

Status of the forensically important genus *Ophyra* (Diptera: Muscidae) in Argentina

PATITUCCI, Luciano D.***, Pablo R. MULIERI***, Adriana OLIVA*** and Juan C. MARILUIS***

* CONICET, Buenos Aires, Argentina.

** Departamento Vectores-CeNDIE, ANLIS "Dr. Carlos G. Malbrán", Av. Vélez Sársfield 563, C1281AFR, Buenos Aires, Argentina; e-mail: lpatitu@yahoo.com.ar, mulierii@yahoo.com, jcmartiluis@yahoo.com.ar

*** Laboratorio de Entomología Forense, Museo Argentino de Ciencias Naturales, Av. A. Gallardo 470, C1405DJR, Buenos Aires, Argentina; e-mail: aoliva@macn.gov.ar

Estado del género de importancia forense *Ophyra* (Diptera: Muscidae) en Argentina

■ **RESUMEN.** El género *Ophyra* Robineau-Desvoidy es un grupo de múscidos necrófagos distribuidos en los climas cálidos de todo el mundo. La información aquí presentada se basa en la recopilación de datos de distribución, obtenida a partir del material de diferentes colecciones y bibliografía para la Argentina. *Ophyra albuquerquei* Lopes, *Ophyra capensis* (Wiedemann), *Ophyra chalcogaster* (Wiedemann) y *Ophyra solitaria* Albuquerque se registraron por primera vez para el país. Se presenta una clave para las especies argentinas. Se discuten los datos biológicos y forenses de las distintas especies.

PALABRAS CLAVE. *Ophyra*. Muscidae. Entomología forense. Argentina.

■ **ABSTRACT.** The genus *Ophyra* Robineau-Desvoidy is a necrophagous group of Muscidae distributed in warm climates worldwide. The information here presented is based on the compilation of distributional data obtained from material of different collections and bibliography for Argentina. *Ophyra albuquerquei* Lopes, *Ophyra capensis* (Wiedemann), *Ophyra chalcogaster* (Wiedemann) and *Ophyra solitaria* Albuquerque were recorded for the first time for the country. A key for the Argentinean species is presented. Biological and forensic data of species are discussed.

KEY WORDS. *Ophyra*. Muscidae. Forensic entomology. Argentina.

INTRODUCTION

The genus *Ophyra* Robineau-Desvoidy (Diptera: Muscidae) comprises approximately 20 species of small flies distributed in warm climates worldwide. The species of this genus are frequently associated with decaying matter, especially on corpses (Centeno *et al.*, 2002; Couri *et al.*, 2009). *Ophyra* larvae act as

predators on other dipteran larvae, and may be recovered on human cadavers during the late or active decay stage (Skidmore, 1985; Byrd & Castner, 2001). The species of *Ophyra* are frequently found in domestic situations that contribute to both medical and forensic importance (Oliva, 1997, 2001; Aballay *et al.*, 2008; Carvalho & Mello-Patiu, 2008; Rosa *et al.*, 2009). Synanthropic studies in

the Neotropical Region have examined the relationship between the species of this genus and the different environments (Carvalho *et al.*, 1984; Costa *et al.*, 2000; Ribeiro *et al.*, 2000; Figueroa-Roa & Linhares, 2004).

The phylogenetic placement of the genus *Ophyra* has been the subject of debate for a long time. Older hypotheses place this genus in the Phaoniinae (Malloch, 1923; Séguy, 1937). Currently, this idea was rejected in several works (Hennig, 1965; Pont, 1973; Skidmore, 1985; Pamplona & Couri, 1989; Carvalho, 2002). On one hand, some authors consider the genus *Ophyra* as a junior synonym of *Hydrotaea* within the Azeliinae (Vockeroth, 1996, Savage & Wheeler, 2004). On the other hand, some authors considered *Ophyra* and *Hydrotaea* as separate Azeliinae genera (Skidmore, 1985; Pamplona & Couri, 1989; Carvalho, 2002). More recently, phylogenetic analyses based on morphological (Savage & Wheeler, 2004) and molecular characters (Schuehli *et al.*, 2004; Schuehli *et al.*, 2007) suggest the placement of *Ophyra* within the Muscinae.

