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NATURAL OCURRENCE OF HYMENOPTEROUS PARASITOIDS ASSOCIATED WITH *ANASTREPHA FRATERCULUS* (DIPTERA: TEPHRITIDAE) IN MYRTACEAE SPECIES IN ENTRE RIOS, NORTHEASTERN ARGENTINA

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ABSTRACT

Parasitoids of *Anastrepha fraterculus* (Wiedemann) were monitored on ripe fruit of 3 native and 1 exotic, wild Myrtaceae species in the Province of Entre Rios, NE Argentina, between Jan and Mar 1993 and 1994 with the aim of identifying indigenous parasitoid species and determining natural parasitization rates and fruit infestation levels. The fruit species surveyed were *Psidium guajav*a L. (common guava), *Feijoa sellowiana* (O. Berg) O. Berg (feijoa), *Eugenia uniflora* L. (Surinam cherry), and *Myrcianthes pungens* (Berg) Legrand (mato). Altogether 2,186 tephritid puparia were obtained, 95% of which were *A. fraterculus* and 5% of which were *Ceratitis capitata* (Wiedemann). Of 1,667 adult insects that emerged from these puparia, 1,378 were *A. fraterculus*, 89 *C. capitata*, and 200 larval-pupal parasitoids, representing 4 species of 2 Hymenoptera families: *Doryctobracon areolatus* (Szépligeti), *D. brasiliensis* (Szépligeti), *Utetes anastrephae* (Viereck) (all Braconidae, Opiinae), and A*ganaspis pelleranoi* (Brèthes) (Figitidae, Eucoilinae). All these parasitoid species are new reports for Entre Rios. Moreover, these records represent the southernmost natural distribution range in the Americas for these species. *Doryctobracon areolatus* and *A. pelleranoi* were recovered from all of the Myrtaceae species sampled, and they were the most abundant parasitoid species. Infestation patterns by *A. fraterculus* in mato, Surinam cherry, guava, and feijoa varied from 15.2 to 41.8, 21.3 to 49.4, 34.1 to 109.2, and 78.9 to 140.6 larvae per kg of fruit, respectively. Highest levels of parasitism were recorded in *P. guajava*, whereas *M. pungens* had the lowest parasitization rates. However, overall mean parasitism levels (i.e., considering all parasitoid species) did not appear to have great differences when comparing Myrtaceae species, collection sites, and years. The relative abundance and parasitization rates data of the recovered parasitoids in the 4 Myrtaceae species suggest some degree of host plant preference by *U. anastrephae* and *D. brasiliensis*.

Key Words: fruit flies, parasitoids, Braconidae, Figitidae, Argentina, Myrtaceae

RESUMEN

Con el propósito de identificar especies de parasitoides asociadas con *Anastrepha fraterculus* (Wiedemann) y determinar niveles de parasitismo natural y de infestación en fruta en la provincia de Entre Rios, Noreste de Argentina, se colectaron tres especies nativas y una exótica de Myrtaceae entre Enero y Marzo de 1993 y de 1994. Las especies frutales colectadas fueron *Psidium guajava* L. (guayaba común), *Feijoa sellowiana* (O. Berg) *O. Berg* (feijoa), *Eugenia uniflora* L. (arrayán), y *Myrcianthes pungens* (Berg) Legrand (mato). Se obtuvo un total de 2.186 puparios, de los cuales el 95% correspondió a *A. fraterculus* y el 5% restante a *Ceratitis capitata* (Wiedemann). De los 1.667 insectos adultos que emergieron de estos puparios, 1.378 fueron *A. fraterculus,* 89 *C. capitata* y 200 fueron parasitoides larvo-pupales, representando cuatro especies de dos familias de Hymenoptera: *Doryctobracon areolatus* (Szépligeti), *D. brasiliensis* (Szépligeti), *Utetes anastrephae* (Viereck) (todos Braconidae, Opiinae), y *Aganaspis pelleranoi* (Brèthes) (Figitidae, Eucoilinae). Todas estas especies de parasitoides son nuevas citas para la provincia de Entre Ríos. Además, estos registros representan el rango natural de distribución más austral en el continente americano para estas cuatro especies de parasitoides. *Doryctobracon areolatus* y *A. pelleranoi* fueron recuperados de todas las especies de Myrtaceae colectadas, y fueron las especies de parasitoides más abundantes. Los niveles de infestación por *A. fraterculus* en mato, arrayán, guayaba, y feijoa variaron de 15.2 a 41.8, 21.3 – 49.4, 34.1 – 109.2, y 78.9 – 140.6 larvas por kg de fruta, respectivamente. Sin embargo, los valores medios totales de parasitismo (incluyendo todas las especies de parasitoides) no presentaron grandes diferencias cuando se consideraron las distintas especies de Myrtaceae, lugares de colecta, y años de muestreo. Los datos sobre abundancia relativa de parasitoides y las tasas de parasitismo en las cuatro especies de Myrtaceae sugieren cierto grado de preferencia por la planta hospedera por parte de los parasitoides *U. anastrephae* y *D. brasiliensis*.

