Hydrobiologia **359:** 63–68, 1997.
M. A. Simovich, C. Sassaman & D. Belk (eds), Studies on Large Branchiopod Biology and Conservation.

New records of large branchiopods (Branchiopoda: Anostraca, Notostraca, and Spinicaudata) in Mexico

Alejandro M. Maeda-Martínez[1], Hortencia Obregón-Barboza[1] & Humberto García-Velazco[2]
[1] *División de Biología Marina, Centro de Investigaciones Biológicas del Noroeste, S.C., Apdo. Postal 128, La Paz, B.C.S. 23000, Mexico*
[2] *Centro de Bachillerato Tecnológico Agropecuario 146, Padre Kino, San Quintín, B.C., Mexico*

Key words: geographical distribution, fairy shrimp, tadpole shrimp, clam shrimp, *Lepidurus, Cyclestheria,* coloration

Abstract

This paper reports new distribution records of large branchiopods for Mexico following a three year survey of the Baja California peninsula. The occurance of the anostracans *Thamnocephalus mexicanus* (Linder, 1941) and *T. platyurus* (Packard, 1877), the notostracan *Lepidurus lemmoni* (Holmes, 1894), and the spinicaudatans *Eulimnadia cylindrova* (Belk, 1989) and *E. texana* (Packard, 1871), all represent the first records for the peninsula. An undescribed species of the anostracan genus *Streptocephalus* is recorded from the state of Baja California (Norte). The occurrence of the notostracan genus *Triops* and four other anostracan species on the peninsula is also confirmed. The conchostracan *Cyclestheria hislopi* (Baird, 1859) is recorded from the state of Quintana Roo. The collections of *Lepidurus* and *Cyclestheria* are the first records for México. These records increase the number of species of large branchiopods reported from México to 36: 20 Anostraca, 3 Notostraca, 11 Spinicaudata, and 2 Laevicaudata.

Introduction

In 1991, Maeda-Martínez listed 25 described species of large branchiopods for Mexico: 12 Anostraca, 1 Notostraca, 10 Spinicaudata, and 2 Laevicaudata. Since then, several new species and new distribution records for Mexico have been published. Maeda-Martínez et al. (1992a) described *Branchinecta belki* based on specimens from southern Coahuila. Maeda-Martínez et al. (1992b) reported *Streptocephalus dorothae* Mackin in Mexico from the state of Baja California Sur. Campoy-Favela & Quijada-Mascareñas (1993) added *Branchinecta packardi* Pearse to the anostracan fauna of Sonora. Fugate (1993) included Valle de las Palmas, Baja California (Norte) as a location for *Branchinecta sandiegonensis* Fugate. Maeda-Martínez et al. (1993) described *Branchinecta mexicana* from the state of Puebla. Brown et al. (1993) reported the first records for Mexico of *Streptocephalus woottoni* Eng, Belk & Eriksen and *Branchinecta mackini* Dexter, as well as a new locality for *B. sandiegonensis*, all of them from Baja California (Norte). Maeda-Martínez et al. (1995a) described *Streptocephalus guzmani* from southern Coahuila, and *S. potosinensis* from the state of San Luis Potosí. Finally, Dodson & Silva-Briano (1996) reported *Thamnocephalus platyurus* Packard and *Triops longicaudatus* (LeConte) from the state of Aguascalientes.

To continue with the inventory of large branchiopod species of México, we made a number of surveys of the Baja California Peninsula. Additionally, we studied a conchostracan sample from the state of Quintana Roo. In this paper we report our findings on species distribution, including the first record of two genera in México and several new state records for some species.

