

First reports of the invasive pest Bermudagrass Stem Maggot, *Atherigona reversura* Villeneuve, 1936 (Diptera: Muscidae), in South America

Luciano D. Patitucci^{1*}, Matías I. Dufek² and Pablo R. Mulieri¹

- 1 Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina. Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (MACN). Av. Ángel Gallardo 470, Buenos Aires, Argentina
 - 2 Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET). Universidad Nacional del Nordeste, Facultad de Ciencias Exactas y Naturales y Agrimensura, Biología de los Artrópodos, Av. Libertad 5470, Corrientes, Argentina
- * Corresponding author. E-mail: lpatitu@yahoo.com.ar

Abstract: This study presents the first occurrence of *Atherigona reversura* in South America. This muscid, commonly known as shoot-fly, is a significant pest of cereal crops throughout the Old World tropics and subtropics. Several specimens were collected during various months in 2014 and 2015. These new records are dispersed in a wide geographical area of temperate and subtropical regions of eastern Argentina. The main host of *A. reversura*, the exotic bermudagrass *Cynodon dactylon*, is considered a pest and is widely distributed in South America.

Key words: pest crops; exotic species; muscoid; fly; world distribution; Argentina

Atherigona Rondani, 1856 is a genus of Muscidae from the Old World that is widely distributed in the Afro-tropical and Oriental regions. These muscids, commonly known as shoot-flies, are a significant pest of cereal crops throughout the Old World tropics and subtropics (Pont and Magpayo 1995). *Atherigona* is divided in two subgenera: *Acritochaeta* (Grimshaw, 1901), whose larvae live in decaying plant or even animal matter, and *Atherigona* s. str., whose larvae are phytophagous and primary pests of various species of Poaceae (Skidmore 1985).

In the New World, only two introduced species are present: *Atherigona (Acritochaeta) orientalis* Schiner, 1868, with a distributional range from southern USA to northeastern Argentina (Carvalho et al. 2005), and *A. (Atherigona) reversura* Villeneuve, 1936, recently recorded from the North American continent (Hudson 2010).

Larvae of *A. reversura*, commonly known as Bermudagrass Stem Maggot, can cause severe damage

to plants. Although this species breeds mainly in Bermudagrass (*Cynodon dactylon* [L.]), other Poaceae host plants have been reported, including crops such as *Echinochloa colona* (L.) Link, *Eleusine coracana* (L.) Gaertn., *Eriochloa procer*a (Retz.) C.E. Hubb., *Sehima nervosum* (Rottl.) Stapf., *Sorghum bicolor* (L.) and *Zea mays* (L.) (Pont and Magpayo 1995). Although the immature stages of *A. reversura* have been already described (Grzywacz et al. 2013), their life cycle and biology remain unknown.

The geographic distribution of this Oriental species included Burma, China, India, Indonesia, Malaysia, the Philippines, Sri Lanka, and Taiwan, but has now extended to the Australasian (Hawaii, Papua New Guinea), Palearctic (Japan, Oman), Nearctic (USA), and Neotropical (Mexico) regions (Table 1; Figure 1).

Here, we report the first occurrence of *A. reversura* in South America and its first record in Argentina. We collected this species in several localities of Buenos Aires, Santa Fe and Chaco provinces. Some of the specimens collected in Santa Fe and Chaco were associated to cultivated fields.

Specimens of *A. reversura* were collected during two surveys of the diversity of Calyprtratae in two different ecoregions: Oriental Chaco (Villa Berthet) and Pampas Grasslands (Reserva Natural Estricta (RNE) Otamendi). Flies from Villa Berthet were collected using Van Someren-Rydon canopy traps (Rydon 1964) baited with rotten squid, whereas specimens from RNE Otamendi were obtained with Malaise traps. These trapping programs were performed monthly in Villa Berthet and seasonally in RNE Otamendi. In addition, a small number of supplemental specimens of *A. reversura* were obtained from occasional catches with a hand net at Burzaco, Buenos Aires province and at Santa

Isabel, Santa Fe province (Figure 1). These catches were obtained during July 2015 and December 2014, respectively (Table 2). We obtained the georeferences from bibliographic and internet sources (Table 1). If localities were only mentioned without coordinates in

the sources, their georeferences were obtained from Google Earth™.

Voucher specimens were pinned and deposited in the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (MACN), Buenos Aires, Argentina: MACN-En

Table 1. Known records of *A. reversura* in the world. Latitude and longitude are shown only when record can be georeferenced.