In the Neotropical region, the genus is represented by seven species (Pamplona & Couri, 1989; Carvalho *et al.*, 2005). In Argentina, the genus *Ophyra* has been scarcely studied in previous taxonomic works with a single species, *Ophyra aenescens* (Wiedeman), and listed for the local fauna (Nihei & Dominguez, 2008; Battan Horenstein *et al.*, 2010). This species was recorded by Bigot (1885) as *Ophyra argentina* and by Shannon & Del Ponte (1926, 1928) as *Ophyra carbonaria*, and subsequent studies have used these synonymic names (Oliva, 1997, 2001, 2007; Centeno *et al.*, 2002). On the other hand, unidentified species of *Ophyra* were reported by Oliva (2001), Laos *et al.* (2004), Battan Horenstein *et al.* (2005) and Aballay *et al.* (2008) for several locations in Argentina.

In the present study, the knowledge of the necrophagous genus *Ophyra* in Argentina is revised and first country records for *Ophyra albuquerquei* Lopes, *Ophyra capensis* (Wiedemann), *Ophyra chalcogaster* (Wiedemann) and *Ophyra solitaria* Albuquerque are presented. A key

for the Argentinean species is provided, and the range of distribution of the species is extended.

MATERIALS AND METHODS

The present study was based principally on specimens collected during ecological studies with a sweep net on attracting baits (meat, rotten cow liver and chicken viscera); and from autopsy samples analyzed between the years 1995 and 2008.

Identification of specimens was ensured by the use of original descriptions and redescriptions of the species (see remarks). All the specimens studied belong to the following institutions: ANLIS "Dr. Carlos G Malbrán", Departamento Vectores (ANLIS); Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Laboratorio de Entomología forense (MACN-EF); Facultad de Agronomía-UBA, Cátedra de Biología Agrícola (FAUBA); Fundación Miguel Lillo (FML); Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA). The specimens collected by the authors were deposited at ANLIS and MACN-EF. Acronyms used for collections are as follows: BMNH the Natural History Museum, London, United Kingdom; MNHN Muséum National d'Histoire Naturelle, Paris, France; MNRJ Universidade do Rio Janeiro, Museu Nacional, São Cristóvão, Rio de Janeiro, Brazil; NMW Naturhistorisches Museum Wien, Wien, Austria; UMO Oxford University Museum of Natural History, Oxford, United Kingdom; USNM National Museum of Natural History, Washington D.C., USA; ZMUC University of Copenhagen, Zoological Museum, Copenhagen, Denmark.

The terminology used in key for the external morphology follows McAlpine (1981) and Hockett & Vockeroth (1987).

RESULTS

Ophyra Robineau-Desvoidy, 1830

Ophyra Robineau-Desvoidy, 1830: 516.

Type-species, *Ophyra nitida* Robineau-Desvoidy (Rondani, 1866: 70, 84) [= *Musca ignava* Harris, 1780].

Ophyra aenescens (Wiedemann, 1830)

Anthomyia aenescens Wiedemann, 1830: 435. Type-locality: "New-Orleans", USA. Lectotype male (by designation of Pont, 1997: 88) (NMW), paralectotype (NMW).

Ophyra virescens Macquart, 1843: 321. Type-locality: "Guarutuba, Brésil". Syntype female (MNHN). Synonymy with *aenescens* by Pont, 1972: 13.

Anthomyia setia Walker, 1849: 956. Type-locality: "Galapagos". Holotype female (BMNH). Synonymy with *aenescens* by Aldrich, 1928: 4, 5 and confirmed by Curran, 1932: 360.

Ophyra argentina Bigot, 1885: 302. Type-locality: "Buenos-Aires". Holotype female (UMO). Synonymy with *aenescens* by Stein, 1907: 212.

Ophyra carbonaria Shannon & Del Ponte, 1926: 576. Type-locality: Argentina: Tucumán & Buenos Aires Syntypes male/female, (USNM and ANLIS). Synonymy with *aenescens* by Aldrich, 1928: 4 and by Shannon & Del Ponte, 1928: 142.