Material and methods

Identifications were based on the keys and publications of Belk (1975, 1989), Linder (1952), Maeda-Martínez et al. (1995a), Martin (1989), Moore (1966),

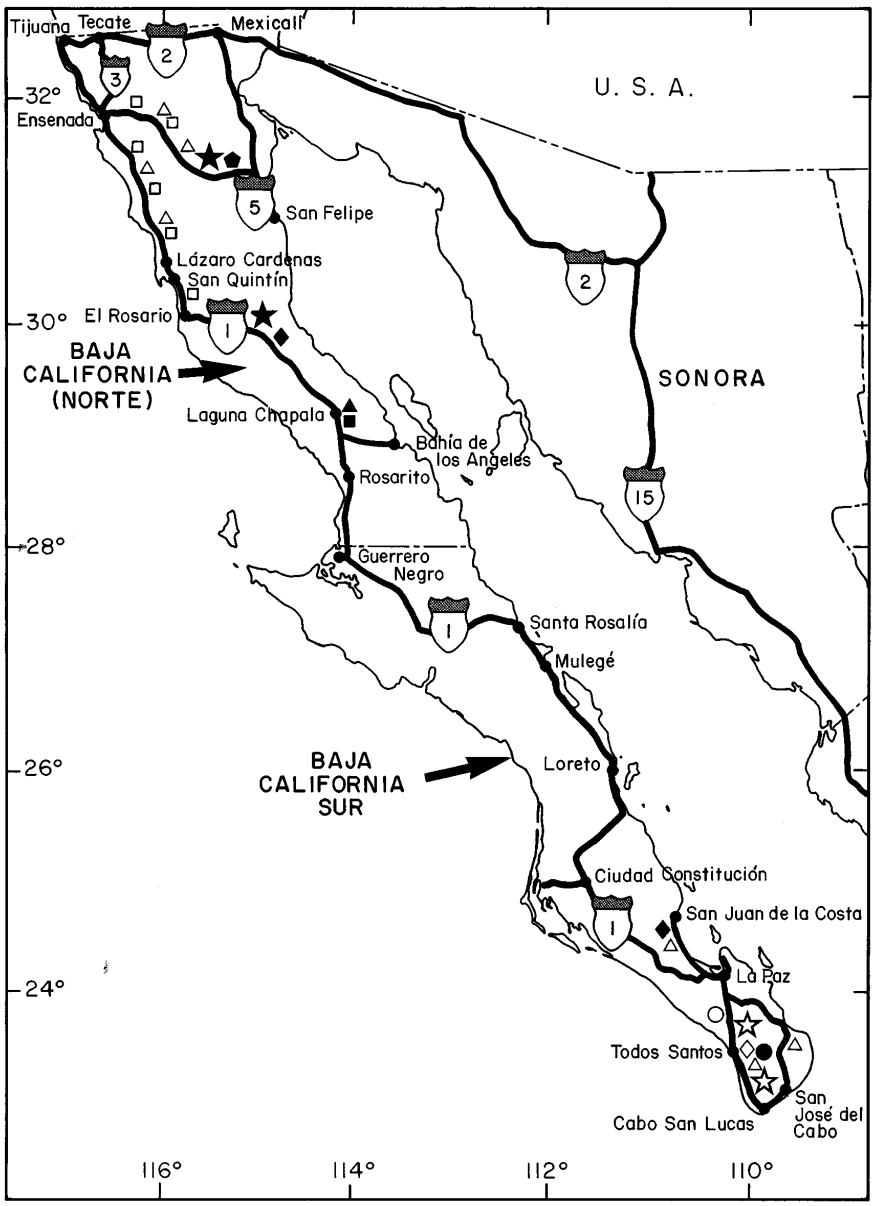

Figure 1. Approximate locations of the new distribution records of *Branchinecta lindahli* (open squares), *B. mackini* (closed squares), *Streptocephalus dorothae* (open circles), *S. texanus* (closed circles), *S.* sp. (closed pentagon), *Thamnocephalus mexicanus* (open stars), *T. platyurus* (closed stars), *Lepidurus lemmoni* (closed triangle), *Triops* sp. (open triangles), *Eulimnadia cylindrova* (open rhombus), and *E. texana* (closed rhombus).

and Moore & Young (1964). The material and the specific collection data are deposited at Centro de Investigaciones Biológicas del Noroeste, S.C. (CIB), La Paz, B.C.S., Mexico. Approximate locations of new distribution records are shown in Figures 1 and 2.

Results and discussion

Our data along with information from the literature, brings the number of large branchiopods recorded from México to 36.