Continent	Country	Province / State	Localities	Latitude	Longitude	Reference
Asia	Burma	—	—	—	—	Pont and Magpayo 1995
Asia	China	Guangdong	—	—	—	Fan and Lui 1982
Asia	China	Hebei, and Jiangsu	—	—	—	Pont and Magpayo 1995
Asia	China	Sichuan	—	—	—	Villeneuve 1936
Asia	India	Andra Pradesh	Patancheru, Hyderabad	17°32'03.90"N	078°15'19.38"E	Seshu Reddy and Davies 1977
Asia	India	Assam, Delhi, Maharashtra, Sikkim, Uttar Pradesh, and West Bengal	—	—	—	Pont and Magpayo 1995
Asia	Indonesia	Java Is., Lombok Is., Sulawesi Is., and Sumbawa Is.	—	—	—	Pont and Magpayo 1995
Asia	Malaysia	Malaya, and Sabah	—	—	—	Pont and Magpayo 1995
Asia	Philippines	Balabac Is.	—	08°09'41.68"N	117°08'34.45"E	Pont and Magpayo 1995
Asia	Philippines	Busuanga Is.	—	12°09'30.71"N	119°55'39.84"E	Pont and Magpayo 1995
Asia	Philippines	Luzon Is.	Manila	14°36'18.61"N	120°59'36.31"E	Pont and Magpayo 1995
Asia	Philippines	Luzon Is.	Mayoyao	16°57'04.73"N	121°13'00.65"E	Pont and Magpayo 1995
Asia	Philippines	Luzon Is.	Laguna Liliw	14°08'11.22"N	121°26'23.65"E	Pont and Magpayo 1995
Asia	Philippines	Mindanao	Agusan River	08°55'13.02"N	125°31'50.57"E	Pont and Magpayo 1995
Asia	Philippines	Mindanao	Cotabato	07°06'30.79"N	125°02'19.77"E	Pont and Magpayo 1995
Asia	Philippines	Mindanao	Zamboanga	08°09'09.44"N	123°15'40.59"E	Pont and Magpayo 1995
Asia	Philippines	Palawan Is.	Puerto Princess	09°48'33.61"N	118°44'35.12"E	Pont and Magpayo 1995
Asia	Philippines	Sulu Is.	—	05°58'16.53"N	121°07'20.97"E	Pont and Magpayo 1995
Asia	Sri Lanka	—	—	—	—	Pont and Magpayo 1995
Asia	Taiwan	Taihoku	—	25°01'58.69"N	121°33'55.50"E	Pont 1986
Asia	Japan	Kyushu	Mizayaki area	—	—	Ikeda et al. 1991
Asia	Oman	—	—	—	—	Pont and Magpayo 1995
North America	Mexico	Chiapas	Chiapa de Corzo	16°42'39.19"N	093°01'22.90"W	Grzywacz et al. 2013
North America	USA	California	Long Beach, Los Angeles County	33°46'12.18"N	118°11'37.46"W	Holderbaum 2009
North America	USA	California	Westminster, Orange County	33°45'04.83"N	117°59'38.21"W	Woodworker 2015
North America	USA	California	El Dorado Nature Center, Los Angeles County	33°48'34.39"N	118°05'12.90"W	Moore 2015
North America	USA	California	Laguna Niguel, Orange County	33°31'21.10"N	117°42'27.20"W	Lazere 2014
North America	USA	California	Shipleigh Nature Center, Huntington Beach, Orange County	33°42'05.12"N	118°00'23.70"W	Hemberger 2013
North America	USA	Florida	Rotonda West, Charlotte County	26°53'01.23"N	082°17'24.34"W	Barnd 2011
North America	USA	Florida	Boca Raton, Palm Beach County	26°39'05.22"N	080°16'36.24"W	Kolstad 2013
North America	USA	Georgia	Tifton County	31°24'35.97"N	083°33'10.53"W	Grzywacz et al. 2013
North America	USA	Georgia	Dalton, Whitfield County	34°48'11.87"N	084°58'54.19"W	Cruz 2012
North America	USA	Georgia	Montrose, Laurens County	32°26'07.62"N	082°59'42.64"W	Hart 2010
North America	USA	Mississippi	Big Level, Stone County	30°48'42.56"N	089°03'04.69"W	Werle 2012
North America	USA	New Jersey	Atco, Camden County	39°46'11.24"N	074°53'16.61"W	Alexander 2010
North America	USA	North Carolina	Swanannoa, Buncombe County	35°35'52.44"N	082°23'59.40"W	Alexander 2011
North America	USA	Oklahoma	Pryor, Mayes County	36°18'30.33"N	095°19'00.88"W	Webster 2014
North America	USA	Pennsylvania	Allison Park, Allegheny County	40°26'41.61"N	080°00'34.20"W	Rosenfeld 2015
North America	USA	South Carolina	Gray Court, Laurens County	34°31'18.35"N	082°07'38.47"W	Moorman 2014
North America	USA	Texas	El Paso, El Paso County	31°48'14.34"N	106°12'18.50"W	Vitanza 2015
North America	USA	Texas	Houston, Harris County	29°45'39.01"N	095°22'19.05"W	Schneider 2012
North America	USA	Virginia	Independent Hill, Prince William County	38°47'00.73"N	077°36'30.74"W	Gallagher 2013
North America	USA	Virginia	Norfolk	36°51'02.75"N	076°17'09.21"W	Justis 2011
Oceania	Papua New Guinea	—	—	—	—	Pont and Magpayo 1995
Oceania	USA	Hawaii	Oahu Is.	21°26'20.08"N	158°00'00.20"W	Hardy 1981
Oceania	USA	Hawaii	Mauai Is.	20°47'54.11"N	156°19'54.93"W	Hardy 1981
Oceania	USA	Hawaii	Kauai Is.	21°57'57.99"N	159°34'25.65"W	Hardy 1981
Oceania	USA	Hawaii	Kaunakakai, Molokai Is.	21°08'12.61"N	157°01'44.71"W	Nakahara 1982

