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APHELINIDAE (HYMENOPTERA: CHALCIDOIDEA) IN THE MOUNTAIN LOCALITIES OF MIQUIHUANA AND VICTORIA, TAMAULIPAS, MEXICO, WITH DESCRIPTION OF A NEW SPECIES OF *ENCARSIA*

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Abstract

Twenty species of parasitoid wasps of the family Aphelinidae were collected in mountain localities of the municipalities of Miquihuana and Victoria, Tamaulipas, Mexico. This is compared with the fauna of Aphelinidae present in the urban area of Ciudad Victoria. A new species, *Encarsia santaelenae* **sp. nov.** (Hymenoptera: Aphelinidae), collected in Rancho Santa Elena, Victoria, is described and illustrated.

Key Words: Aphelinidae, *Encarsia santaelenae* **sp. nov**.

Resumen

Se han colectado 20 especies de avispas parasíticas de la familia Aphelinidae en localidades de montaña de los municipios de Miquihuana y Victoria, Tamaulipas, México. Se compara con la fauna de Aphelinidae presente en la zona urbana de Ciudad Victoria. Se describe *Encarsia santaelenae* **sp. nov.** (Hymenoptera: Aphelinidae), especie obtenida en el Rancho Santa Elena, Victoria, con ilustraciones de las partes morfológicas diagnósticas.

Palabras Clave: Aphelinidae, *Encarsia santaelenae* **sp. nov**.

All Aphelinidae are parasitoids, the most common hosts being hemipterans in the suborder Stenorrhyncha; many species of Aphelinidae have great economic importance in biological control of insect pests, including whiteflies (Aleyrodidae), armored scales (Diaspididae), soft scales (Coccidae) and aphids (Aphididae) (Woolley 1997). Several species in the genera *Encarsia* Foerster and *Aphytis* Howard have been introduced into Mexico to combat whiteflies and armored scales in citrus and other crops (Myartseva & Ruiz-Cancino 2000).

Aphelinidae contains 40 genera and more than 1,350 species in the world (Woolley 1997; Jung-Wook & Heraty 2012; Noyes 2012). In Mexico 194 species in 12 genera have been recorded (Myartseva et al. 2012a). Myartseva & Evans (2008) reviewed the species of *Encarsia*, the most diverse genus in the family in Mexico, and furnished a key for identification, including 88 species in 12 genera; 47 species were described by them as new for science. Reviews of the species in the more important aphelinid genera used for biocontrol in Mexico—*Aphytis* Howard, *Eretmocerus* Haldeman and *Coccophagus* Westwood—were published (Myartseva 2006a, 2006b, 2011a). Many of these publications include new information on natural enemy complexes of insect pests, and descriptions of new species generally collected in urban areas. Given its host specificity and enormous diversity, the genus *Encarsia* has species that represent a huge, untapped resource for biological control of armored scale and whitefly pests. Effective utilization of this resource requires a clear knowledge of its taxonomy. Perhaps even more important, their role in controlling insects in natural ecosystems is virtually unknown (Polaszek et al. 2009).

The Sierra Madre Oriental is a mountain system, where tropical (200-800 m asl) and cloud (800-1,400 m asl) forests reach their northern limits in Mexico. Pine (*Pinus*) and oak (*Quercus*) forests form the more frequent types of vegetation (Gonzalez 2004). Isolation between mountains has been a fundamental factor in the regional biodiversity of plants and insects (Ruiz-Cancino 2010). In Tamaulipas, *Pinus-Quercus* forests are located between 800 and 2,500 m asl, this type of vegetation covers extensive areas between 1,400 and 2,300 m asl; in Miquihuana pine forest occurs between 1,400 and 3,100 m asl in separate areas. The dominant species in oak forests are *Quercus glau-*