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The South American fruit fly, *Anastrepha fraterculus* (Wiedemann), and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), are among the most significant insect pests of edible fruit in Argentina (Spinetta 2004) and in the remaining South American countries (Malavasi et al. 2000; Aluja et al. 2003a). The native *A. fraterculus* is basically restricted to NE and NW Argentina, where the climate mainly is warm and humid, whereas the exotic *C. capitata* is currently distributed throughout all fruit-growing regions of the country (Ovruski et al. 2003; Segura et al. 2006). Although *A. fraterculus* represents a cryptic species ensemble (Steck 1991; Aluja et al. 2003a; Hernández-Ortiz et al. 2004; Vera et al. 2006) distributed throughout continental America from Mexico to Argentina (Aluja 1999; Norrbom 2004), the Argentine populations of the complex belong to a single biological species (Alberti et al. 2002).

In the northeastern province of Entre Ríos, where *A. fraterculus* and *C. capitata* coexist in large citrus crop areas (Segura et al. 2006), common guavas grown in thin patches of wild vegetation adjacent to commercial orchards support larger local *A. fraterculus* populations (Turica & Mallo 1961; Putruele 1996). Though *A. fraterculus* has one of the broadest host ranges of all known *Anastrepha* species (Norrbom 2004), fruit in the Myrtaceae family are among its favored host plant (Aluja 1999; Raga et al. 2005).

Poisoned bait sprays for *A. fraterculus* and *C. capitata* control were tried with some success as early as 1930 in Entre Ríos (Ovruski & Fidalgo 1994). Some attempts to develop biological control programs were made in the 1940s and the 1960s. Thus, 3 exotic larval parasitoid species (*Tetrastichus giffardianus* Silvestri, *Aceratoneuromyia indica* (Silvestri), and *Diachasmimorpha longicaudata* (Ashmead)) were introduced and released in limited numbers in citrus crop areas of Entre Rios (Ovruski et al. 1999). *Tetrastichus giffardianus* and *A. indica* are 2 gregarious eulophid parasitoids originally collected in West Africa and Southeast Asia, respectively, whereas *D. longicaudata* is a solitary braconid parasitoid originally from the Malaysia-Philippine region (Ovruski et al. 2000). Only *A. indica* and *D. longicaudata* were recovered (Turica 1968).