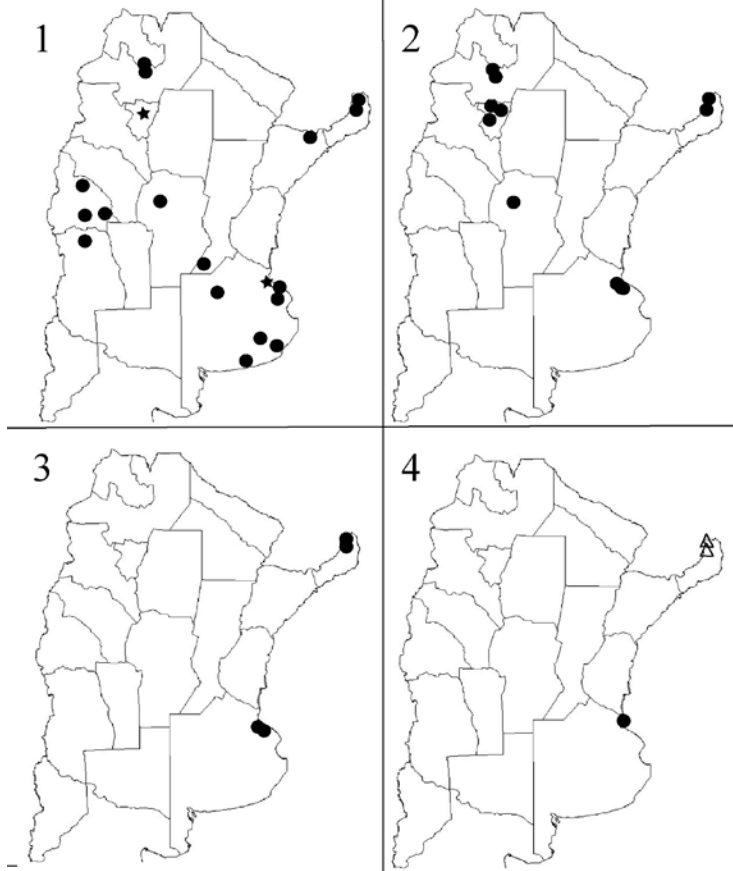
Type material. Syntypes of *Ophyra carbonaria*. **Buenos Aires:** San Isidro, 25-VIII-1926, Shannon leg., 2 males, 5 females (ANLIS); **Tucumán:** Tucumán, 21-VI-1926, Shannon leg., 1 male (ANLIS).

Other material examined. **Buenos Aires:** Balcarce, II-1947, Wappers leg., 1 female (ANLIS); Buenos Aires, 20-IV-1915, Bruch leg., 1 male (ANLIS); Buenos Aires, # 271, 7-X-2003, Oliva leg., 1 female (MACN-EF); Buenos Aires Emerg. 111, 5-I-2000, Oliva leg., 6 females (MACN-EF); Buenos Aires, 3-VI-1907, Oliva leg., 1 females (MACN-EF); Burzaco, 13-II-2007, Mulieri leg., 3 males, 13 females (ANLIS); Carlos Casares, 14-II-2006, Medan, Devoto & Fernandez leg., 1 male (FAUBA); Ciudad Universitaria, Capital Federal, 7-XII-2007, Patitucci leg., 8 females (ANLIS); Instituto Bacteriológico