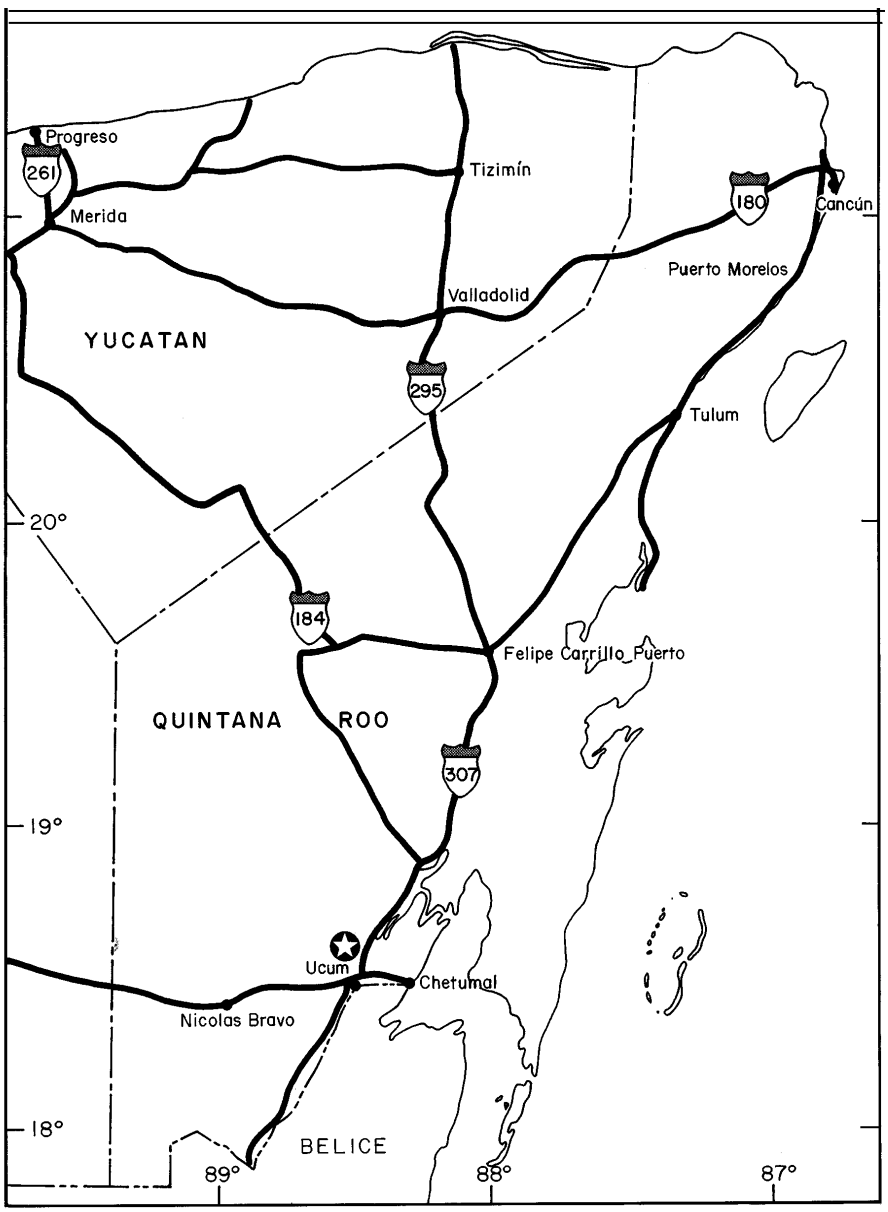

Figure 2. Approximate location of the new distribution record of *Cyclestheria hislopi* (open star) in Quintana Roo, Mexico.

Anostraca

Branchinecta lindahli Packard, 1883. *Branchinecta lindahli* has a wide distribution, throughout western North America including Canada and the USA (Belk, 1975; Belk & Brtek, 1995). In Mexico it was previously recorded from five places in the states of Baja California Sur and Baja California (Norte), including Isla Guadalupe (Belk & Lindberg, 1979; Belk, 1983; Maeda-Martínez, 1991). We found it to be common in Baja California (Norte) occurring during January, February, March, and September 1995 in 46 ephemeral ponds, most of them roadside pools on Federal Highways No. 1 (Ensenada-El Rosario) and No. 3 (Ensenada-San Felipe) (CIB 001, 002, 007, 015–017, 020–025, 027, 029, 030, 032–044, 046–059, 062, 064, 068, 079, 138).

