. 4).

Callibaetis pictus (Eaton)(Figs. 5-12)

Baetis pictus Eaton, 1871: 122.

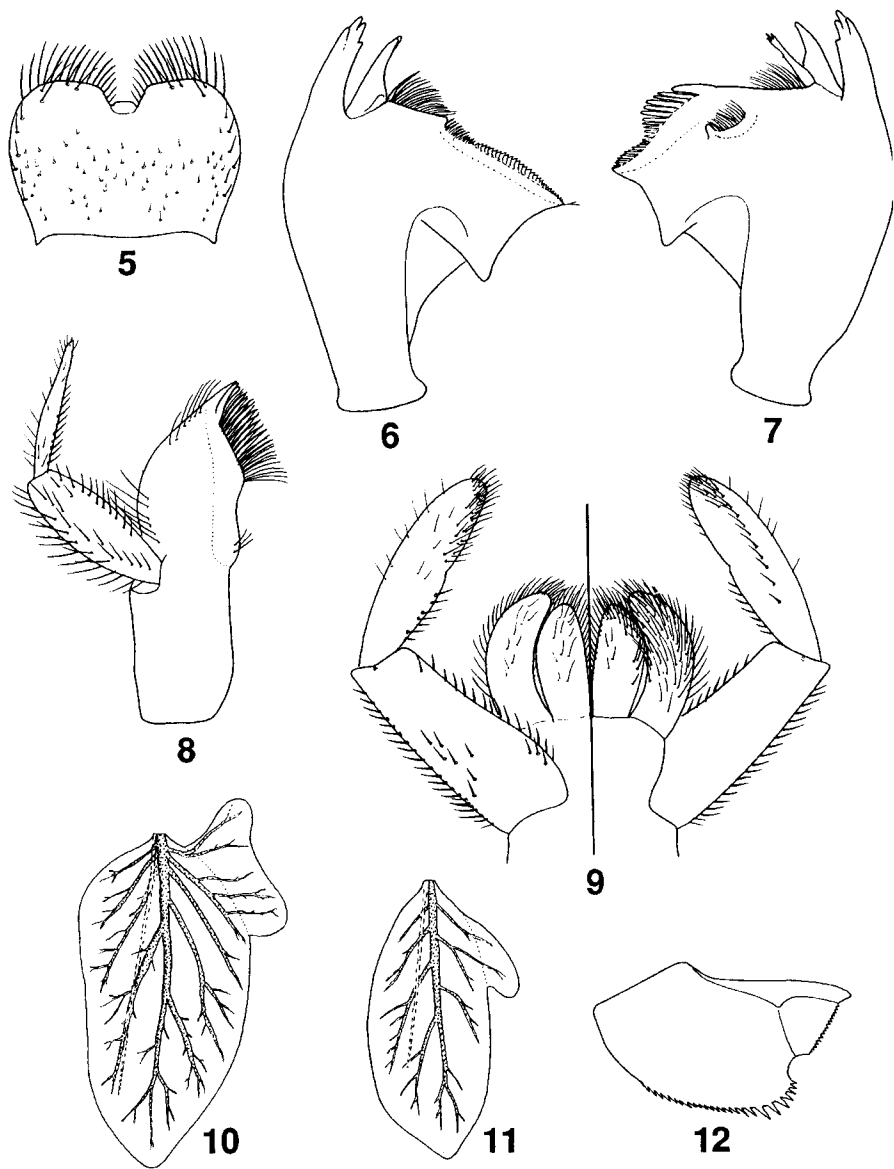
Callibaetis pictus (Eaton), Eaton, 1881: 196.

Callibaetis signatus Banks, 1918: 11.

Callibaetis pacificus Seeman, 1927: 49.

Callibaetis doddsi Traver, 1935: 664.

Larva. Body length: 6.0-13.0 mm; caudal filaments: 6.0-8.0 mm. Head: Coloration yellow-brown to brown, with no distinct pattern. Antennae almost three



Figs. 5-12. *Callibaetis pictus*, larva. 5. Labrum (dorsal). 6. Right mandible. 7. Left mandible. 8. Right maxilla. 9. Labium (left-ventral; right-dorsal). 10. Gill 5. 11. Gill 7. 12. Paraproct.