coides Martens & Galeotti, *Q. lauriana* Bonpl., *Q. polymorpha* Schlechthendal & Chamisso, *Q. virginiana* Mill, *Q. oleoides* Schlechthendal & Chamisso and *Q. clivicola* Trell. & C. H. Mull. Other trees found in these forests include madrone (*Arbutus xalapensis* Kunth; Ericales: Ericaceae), *Croton fruticulosus* Engelm. (Euphorbiales: Euphobiaceae), *Persea podadenia* S. F. Blake (Laurales:Lauraceae) and *Randia* sp. (Gentianales: Rubiaceae) (Treviño-Carreón & Valiente-Banuet 2005). At El Madroño, Victoria, oak forests (*Q. rysophylla* Weatherby, *Q. laurina*) occur with other trees such as madrone and pecan nut (*Carya illinoensis* Koch) (Juglandales: Juglandaceae), palms (*Sabal mexicana* Mart.; Arecales: Areaceae), agaves (*Agave* spp.; Asparagales: Asparagaceae), prickly pear cactus (*Opuntia* sp.; Caryophyllales: Cactaceae) and other cacti; shrubs as *Karwinskia humboldtiana* (Roem. & Schult.) (Rosales: Rhamnaceae) and 'chamal' (*Dioon edule* Lindley; Cycadales: Zamiaceae), herbaceous plants (*Croton ciliatoglandulosus* Ortega, *Ageratina* sp.; Asterales: Asteraceae) and grasses (Poales: Poaceae) are also present in the area (Ruiz 1984).

The objectives of this paper were to report the species of Aphelinidae collected in mountain localities in 2 municipalities (Miquihuana and Victoria) of the State of Tamaulipas, Mexico, located in the Sierra Madre Oriental mountain range, and to describe a new species of *Encarsia*.

Material and Methods

Specimens of Aphelinidae collected in several localities of the State of Tamaulipas and deposited at the Insects Museum of Universidad Autonoma de Tamaulipas, in Ciudad Victoria, were studied. Collecting took place in 4 localities of the municipalities of Miquihuana and Victoria, Tamaulipas. Miquihuana is located at N 23° 34' W 99· 45', and 1,500-3,670 m asl. Victoria is located at N 23º 44.06' W 99° 07.51', and 300-1,800 m asl.

In Victoria, specimens were collected in 3 mountain localities: 'Balcón de Moctezuma', 'El Madroño' and 'Rancho Santa Elena'. Balcón de Moctezuma is located at Ejido Altas Cumbres, 18 km south of Ciudad Victoria, at 1,200 m asl; El Madroño is located 25 km southwest Ciudad Victoria, at 1,300-1,450 m asl; Rancho Santa Elena is located 15 km Southwest Ciudad Victoria, at 750 m asl.

Whiteflies, soft scales and armored scales were collected in different seasons on leaves and twigs of several plant species. Material was taken to the Laboratory of Biological Control, and held for parasitoid emergence. Parasitoids were preserved in vials with 75% ethanol. Also, material obtained in 2 Malaise traps located at El Madroño and Rancho Santa Elena was examined. Part of the material was mounted for species determination.

Results and Discussion

The fauna of Aphelinidae in the mountain localities includes 20 species in 5 genera (Table 1). *Encarsia* is the genus with more species (13). Two species of *Aphytis* found at this locality are parasitoids of armored scales, including *A. miquihuana* Myartseva, a new species described in 2010 (Myartseva et al. 2010). Two species of *Eretmocerus* are whitefly parasitoids and 1 species of *Coccophagus* is parasitoid of soft scales. Of the 13 species of *Encarsia*, 12 are parasitoids of Aleyrodidae and one attacks Diaspididae. Two species of *Coccobius* parasitoids armored scales were collected. The family Aphelinidae in these mountain localities therefore has 3 groups of hosts: Aleyrodidae (12 parasitoid species, 65% of all the Aphelinidae species), Coccidae (1 species, 5%) and Diaspididae (5 species, 25%). The host of the new species, *E. santaelenae*, is unknown; this species was obtained in a Malaise trap.

According to Miller (1996), 224 species in 68 genera of Diaspididae have been recorded from Mexico. Martin & Mound (2007) published a list of New World whiteflies, which included 3 subfamilies, 20 genera and 52 new species. According to Evans (2007), the aleyrodid fauna in Mexico consists of 123 species in 30 genera of 2 subfamilies.

In Mexico, we have found or reared 155 species of Aphelinidae whose hosts include primarily whiteflies and armored scales. Most of them were collected in natural and urban ecosystems. For example, in Ciudad Victoria 50 species in 6 genera were recorded (Myartseva et al. 2011b). In natural ecosystems in the State of Tamaulipas, especially in the Biosphere Reserve "El Cielo", 42 species in 7 genera have been collected (Myartseva et al. 2011c).