Branchinecta mackini Dexter, 1956. *Branchinecta mackini* is also known throughout western North America from Canada and the USA (Belk, 1975; Belk & Brtek, 1995). In Mexico it was previously recorded from only one locality on the basis of four specimens collected in Laguna Chapala, Baja California (Norte) (Brown et al., 1993). We confirm the occurrence of this species in Laguna Chapala. It was abundant in January 1995 (CIB 060: 432 males & 254 females). We also report a new location, a roadside pool 45 km south of Laguna Chapala on Federal Highway No. 1 (Laguna Chapala-Rosarito) (CIB 063: 14 males & 24 females).

Streptocephalus dorothae Mackin, 1942. *Streptocephalus dorothae* is known from the USA (Belk, 1975; Belk & Brtek, 1995; Maeda-Martínez et al., 1995a). In Mexico it was previously recorded from only one locality in Baja California Sur (Maeda-Martínez et al., 1992b). We found *S. dorothae* to be a common species in ephemeral ponds along the first 50 km south of La Paz, Baja California Sur, on Federal Highway No. 1 (La Paz-Todos Santos). We collected this species from 10 locations during September, October, and December 1994, and February, September, and October 1995 (CIB 086–089, 097, 099, 103, 106, 108, 126, 127, 129, 130).

Streptocephalus texanus Packard, 1871. *Streptocephalus texanus* is known from the USA, and from the Caribbean Islands of Barbuda and Desirade (Belk, 1975; Belk & Brtek, 1995). In Mexico it was previously recorded from eight states (Maeda-Martínez, 1991). Belk (1983) reported this species from the extreme north of Baja California Sur, and here we report its presence in the extreme south of the state. Populations were found in four ephemeral ponds along the Federal Highway No. 1 (Todos Santos-Cabo San Lucas) during January and October 1995 (CIB 121–123, 131, 135). All the females showed a particular coloration pattern consisting of two red stripes on the midventral side of the brood pouch. Because of this feature, these populations appear unique within the American Streptocephalidae. Belk (1991) pointed out the absence of such a feature in the other American species, however, several Old World species have a similarly coloured brood pouch, e.g. *S. dichotomus* Baird, 1860, and *S. torvicornis* (Waga, 1842) (Belk, 1991; A.M. Maeda-Martínez, pers. obs.). The populations of *S. texanus* in Baja California Sur deserve further comparison with populations from other regions to determine the value of this characteristic (red brood pouch) in the systematics of the *mackini* subgroup, *torvicornis* species group (see Maeda-Martínez et al., 1995a,b).

Streptocephalus sp. In August 1996, we collected specimens of an undescribed species from three roadside ephemeral ponds on Federal Highway No. 3 (Ensenada-San Felipe), in the state of Baja California (Norte) (CIB 082–084). This form is morphologically very similar to *Streptocephalus mackini* Moore, 1966 (*mackini* subgroup, *torvicornis* group) (see Maeda-Martínez et al., 1995a,b). Study of these specimens is in progress and a description will be presented elsewhere.

Thamnocephalus mexicanus Linder, 1941. *Thamnocephalus mexicanus* is known from the USA in Arizona and Texas (Belk, 1975; Belk & Brtek, 1995). In Mexico it was previously recorded from five states (Maeda-Martínez, 1991). Here we report the first records of the genus for the Baja California peninsula and the first records for the state of Baja California Sur. In October, November, and December 1994 and 1995, we collected *T. mexicanus* in four localities (CIB 092, 104, 132, 136). This species occurred with *Streptocephalus dorothae* in roadside pools on Federal Highway No. 1 (La Paz-Todos Santos), and with *S. texanus* in roadside pools on Federal Highway No. 1 (Todos Santos-Cabo San Lucas).