times as long as head capsule; scapes and pedicels dark brown dorsally and brownish to whitish ventrally, with scattered fine, simple setae over surface. Labrum (Fig. 5) with anterior margin parallel and deep anteromedial emargination; scattered fine, simple setae dorsally and with submarginal anterior row consisting of 18-20 long, simple setae. Right mandible (Fig. 6) with two separate sets of incisors; distal set with three to four denticles, proximal set with two denticles and median row of very small, simple setae (setae almost inconspicuous); prosthema very slender, spinelike. Left mandible (Fig. 7) similar to right mandible, except prosthema long, with two to three weakly defined denticles distally and tuft of simple setae near base of mola. Maxillae (Fig. 8) robust; distal denticles short and stout; one to three simple setae basally; four to five long, simple setae distally on lateral margin; five to six long, simple setae near base of palps; palps 2-segmented, segments subequal in length; segment 1 more robust than segment 2, with many long, simple setae over surface; segment 2 with long, simple setae over surface, not as abundant as in segment 1. Labium (Fig. 9) with paraglossae longer than glossae; paraglossae curved, with many long, simple setae on surface; glossae with three to four distal rows of long, simple setae; labial palps 3-segmented; palp segment 1 as long as segments 2 and 3 combined, with long, branched setae ventrally; segment 2 elongate, with 10-12 robust, simple setae proximally on median margin and 8-10 long, simple setae ventrally; segment 3 short, weakly demarcated and indicated by constriction on medial margin, and with many long, simple setae distally on median margin.

Thorax dark brown to yellow-brown. Sterna dark brown to pale brown, covered with very fine, short, simple setae. Legs dark brown to yellow-brown, often with punctation visible; femora with many short, stout, simple setae dorsally and ventrally, dorsal margin with two to three long, simple setae distally; tibiae and tarsi dorsally bare except for scattered fine, simple setae, ventrally with long, fine and short, stout, simple setae; tarsal claws long, with two rows of long, sharp denticles increasing in length distally.

Abdomen medium brown to yellow-brown, variable in pattern. Tergal surfaces with scattered fine, short, simple setae and densely covered with scales; posterior margin with long, sharp spines. Sterna medium brown to yellow-brown, covered with fine, short, simple setae and scales; posterior margin with long, sharp spines. Gills 3-6 (Fig. 10) with two lamellae broadly connected to each other, ventral lamella smaller than dorsal lamella; gill 7 (Fig. 11) with small inner flap broadly connected to dorsal lamella. Paraprocts (Fig. 12) with 25-30 spines, increasing in length and width towards distal end. Caudal filaments yellow-brown to pale, with numerous simple setae at joints.

Material examined. Costa Rica, San José Prov., San Isidro, VII-1-1967, A. Ortiz (female adult), deposited at PERC; USA, Arizona, Apache Co., Paradise Cr, at Hawley Lake Rd, Rt 473, IX-9-1967, R. Koss and D. Argyle, larvae, deposited at PERC; Coconino Co., Lindbergh Spring, nr rest area E of US 89A, 5 mi S of Flagstaff, 6820 ft, V-5-1981, W. U and A. R. Brigham and M. W. Sanderson, larvae, deposited at PERC; Navajo Co., Tool Hollow Lake, Show Low, VI-19-1963, larvae, deposited at PERC; Yavapai Co., Sycamore Canyon, Clarkdale, X-6-1976, M. W. Sanderson, larvae, deposited at PERC; Yavapai/Gila Cos., Boulder Cr, at rd to Verde Hot Springs, W of Pine, V-6-1969, R. W. Koss and A. V. Provonsha (larvae, exuviae, reared male and female adults).

Remarks. *Callibaetis pictus* is widespread in the western United States and Mexico (McCafferty and Waltz, 1990; McCafferty and Davis, 1992; McCafferty et al., 1993; Lugo-Ortiz and McCafferty, 1994). The present record from Costa Rica considerably extends its known range southward.

Eaton (1871) described *C. pictus* from male and female adults. Banks (1900) considered *C. pictus* to be a junior synonym of *C. undatus* (Pictet). Traver (1935) reinstated *C. pictus* as a valid species. Spieth (1941) designated the only male from the type series as the lectotype. McCafferty and Waltz (1990) synonymized *C. doddsi*, *C. pacificus*, and *C. signatus* with *C. pictus*. Seeman's (1927) description of *C. pacificus* was of the larva and male adult; however, that of the larva was brief and did not include any diagnostic characters. Our comprehensive description of the larva is based on reared larvae.

The larvae of *C. pictus* show considerable variability in general coloration and body length. However, we found the broadly-connected lamellae of gills 3-6 (Fig. 10) and the spination of the paraprocts (Fig. 12) to be reliable characters to differentiate this species from other known larvae of *Callibaetis*, especially the relatively similar *C. montanus*.