"Dr. Carlos G. Malbrán", Capital Federal, 9-VII-1938, 1 female (ANLIS); Laguna La Tablilla, Chascomús, 01-XII-2007, Torretta leg., 2 males, 1 female (FAUBA); Magdalena, 30-XI-2000, Torretta leg., 1 female (FAUBA); Mar del Plata, XI-2007, Patitucci leg., 1 male, 1 female (ANLIS); Ministro Rivadavia, 17-I-2007, Mulieri leg., 11 males, 53 females (ANLIS); Quequen, I-2010, Patitucci leg., 2 females (ANLIS); Tandil, 21-XI-2003, cerdo 52 d., Oliva leg., 1 male, 1 female (MACN-EF); Villa Elisa, La Plata, II-1982 Mariluis leg., 2 males, 2 females (ANLIS). **Córdoba:** Capilla del Monte, I-2001, Mariluis leg., 1 female (ANLIS). **Corrientes:** Ituzaingo, XII-1976, Mariluis leg., 2 males, 8 females (ANLIS). **Mendoza:** capital, IADIZA, 31-VII-2007, Aballay leg., 2 males (IADIZA). **Misiones:** Iguazú, 23-III-1987, Mariluis leg., 5 males, 3 females (ANLIS); Puerto Esperanza, X-1978, Mariluis leg., 1 male, 3 females (ANLIS). **Santa Fe:** Christophersen, General López, 25-IV-2009, Patitucci leg., 3 males, 14 females (ANLIS). **Salta:** La Caldera, XII-1986, Mariluis leg., 5 males, 9 females (ANLIS); El Maray, Depto Chicoana, XII-1986, Mariluis leg., 1 female (ANLIS). **San Juan:** Jachal, La Legua, 1164 m.a.s.l., 06-IV-2005, Aballay leg., 2 males (IADIZA); same data except., 27-III-2005, 1 female (IADIZA); Rivadavia, 674 m.a.s.l., 11-I-2006, Aballay leg., 1 male, 1 female (IADIZA); same data except., 10-I-2006, 2 females (IADIZA); same data except., 12-I-2006, 1 male (IADIZA); Rivadavia, Barrio Aramburu, 08-X-2005, 3 females (IADIZA); same data except., 666 m.a.s.l., 07-VI-2005, 1 female (IADIZA); Valle Fértil, 560 m.a.s.l., 30-VI-2006, Aballay leg., 2 males, 5 females (IADIZA)

Distribution. **Buenos Aires**, **Córdoba**, **Corrientes** (new record), **Mendoza** (new record), **Misiones** (new record), **Santa Fe** (new record), **Salta** (new record), **San Juan** (new record), **Tucumán** (Fig 1).

Remarks. The specimens examined agree with the description given by Pamplona & Couri (1989). In addition, we compare the specimens captured with the type material of *O. carbonaria* Shannon & Del



Figs. 1-4. Geographic distribution of *Ophyra* species in Argentina. 1, *Ophyra aenescens* (black spots = new record; black star = bibliographic record); 2, *O. albuquerquei* (black spots = new record); 3, *O. capensis* (black spots = new record); 4, *O. chalcogaster* (black spots = new record) and *O. solitaria* (white triangle = new record).

Ponte. *Ophyra aenescens* is a widespread synanthropic species, originally from the Neotropical Region (Hogsette & Washington, 1995). This species is associated with urban environments and is more abundant during the summer months (Linhares, 1981; Ribeiro *et al.*, 2000). This species has been recorded breeding in numerous media as crab, liver cow, fish, shrimp and mouse carcass (d'Almeida, 1988; d'Almeida, 1994; Moura, 2004). Larvae are saprophagous during the first instar, but second- and third-instar larvae are predators on *Musca domestica* L. (d'Almeida *et al.*, 1999). In forensic studies, the larvae are often found in body exudates that have soaked into soil beneath remains, and commonly associated with exposed gut contents (Byrd & Castner, 2001).

Ophyra albuquerquei Lopes, 1985

Ophyra albuquerquei Lopes, 1985: 117 (Figs. 1-8). Type-locality: Brazil, Rio de Janeiro, Le Vallon, Alto da Mosela Holotype male (MNR), paratypes (MNR).

Material examined. Buenos Aires: Burzaco, 15-XII-2006, Mulieri leg., 1 female (ANLIS); Capital Federal, XII-2007, Patitucci leg., 1 female (ANLIS); Ministro Rivadavia, 15-I-2007, Mulieri leg., 15 females (ANLIS). **Córdoba:** Capilla del Monte, I-2001, Mariluis leg., 2 females (ANLIS). **Misiones:** Iguazú, 23-III-1987, Mariluis leg., 2 males, 4 females (ANLIS); Puerto Esperanza, X-1978, Mariluis leg., 2 males, 7 females (ANLIS).