Studies on native parasitoids attacking tephritid pests in northeastern Argentina have been largely neglected. Examples of fruit fly parasitoid surveys are only those developed in Misiones (Ogloblin 1937) and Corrientes (Turica & Mallo 1961; Ovruski & Schliserman 2003a). These studies were focused largely on commercial fruit in citrus growing areas. Some parasitoid species also were reported from fruit samples sporadically collected in Entre Rios (Blanchard 1947) and Corrientes (Brèthes 1924; Blanchard 1966). Most of the available new information on native fruit fly parasitoids of Argentina is based on the surveys carried out in NW Argentina (Turica & Mallo 1961; Nasca 1973; Fernández de Araoz & Nasca 1984; Ovruski 1995; Wharton et al. 1998; Ovruski & Schliserman, 2003b; Schliserman et al. 2004; Schliserman & Ovruski, 2004; Ovruski et al. 2004, 2005, 2006; Oroño et al. 2005). As many as 11 native parasitoid species associated with *A. fraterculus* on native and exotic host fruit species have been so far recorded in Argentina (Ovruski et al. 2005). Most of them also have been found parasitizing diverse *Anastrepha* species in several Latin American countries, including Brazil (Leonel et al. 1995; Aguiar-Menezes & Menezes 1997; Canal & Zucchi 2000; Guimarães et al. 2000; Carvalho 2001; Aguiar-Menezes et al. 2001; Uchôa-Fernandes et al. 2003), Venezuela (Katiyar et al. 1995), Colombia (Yépes and Vélez 1989; Carrejo & González 1999), Costa Rica (Jirón & Mexzon 1989; Wharton et al. 1981), Guatemala (Eskafi 1990), and Mexico (Aluja et al. 1998, 2003b; López et al. 1999; Sivinski et al. 1997, 2000, 2001; Guillén et al. 2002; Hernández-Ortiz et al. 1994, 2006).

The specific aims of this study were to survey selected wild Myrtaceae species commonly infested by *A. fraterculus* in order to provide information on infestation levels in the fruit sampled, degree of larval parasitization, and the parasitoid fauna attacking this fruit fly pest in Entre Ríos, NE Argentina, as well as to document natural distribution ranges of these parasitoids along a latitudinal gradient. This article complements our previous study on the diversity and distribution of native fruit fly parasitoid in the extremely endangered subtropical rainforests in north Argentina (Ovruski et al. 2004, 2005).

Materials and Methods

Collections were made during Jan-Mar 1993 and 1994 in the following localities of Entre Ríos, NE Argentina: Paraná (31°64'S, 60°32'W, elevation 90 m), La Paz (30°44'S, 59°38'W, 75 m), and Concordia (31°24'S, 58°01'W, 48 m). The climate is characterized as temperate-humid with long and warm summers, the temperature of the hottest month being >22°C and the temperature of the coldest month being <18°C; it rains all year long, but the proportion of winter rainfall is <5% of the total, the rainfall being between 933 mm (Cakf (w)) (Anonymous 1992).

Fruit samples included 3 native and 1 exotic, wild species of Myrtaceae: *Psidium guajava* L. (common guava) (exotic species), *Feijoa sellowiana* (O. Berg) O. Berg (feijoa), *Eugenia uniflora* L. (Surinam cherry), and *Myrcianthes pungens* (Berg) Legrand (mato) (all native species). Fruit were collected in backyard gardens in suburban areas and patches covered with wild native vegetation adjacent to small citrus orchards (sour and sweet oranges, tangerines, lime, sweet lemon, and

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TABLE 1. ABUNDANCE OF *A. fraterculus* PARASITOIDS COLLECTED FROM 4 MYRTACEAE SPECIES IN ENTRE RIOS, NW ARGENTINA, BETWEEN JAN AND MAR 1993 AND 1994.

Collection sites and years	Host plant species	No. of samples	No. and weight (kg) of fruit sampled	No. of recovered *A. fraterculus* pupae and adults	No. of recovered parasitoid adults[1]				Mean % parasitism (± SD)
					D.a	D.b	U.a	A.p	
Concordia (1993)	*P. guajava*	14	143	5.0	277	170	2	1	0	8	11.4 ± 3.2
Concordia (1994)	*P. guajava*	6	62	2.7	207	191	17	5	0	7	13.2 ± 4.7
La Paz (1993)	*F. sellowiana*	5	50	1.3	111	69	6	5	0	1	12.7 ± 2.3
	P. guajava	4	41	1.8	109	71	5	3	0	11	18.9 ± 3.1
La Paz (1994)	*F. sellowiana*	5	57	1.7	204	164	17	0	1	5	12.7 ± 2.7
	P. guajava	22	225	8.3	559	327	12	2	4	13	9.8 ± 6.3
Paraná (1993)	*E. uniflora*	6	211	1.6	79	64	2	6	8	1	11.2 ± 6.9
	M. pungens	3	104	1.1	46	28	1	0	3	0	4.9 ± 4.3
	P. guajava	8	83	3.9	231	149	12	0	1	7	14.8 ± 7.4
Paraná (1994)	*E. uniflora*	6	209	1.5	77	51	3	6	4	0	8.7 ± 9.2
	M. pungens	6	206	2.0	81	39	1	0	4	1	5.8 ± 8.1
	P. guajava	6	61	2.1	94	55	3	0	0	2	9.7 ± 3.3