Thamnocephalus platyurus Packard, 1877. *Thamnocephalus platyurus* has a wide distribution, occurring in several states in the USA (Belk, 1975; Belk & Brtek, 1995). In Mexico it was reviously recorded from six states (Maeda-Martínez, 1991). Here we report on the occurance of this species in Baja California (Norte). In August and September 1994, and in March 1995 we collected *T. platyurus* from 10 locations (CIB 003, 005, 009, 011, 013, 018, 066, 069, 071, 073). This species occurred with *Triops* in roadside pools on Federal Highways No. 1 (Lázaro Cárdenas to the junction to Bahía de Los Angeles) and No. 3 (Ensenada to the junction to San Felipe), and with *Branchinecta lindahli* in a roadside pool on Federal Highway No. 1 (Lázaro Cárdenas to the junction to Bahía de Los Angeles).

Notostraca

Lepidurus lemmoni Holmes, 1894. *Lepidurus lemmoni* has been reported from the USA, in California, Montana, Nevada, Oregon, Washington, and Wyoming

(Lynch, 1966). No previous formal record of *Lepidurus* in Mexico exists (Hartland-Rowe, 1982; Maeda-Martínez, 1991; Villalobos-Hiriart et al., 1993). Here we record *L. lemmoni* from Baja California (Norte). In January 1995, we collected one adult female and four juveniles of *L. lemmoni* (CIB 061) in Laguna Chapala (Federal Highway No. 1, San Quintín-Guerrero Negro, 29° 24′ 02″ N, 114° 22′ 21″ W) along with *Branchinecta mackini*. The *L. lemmoni* specimens from the peninsula were compared with two lots of conspecific specimens from Kern, Co. California (from the collection of M. Simovich).

Triops sp. These notostracans have a wide distribution in Mexico and were previously recorded from 11 states (Maeda-Martínez, 1991). In August and September 1994, January, February, March, and September 1995, we collected *Triops* sp. from 26 locations in Baja California (Norte) along the Federal Highways No. 1 and No. 3 (CIB 004, 006, 010, 012, 014, 019, 026, 028, 045, 065, 067, 070, 072, 074, 075, 078, 080). Also, in November and December 1994, and January, February, October, and December 1995, we collected *Triops* sp. from 17 new locations in Baja California Sur along the Federal Highway No. 1 (La Paz-Cabo San Lucas) (CIB 093, 101, 105, 109, 114, 117, 118, 124). In most places, *Triops* co-occurred with other large branchiopod species. In Baja California (Norte), *Triops* sp. occurred with *Branchinecta lindahli* and *Thamnocephalus platyurus*, and in Baja California Sur, with *Streptocephalus dorothae, S. texanus*, and *Thamnocephalus mexicanus*.

Linder (1952) proposed that all *Triops* species described from the North American continent were synonyms of *Triops longicaudatus* (LeConte, 1846). However, Sassaman et al. (1997) demonstrated by electrophoretic and morphological analyses that this species is a mixture of at least two reproductively isolated species. They report having reared unisexual *T. longicaudatus* from a site in northern Baja California (Norte), and female *T. newberryi* (Packard, 1871) from southern Baja California (Norte) (Sassaman et al., 1997). In light of this, all *Triops* specimens, including those reported by Maeda-Martínez in 1991, are being evaluated relative to the morphological characters presented in Sassaman et al. (1997).

Spinicaudata

Eulimnadia cylindrova Belk, 1989. *Eulimnadia cylindrova* is known from the USA (Belk, 1989). In Mexico it was previously recorded from four states (Belk, 1989; Maeda-Martínez, 1991). No previous record of the genus *Eulimnadia* from the Baja California peninsula exists. We report *E. cylindrova* from Baja California Sur. In November and December 1994 and January and September 1995, we collected *E. cylindrova* from three localities near La Paz (CIB 090, 094, 098, 102, 119) along with *Streptocephalus dorothae, Thamnocephalus mexicanus*, and *Triops* sp.

Eulimnadia texana (Packard, 1871). *Eulimnadia texana* is widely distributed throughout the southwestern USA (Belk, 1989; Sassaman, 1989). In Mexico it was previously recorded from six states (Belk, 1989; Maeda-Martínez, 1991). We add two new states for the species. During September 1995, *E. texana* was collected in Baja California (Norte) from two roadside pools along Federal Highway No. 1 (Lázaro Cárdenas to the junction to Bahía de Los Angeles) (CIB 077, 081). In one of these locations, *E. texana* occurred with *Branchinecta lindahli* and *Triops* sp. In January 1995, *E. texana* was collected from a single roadside pool on the La Paz-San Juán de la Costa Highway, Baja California Sur (CIB 120).