In the mountain localities in Tamaulipas, which consisted of mainly oak forest, Aleyrodidae on trees and shrubs were found as the most common hosts of Aphelinidae (13 species). Seven species in 3 genera of Aphelinidae were described as new (Myartseva & Evans 2008; Myartseva et al. 2012 b). One new species is described in this article.

Nine species of the aphelinids obtained in mountain localities were also found in urban areas. These are polyphagous species (Woolley 1997), which include the scale parasitoids *Aphytis comperei* DeBach and Rosen and *Encarsia citrina* (Crawford), and the whitefly parasitoids *Eretmocerus comperei* Rose, *Encarsia citrella* (Howard), *E. formosa* Gahan, *E. luteola* Howard and *E. pergandiella* Howard. The global host list

TABLE 1. APHELINIDAE COLLECTED IN MOUNTAIN LOCALITIES IN MIQUIHUANA AND VICTORIA, TAMAULIPAS. (A – ALEYRODIDAE, C – COCCIDAE, D – DIASPIDIDAE, + PRESENT, - ABSENT). 1998-2012.

Species of Aphelinidae	Miquihuana	El Madroño	Balcon Moctezuma	Rancho Santa Elena	Host	Urban zone
Aphytis comperei DeBach & Rosen				IX-2007	D	+
A. miquihuana Myartseva	IV-2001				D	—
Eretmocerus comperei Rose	X-1998				A	+
E. montanus Myartseva		XI &XII. -2001, I-2002, IX-2007	II-1999		A	—
Coccophagus sp.	X-2012				C	—
Encarsia citrella (Howard)		IX-2007	II-1999		A	+
E. citrina (Crawford)	XI-2007				D	+
E. altacima Myartseva & Evans			X-1998		A	—
E. costaricensis Evans & Angulo			II-1999		A	—
E. formosa Gahan	IV-2001				A	+
E. leucaenae Myartseva & Evans			I-1999		A	—
E. luteola Howard			II-1999		A	+
E. macula Myartseva & Evans	X-1998, V- IX- 2000, IV- 2001, III- IV-2002, X-2005, IX-2007				A	+
E. mahoniae Myartseva & Evans	V-2000				A	—
E. mexicana Myartseva		XI-2001	II-1999		A	+
E. moctezumana Myartseva & Evans			II-1999		A	—
E. pergandiella Howard	VI-2001				A	+
E. santaelenae Myartseva **sp. n.**				XI-XII.2011	-	—
Coccobius donatellae Pedata & Evans	V-2000				D	—
C. stanfordi (Howard)	X-1998				D	—

for *E. citrina* includes more than 65 Diaspididae species, *E. pergandiella* and *E. formosa* have 19 and 17 host species, respectively (Myartseva & Evans 2008). Hosts of these Aphelinidae also include several insect pests of citrus and other crops in Mexico (Miller 1996): armored scales—California red scale *Aonidiella aurantii* (Maskell), citrus snow scale *Unaspis citri* (Comstock), lesser snow scale *Pinnaspis strachani* (Cooley), vanda orchid scale *Parlatoria pseudaspidiotus* Lindinger; whiteflies—sweetpotato whitefly *Bemisia tabaci* Gennadius, greenhouse whitefly *Trialeurodes vaporariorum* (Westwood), citrus woolly whitefly *Aleurothrixus floccosus* (Maskell), and mulberry whitefly *Tetraleurodes mori* Quaintance. Some parasitoid species (*Aphytis miquihuana*, *Eretmocerus montanus* Myartseva and *Encarsia altacima* Myartseva & Evans) of these pests were found in mountain localities for the first time.

Aphelinidae species contribute to the natural control of Aleyrodidae and Diaspididae, protecting trees, shrubs and herbaceous plants in mountain localities in Tamaulipas. In Miquihuana and Victoria, species of polyphagous parasitoids (*Aphytis comperei*, *Encarsia citrella*, *E. citrina*, *E. formosa*, *E. luteola*, *E. pergandiella*) were collected. These parasitoids attack hemipteran pests in agricultural ecosystems and urban areas. Protection of Aphelinidae biodiversity may results in preservation of natural and agricultural areas. Protected areas are appropriate for the conservation of parasitoid wasp's diversity and provide an opportunity for beneficial insects and their hosts to establish an ecological balance.