[1]D.a, *D. areolatus*; D.b, *D. brasiliensis*; U.a., *U. anastrephae*; A.p, *A. pelleranoi*.

grapefruit). All these fruit sampling sites were located in a linear corridor along the banks of Paraná River (West sector of the NE Argentina region), except for the study site in Concordia, which was located close to the banks of Uruguay River (East sector of the NE Argentina region). The original native vegetation was subtropical rainforest locally known as "Selva en Galería", which continued along the banks of southern and northern Paraná and Uruguay River (Cabrera 1976).

Based on fruit size (measured as individual fruit weight) of each plant species, approximately 10 fruit were randomly taken from each guava and feijoa tree, and 35 fruit from each Surinam cherry and mato tree. Guava and feijoa plants had medium size fruit (mean ± SD: 45.8 ± 4.9 g and 39.2 ± 5.8 g, n = 100, respectively) while Surinam cherry and mato plants had small size fruit (mean ± SD: 6.8 ± 2.3 g, and 7.2 ± 5.8 g, n = 100, respectively). Fruit was picked both from the tree and from the ground under the tree canopy. Therefore, each sample included fruit collected from tree plus fruit of the same tree that had fallen on the ground. Only ripe fruit that was about to fall from the tree was harvested. This allowed fruit fly larvae to complete development, and gave fruit fly parasitoids the opportunity to parasitize larvae throughout their development (Lopez et al. 1999). Fruit samples were placed in styrofoam boxes with sand in the bottom as pupation medium for larvae, and they were taken to the laboratory. All material collected in the field was processed in the laboratory of the CIRPON institute (Centro de Investigaciones para la Regulación de Poblaciones de Organismos Nocivos) in San Miguel de Tucumán (26°50'S, 65°13'W, elevation 426 m), Tucumán, Northwestern Argentina. Each styrofoam box contained only one fruit sample and all cages were kept inside a room at 27 ± 2°C and 60 ± 10% relative humidity. Fruit fly puparia were recovered weekly during 1 month and then transferred to plastic trays containing sterilized humid sand, which was re-moistened every 3 d until all samples had been processed. Each tray was then placed inside a sealed wooden box. All wooden cages were kept inside a rearing room at 25 ± 1°C and 75 ± 5% relative humidity for 4 months. Puparia of *C. capitata* and *Anastrepha* Schiner were separated based on pupal characters (White & Elson-Harris 1992). Emerged flies and/or parasitoids were identified, counted and sexed by sample and summarized for each locality. Afterward, unemerged puparia also were counted. Additional samples of parasitoid specimens collected in El Palmar (32°16'S, 58°28'W, 44 m) and Concordia localities were received from colleagues.

Parasitoid specimens were identified to species by S. Ovruski using Wharton and Marsh's (1978) key and the taxonomic descriptions by Wharton et al. (1998). Fruit flies were identified by S. Ovruski using Zucchi's (2000) taxonomic key. Nomencla-

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ture for the Opiinae follows Wharton (1997) and for the Eucoilinae Wharton et al. (1998). Parasitoid and fly specimens were placed in the entomological collection of the Fundación Miguel Lillo (FML) (San Miguel de Tucumán, Argentina). All plant samples were compared to herbarium specimens at the FML, and identified by Alejandra Roldán (Facultad de Ciencias Naturales e Instituto Miguel Lillo, Universidad Nacional de Tucumán). Nomenclature employed for plant identification was based on Morales et al. (1995).

All parasitism values and fruit infestation levels reported here are based on the number of emerging adult flies and parasitoids (Lopez et al. 1999), and on the number of fruit fly larvae per kg of fruit (Aluja et al. 2000), respectively. Where appropriate, means and standard deviations (mean ± SD) were calculated as summary statistics for the parasitism percentage, fruit size (weight), and ovipositor length of opiine parasitoid species.