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REFERENCES

- BANKS, N. (1900): New genera and species of Nearctic neuropteroid insects. -Trans. Amer. Entomol. Soc. 26: 239-259.
- (1914): New neuropteroid insects, native and exotic. -Proc. Acad. Nat. Sci. Phila. 66: 608-618.
- (1930): New neuropteroid species. -Psyche 37: 187.
- BERNER, L. (1940): Baetinae mayflies from Florida. -Florida Entomol. 23: 33-45, 49-62.
- BERNER, L. and M.L. PESCADOR (1988): The mayflies of Florida. Revised edition. -Univ. Press Florida, Gainesville.
- EATON, A. E. (1871): A monograph of the Ephemeridae. -Trans. Entomol. Soc. Lond. 19: 1-164.
- (1881): An announcement of new genera of the Ephemeridae. -Entomol. Mon. Mag. 17: 191-197.
- [1885 (1883-88)]: A revisional monograph of recent Ephemeridae or mayflies. -Trans. Linn. Soc. Lond. Zool. Ser. 3: 1-352.
- (1892): Biologia Centrali-Americana, Insecta, Neuroptera, Ephemeridae. -Bernard Quaritch, Ltd., Lond. 38: 1-16.
- EDMUNDS, G.F., Jr. (1954): The mayflies of Utah. -Utah Acad. Sci., Arts Letters 31: 64-66.
- EDMUNDS, G.F., Jr., S.L. JENSEN and L. BERNER (1976): Mayflies of North and Central America. -Univ. Minnesota Press, Minneapolis.
- KLUGE, N.Y. (1991): Cuban mayflies of the family Baetidae (Ephemeroptera). I. Genera *Callibaetis*, *Cloeodes* and *Paracloeodes*. -Zool. Zh. 12: 128-135 (in Russian).
- LUGO-ORTIZ, C.R. and W.P. MCCAFFERTY (1994a): New records of Ephemeroptera from Mexico. -Entomol. News 105: 17-26.

- (1994b): The mayflies (Ephemeroptera) of Texas and their biogeographic affinities. pp. 151-169 – *In*: L. CORKUM AND J. CIBOROWSKI (eds.), Current directions in Ephemeroptera Research. Scholar's Choice Publ., Toronto.
- McCAFFERTY, W.P. and J.R. DAVIS (1992): New and additional records of small minnow mayflies (Ephemeroptera: Baetidae) from Texas. – *Entomol. News* 103: 199-209.
- McCAFFERTY, W.P. and C.R. LUGO-ORTIZ (1992): Registros nuevos y notas sobre los Ephemeroptera de Nicaragua. – *Rev. Nica. Entomol.* 19: 1-7.
- (1995): Ephemeroptera. – *In*: J. L. BOSQUETS, A. N. GARCÍA-ALDRETE, and F. GONZÁLEZ (eds.), Biodiversity, taxonomy, and biogeography of Mexican arthropods: towards a synthesis. In press.
- McCAFFERTY, W.P. and R.D. WALTZ (1990): Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. – *Trans. Amer. Entomol. Soc.* 116: 769-799.
- McCAFFERTY, W. P., R. S. DURFEE and B. C. KONDRATIEFF (1993): Colorado mayflies (Ephemeroptera): An annotated inventory. – *Southwestern Naturalist* 38: 252-274.
- McCAFFERTY, W.P., R.W. FLOWERS and R.D. WALTZ (1992): The biogeography of Mesoamerican mayflies. pp. 173-193. – *In*: Biogeography of Mesoamerica: proceedings of a symposium, S.P. DARWIN and A.L. WELDEN (eds.). Tulane Univ. Stud. Zool. Bot., Suppl. Publ. 1.
- NEWELL, R.L. (1970): Checklist of some aquatic insects from Montana. – *Proc. Montana Acad. Sci.* 30: 45-56.
- RAHEL, F. J. and C. S. KOLAR (1990): Trade-offs in the response of mayflies to low oxygen and fish predation. – *Oecologia* 84: 39-44.
- SEEMAN, T.M. (1927): Dragonflies, mayflies, and stoneflies of southern California. – *J. Entomol. Zool.* 19-22: 1-69.
- SPIETH, H.T. (1941). The North American ephemeropteran types of Rev. A. E. Eaton. – *Ann. Entomol. Soc. Amer.* 34: 87-98.
- TRAVER, J.R. (1935): Part II, Systematic. pp. 239-739. – *In*: J.G. NEEDHAM, J.R. TRAVER, and Y.C. HSU (eds.), The biology of mayflies with a systematic account of North American species. Comstock, Ithaca, N. Y.
- (1938). Mayflies of Puerto Rico. – *J. Agri. Univ. Puerto Rico* 22: 5-42.
- TROST, L.M.W. and L. BERNER (1963): The biology of *Callibaetis floridanus* Banks (Ephemeroptera: Baetidae). – *Florida Entomol.* 46: 285-299.