Encarsia santaelenae Myartseva, **sp. nov.**
(Figs. 1-4)

Material Examined

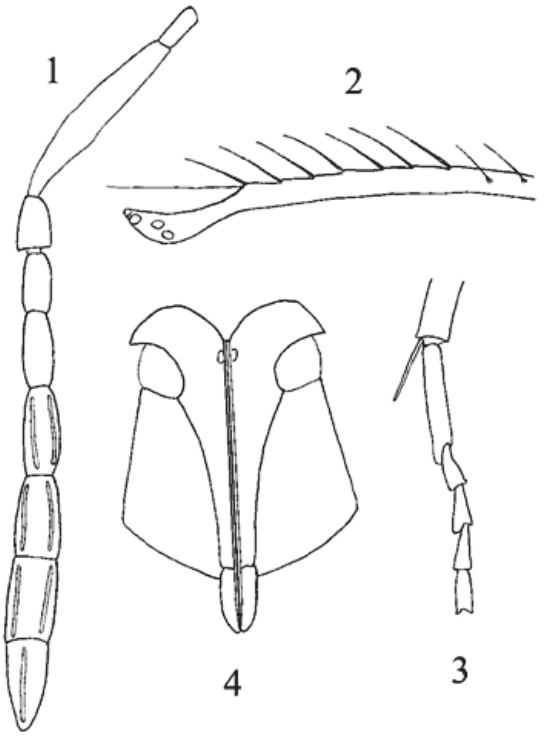
Female

HOLOTYPE: MEXICO, Tamaulipas, Victoria, Rancho Santa Elena, Malaise trap, oak forest, 17-XI to1-XII-2011 (S. Mireles and E. Ruíz Cancino, coll.), on slide. HOLOTYPE deposited in the Entomological Research Museum, University of California, Riverside (UCRC), USA.

Description

Length of body: 0.6 mm.

Color. Head brownish, ocelli reddish, face and antennae yellow. Pronotum dark brown. Mid lobe of mesoscutum mostly brownish, laterally and basally yellow. Scutellum, axillae and side lobes yellow. Fore wings hyaline, venation slightly infuscate. Legs yellow. Propodeum brownish. Petiole infuscate. Gaster dark yellow, along sides narrowly dark, first and sixth gastral tergites brownish. Ovipositor yellow.



Figs. 1-4. *Encarsia santaelenae* Myartseva, **sp. nov.,** female: 1 – antenna, 2 – detail of marginal vein, 3 – midtibial spur and middle tarsus, 4 – ovipositor, ventral view.

Structure. Head not wider than mesosoma, about 1.4 times as wide as high. Frontovertex with stemmaticum transversely striate, about 0.6 times as wide as width of head. Eyes about 2.2 times as long as cheeks. Antennae (Fig. 1) inserted at the level of lower margin of eyes. Distance between toruli about 0.8 times as long as distance from torulus to eye margin. Antennal radicle 2.8 times as long as wide. Scape about 6 times as long as wide. Pedicel about 1.7 times as long as wide. First segment of funicle subequal in length to pedicel and about 2 times as long as wide. Second segment slightly longer and 2.7 times as long as wide. Third segment slightly wider and 2.3 times as long as wide. Club 3-segmented, slightly shorter and wider than funicle. Third to sixth segments of flagellum with 2 linear sensilla each. Mid lobe of mesoscutum with 8 long thin setae situated symmetrically. Sculpture of mid lobe reticulate. Scutellum about 0.7 times as long as mid lobe of mesoscutum and about 2 times as wide as long. Scutellar placoid sensilla very closely spaced. Anterior pair of scutellar setae slightly shorter than posterior pair of setae, and distance between their bases 0.8 times as long as that between bases of posterior pair of scutellar setae. Fore wing uniformly setose, 3 times as long as maximum width