Salta: La Caldera, XII-1986, Mariluis leg., 5 males, 9 females (ANLIS); El Maray, Depto Chicoana, XII-1986, Mariluis leg., 1 male, 5 females (ANLIS). **Tucumán:** Padre Monti, Burruyacu, 7-II-1948, Golbach leg., 2 males (FML), Quebrada La Toma, 21-XII-1950, Golbach leg., 1 male (FML); San Pedro de Colalao, 1190 m., III-1979, Mariluis leg., 1 female (ANLIS).

Distribution. **Buenos Aires** (new record), **Córdoba** (new record), **Misiones** (new record), **Salta** (new record). **Tucumán** (new record) (Fig 2).

Remarks. Diagnosis and illustrations of the male and female genitalia can be found in Lopes (1985) and Pamplona & Couri (1989). *Ophyra albuquerquei* is a Neotropical species, previously known from Brazil (Carvalho *et al.*, 2005). This species was associated to rural or wild environments (Costa *et al.*, 2000). The seasonal fluctuation of this species was similar to *O. aenescens* in Brazil (Riveiro *et al.*, 2000). The biological information of this species is poorly known, with studies referred to breed, longevity and oviposition (Krüger *et al.*, 2003, 2004).

Ophyra capensis (Wiedemann, 1818)

Anthomyia capensis Wiedemann, 1818: 46.
Type-locality: "Vorgebirge der guten Hoffnung", South Africa. Lectotype male (NMW) (by designation of Pont, 1997: 91).

Material examined. **Buenos Aires:** Capital Federal, Cementerio de la Chacarita, 8-VIII-1998, Oliva leg., 2 males (ANLIS); Capital Federal, 5-I-2000, Oliva leg., Emerged from beef bait rearing n° 111, 2 males, 5 females (ANLIS).

Distribution. **Buenos Aires** (new record) (Fig 3).

Remarks. The specimens examined agree with the description given by Pamplona & Couri (1989). *Ophyra capensis* is an exotic species from the Old World (Skidmore,

1985). This species has been reared from human faeces, carrion, nets of various mammals and birds (Couri *et al.*, 2009). *Ophyra capensis* was found on human bodies kept indoors for several months, where blowflies (Diptera, Calliphoridae) do not have access to them (Bourel *et al.*, 2004). Recently, paleopathologic studies found puparia and adult fragments of this species into a mummified body (Couri *et al.*, 2008).

Ophyra chalcogaster (Wiedemann, 1824)

Anthomyia chalcogaster Wiedemann, 1824: 52. Type-locality: "lava", Indonesia. Lectotype male (ZMUC) (by designation of Pont, 1973: 242).

Material examined. **Buenos Aires:** Burzaco, 15-XII-2006, Mulieri leg., 3 females (ANLIS); Buenos Aires, 20-X-1906, A Zotta leg., 1 male (MACN-EF); Buenos Aires 17-IV-2002, Oliva leg., # 219, 1 female (MACN-EF); Capital Federal, X-2007, Patitucci leg., 4 males, 3 females (ANLIS). **Misiones:** Iguazú, X-1988, Mariluis leg., 4 females (ANLIS).