Cyclestheria hislopi (Baird, 1859). *Cyclestheria hislopi* is a circumtropical species occurring on all continents except Antarctica (Roessler, 1995). In North America, this species is known from Cuba and Texas (Olesen et al., 1996). This is the first record of the monotypic genus *Cyclestheria* for México. We studied a sample containing four specimens, two immature and two adult females, one female carrying young larvae and the other carrying eggs. The sample was obtained from Puente Ucum, Quintana Roo (18° 30′ 27″ N, 88° 30′ 48″ W) in June 1995 (CIB 140).

Conclusions

The number of described species of large branchiopods in Mexico is 36: 20 Anostraca (*Artemia* (1 ?), *Branchinecta* (6), *Streptocephalus* (11), and *Thamnocephalus* (2)), 3 Notostraca (*Lepidurus* (1), *Triops* (2)), 11 Spinicaudata (*Caenestheriella* (1), *Cyzicus* (1), *Eocyzicus* (2), *Leptestheria* (1), *Eulimnadia* (5), *Cyclestheria* (1)), and 2 Laevicaudata (*Lynceus* (1)

and *Paralimnetis* (1)). The American taxa not represented in Mexico are the Chirocephalidae *Artemiopsis* and *Eubranchipus*, the Linderiellidae *Dexteria* and *Linderiella*, the Polyartemiidae *Polyartemiella*, and the Thamnocephalidae *Branchinella*, *Dendrocephalus*, and *Phallocryptus*.

Acknowledgements

We thank Mr Abel Soto Rueda, Mr Pedro Guzmán A., Mr Juán Guzmán A., Mr Jesús Arévalo J., Mr Mario Muñoz H., and Mr Alfredo Navarro G. for their assistance during field collections in Baja California. We also thank Mr Eduardo Suárez, Miss Rebeca Gasca, and Mr Marcelo Silva Briano for bringing the Quintana Roo sample to our attention. Our appreciation to Dr Marie A. Simovich for the donation of 2 samples of *Lepidurus* from California. This study forms part of the project H068 supported by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) and Centro de Investigaciones Biológicas del Noroeste, S.C. Thanks to Dr Ellis Glazier for editing the English language text.

References

Belk, D., 1975. Key to the Anostraca (fairy shrimps) of North America. S. West. Nat. 20: 91–103.

Belk, D., 1983. New fairy shrimp distribution records among collections at the California Academy of Sciences. S. West. Nat. 28: 380–381.

Belk, D., 1989. Identification of species in the conchostracan genus *Eulimnadia* by egg shell morphology. J. crust. Biol. 9: 115–125.

Belk, D., 1991. Anostracan mating behavior: A case of scramble-competition polygyny. In R.T. Bauer & J.W. Martin (eds), Crustacean Sexual Biology, Columbia University Press, New York: 111–125.

Belk, D. & J. Brtek, 1995. Checklist of the Anostraca. Hydrobiologia 298: 315–353.

Belk, D. & D.R. Lindberg, 1979. First freshwater animal reported from Isla de Guadalupe represents a southern range extension for *Branchinecta lindahli* (Crustacea: Anostraca). S. West. Nat. 24: 390–391.

Brown, J.W., H.A. Wier & D. Belk, 1993. New records of fairy shrimp (Crustacea: Anostraca) from Baja California, Mexico. S. West. Nat. 38: 389–390.

Campoy-Favela, J. & A. Quijada-Mascareñas, 1993. Additional distribution records of fairy shrimps (Anostraca) from Sonora, Mexico. S. West. Nat. 38: 85–86.

Dodson, S.I. & M. Silva-Briano, 1996. Crustacean zooplankton species richness and associations in reservoirs and ponds of Aguascalientes State, Mexico. Hydrobiologia 325: 163–172.

Fugate, M., 1993. *Branchinecta sandiegonensis*, a new species of fairy shrimp (Crustacea: Anostraca) from western North America. Proc. Biol. Soc. Wash. 106: 296–304.