of wing. Marginal fringe about 0.4 times as long as wing width, base with 4 setae. Submarginal vein slightly shorter than marginal vein and with 2 short and stout setae along anterior margin. Marginal vein (Fig. 2) with 7 thin long setae along anterior margin. Hind wing about 11 times as long as maximum width of wing, its marginal fringe 2 times as long as width of wing. Tarsal formula 5-5-5. Basitarsus of mid tarsus longer than the 3 next tarsal segments combined (Fig. 3). Midtibial spur about 0.5 times as long as basitarsus of mid tarsus. Gastral tergites fifth to seventh with 4 setae each. Ovipositor (Fig. 4) slightly exserted, about 0.9 times as long as mid tibia. Third valvula 0.25 times as long as second valvifer.

Male Unknown.

Comments

According to keys for *Encarsia* species identification by Heraty & Polaszek (2000) and Hayat (2012), *Encarsia santaelenae* **sp. nov**. appears similar to *E. bimaculata* Heraty & Polaszek, introduced from India to U.S.A. (see Table 2). *Encarsia bimaculata* is native to Southeast Asia and was intentionally introduced with other *Encarsia* species into Florida from India (Nguyen & Bennett 1955). According to Heraty & Polaszek (2000), it was found possibly as culture contamination from specimens of *B. tabaci* on *Chamaesyce hyssopifolia* (L.) Small (Euphorbiaceae); collected by P. A. Stansly in 1992 from Mexico.

We found that *Encarsia santaelenae* **sp. nov.** is also similar to *E. mexicella* Myartseva (see Table 3), which was reared from an aleyrodid on leaves of *Leucophyllum frutescens* (Berland) (Lamiales: Scrophulariaceae) in Cd. Victoria, Tamaulipas, Mexico (Myartseva 2009). The new species was compared with the holotype of *E. mexicella*, which is preserved in the Insect Museum in UAT, Ciudad Victoria, Tamaulipas.

Note on Probable Biology

As stated above, *E. santaelenae* **sp. nov.** appears to be closely related to *E. bimaculata* and *E. mexicella*. The closely-placed scutellar placoid sensilla, and the shape of the stigmal vein, strongly suggest it is a member of the *Encarsia strenua* (Silvestri) group, all species of which are parasitoids of Aleyrodidae.

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Table 2. Differences between *Encarsia santaelenae* **sp. nov.** and *E. bimaculata*.

Encarsia santaelenae, **sp. nov.**	*Encarsia bimaculata*
Fore wing hyaline	Fore wing slightly infuscate at the base of submarginal vein and base of frenal fold
Marginal vein with 7 setae along anterior margin and with 4 basal group setae	Marginal vein with 6 setae along anterior margin and with 5-6 basal group setae
Midtibial spur about 0.5 times as long as basitarsus of mid tarsus	Midtibial spur 0.6-0.8 times as long as basitarsus of mid tarsus
Ovipositor 0.9 times as long as mid tibia and third valvula 0.25 times as long as second valvifer	Ovipositor 1.1-1.38 times as long as mid tibia and third valvula 0.32 times as long as second valvifer
Head largely brown	Head largely yellow
Axillae yellow	Axillae brown

Table 3. Differences between *Encarsia santaelenae* **sp. nov.** and *Encarsia mexicella*.

Encarsia santaelenae, **sp. nov.**	*Encarsia mexicella*
Eyes about 2.2 times as long as cheeks	Eyes about 1.3 times as long as cheeks
Antennal scape about 6 times as long as wide	Antennal scape about 4 times as long as wide
Club slightly shorter than funicle	Club slightly longer than funicle
Marginal vein with 7 setae along anterior margin	Marginal vein with 5 setae along anterior margin
Ovipositor 0.9 times as long as mid tibia and about as long as club	Ovipositor about 1.3 times as long as mid tibia and more 1.5 times as long as club
Third valvula 0.25 times as long as second valvifer	Third valvula 0.7 times as long as second valvifer
Pedicel subequal to first segment of funicle	Pedicel longer than first segment of funicle
Axillae yellow, apices of stylets yellow	Axillae brownish, and apices of stylets black

and Aphelinidae (Hymenoptera) in localities of Sierra Madre Oriental in Tamaulipas, Mexico". We thank the reviewers and the associate editor of Florida Entomologist for their excellent suggestions.

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