Results

A total of 1,532 fruit, representing 33.1 kg was processed during this study. Out of these, 420 (3.1 kg) fruit were *E. uniflora*, 310 (3.2 kg) *M. pungens*, 615 (23.8 kg) *P. guajava*, and 107 (3.0 kg) *F. sellowiana*. In total, 2,186 tephritid puparia were obtained from these fruit, 95% of which were *A. fraterculus* and 5% of which were *C. capitata*. Of 1,667 adult insects that emerged from these puparia, 1,378 were *A. fraterculus*, 89 *C. capitata*, and 200 parasitoids, representing 4 species of 2 Hymenoptera families. No parasitoids were recovered from *C. capitata* puparia.

Only *E. uniflora* and *P. guajava* were infested by *C. capitata*, and infestation rates ranged from 0.1 to 1.9 and from 4.3 to 15.2 larvae/kg of fruit, respectively. Approximately 17% and 33% of all Surinam cherry and guava samples were simultaneously infested by both *C. capitata* and *A. fraterculus*. Infestation patterns by *A. fraterculus* in *M. pungens*, *E. uniflora*, *P. guajava*, and *F. sellowiana* varied from 15.2 to 41.8, 21.3 to 49.4, 34.1 to 109.2, and 78.9 to 140.6 larvae/kg of fruit, respectively.

Table 1 summarizes *A. fraterculus* and parasitoid species abundance, and parasitization rates based on fruit species collected per study site and year. Three species of opiine Braconidae parasitoids and 1 species of eucoiline Figitidae parasitoid were identified: *Doryctobracon areolatus* (Szépligeti), *D. brasiliensis* (Szépligeti), *Utetes anastrephae* (Viereck) (Braconidae), and *Aganaspis pelleranoi* (Brèthes) (Figitidae). These species constituted 45.4, 14.0, 12.5, and 28.1% of the total recovered parasitoids, respectively. *Doryctobracon areolatus* was the most abundant parasitoid species in 71% of total fruit samples and it was recovered from all of the Myrtaceae species sampled. *Aganaspis pelleranoi* was also found in association with *A. fraterculus* in *E. uniflora*, *F. sellowiana*, *M. pungens* and *P. guajava*. This eucoiline parasitoid was recovered from 52% of the total fruit samples. *Doryctobracon brasiliensis* was recovered only from 33 and 50% of the total guava and feijoa samples, respectively. Approximately 76% of all *U. anastrephae* specimens was recovered from both *M. pungens* and *E. uniflora*. This opiine species was obtained from 8, 20, 67, and 100% of all guava, feijoa, mato, and Surinam cherry samples, respectively.

Highest levels of parasitism were recorded in *P. guajava*, whereas *M. pungens* had the lowest parasitization rates (Table 1). However, overall mean parasitism levels (i.e., considering all parasitoid species) did not appear to have great differences when comparing Myrtaceae species, collection sites, and year (Table 1). Parasitization by *A. pelleranoi* has accounted for only ≤10% of the total parasitization of *A. fraterculus* on *F. sellowiana*, *M. pungens* and *E. uniflora*. In contrast, in *P. guajava* the degree of larval parasitization by eucoiline species ranged from 24 to 73% of the total parasitization.

From the additional parasitoid specimens collected by colleagues in Entre Ríos, 9 *A. pelleranoi* and 8 *D. areolatus* were identified. Six *D. areolatus* were recovered from guavas collected in El Palmar, whereas the remaining 2 *D. areolatus* and 9 *A. pelleranoi* were obtained from guavas in Concordia.