Hartland-Rowe, R., 1982. Anostraca, Notostraca and Conchostraca. In S.H. Hurlbert & A. Villalobos-Figueroa (eds), Aquatic Biota of Mexico, Central America and the West Indies. San Diego State University, San Diego, California, USA: 175–176.

Linder, F., 1952. Contributions to the morphology and taxonomy of the Branchiopoda Notostraca, with special reference to the North American species. Proc. U.S. Nat. Mus. 102: 1–69.

Lynch, J.E., 1966. *Lepidurus lemmoni* Holmes: A redescription with notes on variation and distribution. Trans. am. Micros. Soc. 85: 181–192.

Maeda-Martínez, A.M., 1991. Distribution of species of Anostraca, Notostraca, Spinicaudata, and Laevicaudata in Mexico. Hydrobiologia 212: 209–212.

Maeda-Martínez, A.M., H. Obregón-Barboza & H.J. Dumont, 1992a. *Branchinecta belki* n.sp. (Branchiopoda: Anostraca), a new fairy shrimp from Mexico, hybridizing with *B. packardi* Pearse under laboratory conditions. Hydrobiologia 239: 151–162.

Maeda-Martínez, A.M., H. Obregón-Barboza & H.J. Dumont, 1992b. Occurrence of the fairy shrimp *Streptocephalus dorothae* Mackin (Branchiopoda: Anostraca) in Baja California Sur; first record from Mexico. Biol. Jb. Dodonaea 60: 138–143.

Maeda-Martínez, A.M., H. Obregón-Barboza & H.J. Dumont, 1993. *Branchinecta mexicana*, new species (Branchiopoda: Anostraca), a fairy shrimp from Central Mexico. J. Crust. Biol. 13: 585–593.

Maeda-Martínez, A.M., D. Belk, H. Obregón-Barboza & H.J. Dumont, 1995a. Diagnosis and phylogeny of the New World Streptocephalidae (Branchiopoda: Anostraca). Hydrobiologia 298: 15–44.

Maeda-Martínez, A.M., D. Belk, H. Obregón-Barboza & H.J. Dumont, 1995b. A contribution to the systematics of the Streptocephalidae (Branchiopoda: Anostraca). Hydrobiologia 298: 203–232.

Martin, J.W., 1989. *Eulimnadia belki*, a new clam shrimp from Cozumel, México (Conchostraca: Limnadiidae), with a review of Central and South American species of the genus *Eulimnadia*. J. Crust. Biol. 9: 104–114.

Moore, W.G., 1966. New World fairy shrimps of the genus *Streptocephalus* (Branchiopoda, Anostraca). S. West. Nat. 11: 24–48.

Moore, W.G. & J.B. Young, 1964. Fairy shrimps of the genus *Thamnocephalus* (Branchiopoda, Anostraca) in the United States and México. S. West. Nat. 9: 68–77.

Olesen, J., J.W. Martin & E.W. Roessler, 1996. External morphology of the male of *Cyclestheria hislopi* (Baird, 1859) (Crustacea, Branchiopoda, Spinicaudata), with a comparison of male claspers among the Conchostraca and Cladocera and its bearing on phylogeny of the 'bivalved' Branchiopoda. Zoologica Scripta, 25: 291–316.

Roessler, E.W., 1995. Review of Colombian Conchostraca (Crustacea) – ecological aspects and life cycles – family Cyclestheriidae. Hydrobiologia 298: 113–124.

Sassaman, C., 1989. Inbreeding and sex ratio variation in female biased populations of a clam shrimp, *Eulimnadia texana*. Bull. mar. Sci. 45: 425–432.

Sassaman, C., M. A. Simovich & M. Fugate, 1997. Reproductive isolation and genetic differentiation in North American species of *Triops* (Crustacea: Branchiopoda: Notostraca). Hydrobiologia 359: 125–147.

Villalobos-Hiriart, J.L., A.C. Díaz-Barriga & E. Lira-Fernández, 1993. Los crustáceos de agua dulce de México. Vol. Esp. (XLIV) Rev. Soc. Mex. Hist. Nat.: 267–290.