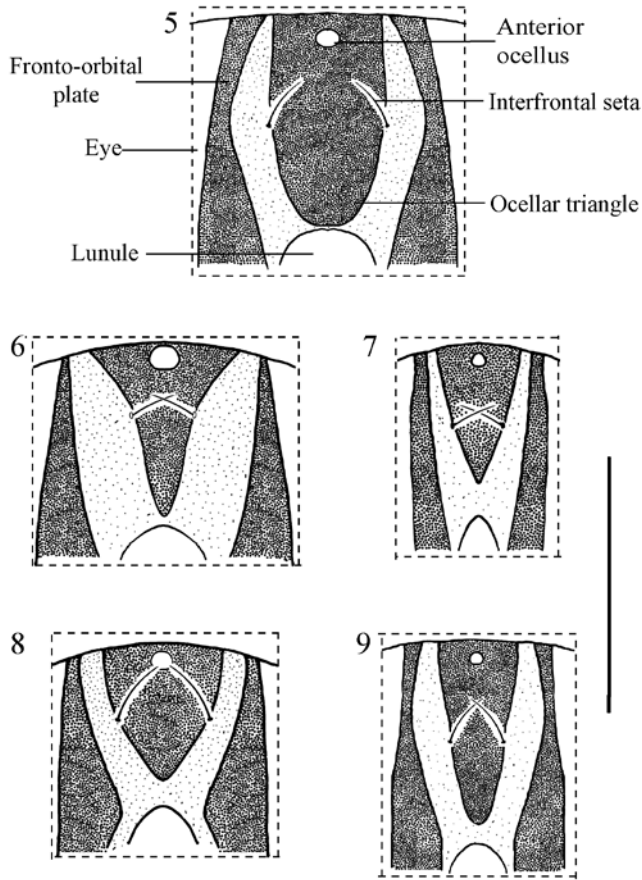
Distribution. **Buenos Aires** (new record), **Misiones** (new record) (Fig 4).

Remarks. The specimens examined agree with the description given by Pamplona & Couri (1989). *Ophyra chalcogaster* is a cosmopolitan species associated to urban or suburban environments (Linhares, 1981; Costa *et al.*, 2000). Different kinds of bait were used to collect and breed this species (human and dog faeces, fish, chicken viscera, mouse carcass) (d'Almeida *et al.*, 1989; Mendes & Linhares, 1993; Moura, 2004). This species is less abundant than *O. aenescens* and *O. albuquerquei* in Brazil (Riveiro *et al.*, 2000).

Ophyra solitaria Albuquerque, 1958

Ophyra solitaria Albuquerque, 1958: 7 (Figs. 12–16). Type-locality: Brazil, Goiás, Anápolis. Holotype female (MNRJ).

Material examined. **Misiones:** Iguazú, 23-III-1987, Mariluis leg., 6 females (ANLIS);



Figs. 5-9. Ocellar triangle, frontal view, female. 5, *Ophyra aenescens*; 6, *O. albuquerquei*; 7, *O. capensis*; 8, *O. chalcogaster*; 9, *O. solitaria*. Scale bars = 1 mm.

Puerto Esperanza, X-1978, Mariluis leg., 1 female (ANLIS).

(Riveiro *et al.*, 2000).

Distribution. Misiones (new record) (Fig. 4).

Key to the species of *Ophyra* in Argentina (modified from Carvalho, 2002)

Remarks. Identification of *Ophyra solitaria* was based on Albuquerque (1958) for the females, and Lopes (1978) for males. In addition, Pamplona & Couri (1989) provided diagnosis of both sexes. This is a Neotropical species, previously known from Brazil (Carvalho *et al.*, 2005). This species was associated to rural or wild environments (Costa *et al.*, 2000). *Ophyra solitaria* was collected and reared from human faeces, crab, fish, shrimp and mouse carcass (d’Almeida, 1988; Leandro & d’Almeida, 2005). This species is less abundant than *O. aenescens* and *O. albuquerquei* in Brazil

1. Palpus orange-yellow. Female: ocellar triangle long and wide with a rounded apex reaching the lunule (Fig. 5). Male: hind trochanter on ventral surface with a tuft of fine setae *O. aenescens* (Wiedemann)
- Palpus brown or black. Female: ocellar triangle shape not as above (Figs. 6-9). Male: hind trochanter on ventral surface without a tuft of fine setae 2
2. Lower calypter dark brown with dark brown margin. Female: ocellar triangle long and sharpened with a rounded apex reaching