Discussion

New fruit fly parasitoid species records for Entre Ríos are *D. areolatus*, *D. brasiliensis*, *U. anastrephae* and *A. pelleranoi*, all native of the Neotropical region. Prior to this report, only the eucoiline *Rhoptromeris* haywardi (Blanchard) had been recorded from both *C. capitata* and *A. fraterculus* in Entre Ríos (Blanchard 1947). All of these species belong to the fruit fly parasitoid guild number 2 described by Ovruski et al. (2000), which is characterized by solitary, koinobiont larval-pupal endoparasitoids of *Anastrepha* spp. The braconids *D. areolatus* and *U. anastrephae*, and the figitid *A. pelleranoi* are widely distributed in Latin American, while *D. brasiliensis* is known to occur in southern Brazil and northern Argentina (Ovruski et al. 2005). The discovery of these 4 native *A. fraterculus*-parasitoid species in Entre Ríos represents their southernmost natural distribution range in the Americas. During this study, *D. brasiliensis* and *U. anastrephae* were found at 31°64'S latitude (Paraná), whereas both *D. areolatus* and *A. pelleranoi* were also collected at 32°16'S latitude (El Palmar). Previously, these parasitoid species had been recorded from *A. fraterculus* in the provinces of Corrientes (27°15'-30°43'S and 59°41'-56°12'W) (Ovruski & Schliserman 2003a), Misiones (25°30'-28°10'S and 53°38'-56°03'W) (Ogloblin 1937; Turica & Mallo 1961),

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Catamarca (25°09'-29°16'S and 65°25'-69°06'W) (Ovruski & Schliserman 2003b), Tucumán (26°05'-28°01'S and 64°28'-66°13'W) (Nasca 1973; Fernández de Araoz & Nasca 1984; Ovruski 1995; Schliserman et al. 2004; Ovruski et al. 2004), and Salta (22°02'-26°21'S and 62°21'-68°34'W) (Ovruski et al. 2005; Oroño et al. 2005). Pupal parasitoids were not found because all of the *A. fraterculus* and *C. capitata* were collected as larvae, so they would not have been obtained even if present at the collection site.

Rhoptromeris haywardi was not found during this study. However, as discussed by Wharton et al. (1998), published records for *R. haywardi* attacking tephritids (Blanchard 1947; Turica & Mallo 1961; Nasca et al. 1980) are questionable and need verification. All records of this eucoiline species come from bulk samples of fruit, from which parasitoid species of both Drosophilidae and Tephritidae could emerge. Without isolation of tephritid puparia, correct host fly—parasitoid species association cannot be made (Wharton et al. 1998).

Neither of the 2 introduced and released exotic fruit fly parasitoid species were recovered from fruit samples collected during this study, even though both *D. longicaudata* and *A. indica* were reported by Turica (1968) as established on *Anastrepha* spp. As noted by Ovruski et al. (1999), both exotic parasitoid species were recovered immediately following release in Concordia in the 1960s, and their establishment was not verified later. Interestingly, *D. longicaudata* was recently recovered in the northeastern province of Misiones (Schliserman et al. 2003) and in the northwestern province of Salta (Oroño & Ovruski 2007) approximately 40 years after its first release. Similarly, recent fruit fly parasitoid surveys made in the provinces of Jujuy (northwestern Argentina), Córdoba (Central Argentina), and Misiones (northeastern Argentina) recorded the presence of *A. indica* (Ovruski et al. 2006).

Although no *C. capitata* parasitoids were recovered in this study, some species, like *A. pelleranoi*, were obtained from *C. capitata* pupae in Tucumán. For example, in a recent fruit fly parasitoid survey in Citrus crop areas of Tucumán, *A. pelleranoi* has been recovered from *C. capitata* pupae in *Citrus aurantium* L. (Rutaceae), an exotic fruit mainly infested by Medfly (Schliserman & Ovruski 2004). According to Ovruski et al. (2004), *C. capitata* is not heavily parasitized by neotropical *Anastrepha* parasitoid species. With the exception of the figitids *A. pelleranoi*, *A. nordlanderi* Wharton, and *Odontosema anastrephae* Borgmeier (Wharton et al. 1998), braconid parasitoids appear to adapt poorly to the exotic *C. capitata* (Ovruski et al. 2004).

Even though the number and size of fruit samples collected during this study were relatively small, the results seemingly suggest that *U. anastrephae* and *D. brasiliensis* would have a certain degree of fruit preference when searching host larvae. For example, *U. anastrephae* with the shortest ovipositor of any of the opiine species obtained (0.7 ± 0.1 times as long as the metasoma, $n = 12$), was most commonly found attacking *A. fraterculus* larvae in *M. pungens* and *E. uniflora*, the smallest fruit species sampled (7 and 8 times smaller than the guava or the feijoa, respectively). This relationship between smaller host fruit species and *U. anastrephae* has been previously reported by Hernández-Ortiz et al. (1994), Lopez et al. (1999), Sivinski et al. (1997, 2000, 2001), and Aluja et al. (2003b) collecting fruit species of *Spondias* (Anacardiaceae) in México, and by Aguiar Menezes et al. (2001) collecting *Eugenia* species (Myrtaceae) in Brazil. On the other hand, *D. brasiliensis*, which has the longest ovipositor of the parasitoid species collected (3.3 ± 0.2 times longer than the metasoma, $n = 12$), was observed only in association with *A. fraterculus* in *F. sellowiana* and *P. guajava*, the largest fruit species sampled. This peculiarity has also been noted by Aguiar-Menezes & Menezes (1997) in Brazil, when collecting *A. fraterculus* larvae parasitized by *D. brasiliensis* exclusively from *Prunus persica* (L.) Batsch (peach), and by Ovruski et al. (2004) in NW Argentina, where *D. brasiliensis* was mainly recovered from both peach and guava. Interestingly, wild fruits of *Prunus persica*, *P. guajava*, and *F. sellowiana* have a similar size (Ovruski et al 2004; Ovruski & Schliserman 2003a). *Doryctobracon areolatus*, which has a relatively long ovipositor (2.3 ± 0.2 times longer than the metasoma, $n = 12$) but 1.4 times shorter than *D. brasiliensis*' ovipositor, may be occupying an intermediate position between *U. anastrephae* and *D. brasiliensis* in host fruit preference. As reported previously Sivinski et al. (1997), Lopez et al. (1999), and Aguiar Menezes et al. (2001), *D. areolatus* might not have any host fruit preference. This opiine species has the broadest host-fly and host-fruit range of any of the Mexican (Sivinski 1997, 2000, 2001; Aluja et al. 2003b) and Brazilian (Canal & Zucchi 2000) fruit fly parasitoid species. In NW Argentina, *D. areolatus* has been reported foraging on a wide range of *A. fraterculus* host plant species (Ovruski et al. 2004). Apparently, a short ovipositor would allow *U. anastrephae* to have access to fly larvae mainly in small fruit, whereas a long ovipositor would allow *D. areolatus* (or *D. brasiliensis*) to reach host larvae in both large and small fruit. While studying a Mexican *Anastrepha*-parasitoid guild of 5 opiine species, including *U. anastrephae* and *D. areolatus*, Lopez et al. (1999) and Sivinski et al. (1997, 2001) found a strong correlation between ovipositor length of parasitoids and the size of host-infested fruits. This relationship would imply that the ovipositor length is an important limitation on foraging (Sivinski et al. 1997). Furthermore, Sivinski et al. (2001) and Sivinski & Aluja (2003) pointed out that the ovipositors in the opiine spe-

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cies attacking Mexican fruit fly would have originally diverged due to the action of environmental factors such as temperature, humidity, seasonality, and/or host-fruit abundance and diversity.

Although data provided here are preliminary, parasitization rates appear to be too low to consider parasitoids as a significant natural mortality factor of *A. fraterculus* in the study area. However, reliable data on the impact of the parasitoids upon natural *A. fraterculus* populations can be obtained only by closely monitoring the host and parasitoid population fluctuations for many generations in exotic and native host plant species. Thus, further studies on the ecology and behavior of *A. fraterculus* and their natural enemies should be carried out in Entre Ríos for implementing a feasible, but cautious, biological control strategy against this fruit fly pest. As suggested by Aluja (1996, 1999), native host plants could be managed to naturally augment parasitoid numbers and to sustain parasitoid populations in wild vegetation areas. Therefore, conservation of native *A. fraterculus*-parasitoids would be an attractive alternative to the indiscriminate introduction of exotic parasitoids (Sivinski & Aluja 2003).

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