- the lunule (Fig. 6).
 *O. albuquerquei* Lopes
 - Lower calypter yellowish or white with yellow or white margins. Female: ocellar triangle shape not as above (Figs. 7-9).....
3
3. Arista yellow at the basal middle and black at the distal middle. Female: ocellar triangle short, with a triangular shape not reaching lunule (Fig. 7). Male: fore tarsi with tarsomeres yellow on ventral surface.....
*O. chalcogaster* (Wiedemann)
 - Arista brown. Female: ocellar triangle shape not as above (Figs. 8-9). Male: fore tarsi with tarsomeres brown on ventral surface.....
4
4. Wing hialine. Female: ocellar triangle broad not reaching lunule (Fig. 8). Male: hind tibia on anteroventral, ventral and posteroventral with a series of long seta at apical two-thirds
 *O. capensis* (Wiedemann)
 - Wing brown at the anterior middle. Female: ocellar triangle long with a rounded apex not reaching lunule (Fig. 9). Male: hind tibia with 2 setae at the middle on anteroventral, 1 seta on anterodorsal and 1 long seta posteroventral
 *O. solitaria* Albuquerque

DISCUSSION

The species of *Ophyra*, based on the literature and the examined material, were associated with different kinds of baits (Carvalho *et al.*, 1984; d’Almeida *et al.*, 1989; Costa *et al.*, 2000). Specimens collected in Buenos Aires, as part of a comprehensive work on Muscidae assemblages along an urban-rural gradient, were mainly collected on meat, cow liver and chicken viscera. Phenology of the species seems to be restricted to the warmer period. The species were captured during November and December (late spring) in agreement with previous works (Costa *et al.*, 2000; Carvalho *et al.*, 1984). In addition, material of *Ophyra* spp. was found in autopsy samples along

the whole year, but it was more abundant in November and December (late spring). Only 14 samples, out of 407 taken between 1995 and 2005, contained *Ophyra* spp. (Oliva, 2007; *sub Hydrotaea argentina*). In the period 1995-2008 there were 32 cases with *Ophyra* spp., of which 3 were exhumations. Adipocere was present in four cases (two exhumations, one corpse wrapped in plastic bags, one dismembered corpse inside a bag).

The distribution of these species was significantly extended. We registered the southernmost point of the South American distribution for *O. aenescens* in Quequen, Buenos Aires (38° 34’ 12.68’’ S, 58° 40’ 24.52’’ W). Also, our current findings expand the geographical distribution of the widespread species, *O. capensis* and *O. chalcogater*, reaching the area of Buenos Aires city. On the other hand, the Neotropical species *O. albuquerquei*, which had only been recorded from Brazil, was registered in Buenos Aires, Córdoba, Salta and Tucumán provinces expanding significantly its geographical distribution. Finally, a few specimens of *O. solitaria* were captured in the province of Misiones.

Muscid flies are of great forensic importance due to their wide distribution, ubiquitous nature, and close association with man (Byrd & Castner, 2001). *Ophyra* species have a specific forensic significance, appearing usually during the period of ammoniacal fermentation (Couri *et al.*, 2008). The fact that species of *Ophyra* attack the corpses in a later succession wave suggests that probably the corpse has not been exposed to open air for some time (Couri *et al.*, 2009). This theory was supported by Smith (1986), who makes clear that in the cold-temperate climate of the British Isles, *Ophyra* spp. will be found in warm, dry ambient, indoors or in coffins. However, in subtropical and tropical climates one may expect to find *Ophyra* spp. in large numbers outdoors.

The species of *Ophyra* occur in different environments along an urban-rural gradient (Linhares, 1981; Costa *et al.*, 2000). The Neotropical species of this genus (*O. albuquerquei* and *O. solitaria*) were collected

in rural and wild environments. On the contrary, the cosmopolitan species (*O. aenescens*, *O. capensis*, and *O. chalcogaster*) were associated to urban areas (Linhares, 1981; Costa *et al.*, 2000). In Buenos Aires, *Ophyra* spp. appear in large numbers on disinterred corpses and indoors in cases of undetected natural deaths (Oliva, 2007). In contrast, Oliva (2001) found *Ophyra* sp. in samples obtained on an outdoors corpse in December (early summer), in Chajarí, Entre Ríos province. These contrasting results may be explained by the presence of different species in different environmental conditions.

The knowledge concerning with the relative abundance and the seasonal fluctuation of species of *Ophyra* in different environments could provide new tools for forensic entomology.

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