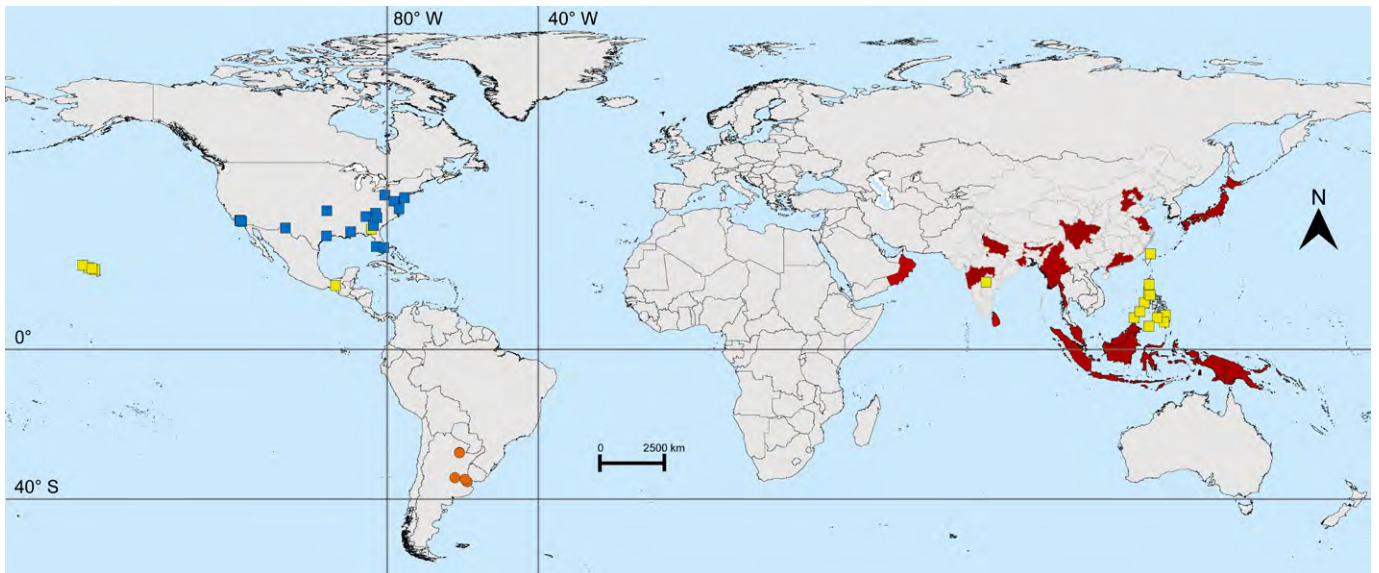


Figure 1. Geographic distribution of *Atherigona reversura* in the world. Orange circle: new records; yellow square: known record georeferenced (bibliographic source); blue square: known record georeferenced (internet source); red area: known record not georeferenced (countries/province/states) (see Table 1 for details).

Table 2. Occurrence of *A. reversura* adults collected in several localities in Argentina.

Province	Locations	Latitude	Longitude	Date of collection	Male specimens of <i>A. reversura</i>	Female specimens of <i>A. reversura</i>	Collection techniques
Buenos Aires	Burzaco	34°50'15.02" S	058°23'52.75" W	24-V-2015	9	1	Hand net
Buenos Aires	RNE Otamendi, Campana	34°13'31.30" S	058°53'56.00" W	07-IV-2015	1	1	Malaise trap
Chaco	Villa Berthet	27°17'25.20" S	060°25'02.80" W	25-III-2015	0	10	Canopy baited trap with rotten squid
Chaco	cattle field close to Villa Berthet	27°14'53.80" S	060°23'39.70" W	25-III-2015	4	10	Canopy baited trap with rotten squid
Chaco	cultivated field near Villa Berthet	27°18'32.20" S	060°21'54.00" W	25-III-2015	0	14	Canopy baited trap with rotten squid
Santa Fe	cultivated field near Santa Isabel	33°52'46.00" S	061°37'14.30" W	XII-2014, IV-2015	1	5	Hand net

12936–12945 (specimens from Burzaco, Buenos Aires province), MACN-En 12946–12947 (specimens from RNE Otamendi, Buenos Aires province), MACN-En 12948–12957 (specimens from Villa Berthet, Chaco province), MACN-En 13013–13029 (specimens from cattle field close to Villa Berthet, Chaco province), MACN-En 13092–13105 (specimens from cultivated field close to Villa Berthet, Chaco province), MACN-En 13030–13035 (specimens from cultivated field close to Santa Isabel, Santa Fe province).

Specimens were identified by L. C. Patitucci (first author) using taxonomic key and descriptions provided by Pont and Magpayo (1995). Adult males and females have transparent wings, a gray thorax and a yellow abdomen with at least one pair of black spots. Males (Figure 2) can be recognized by the bicolored frontal vitta, yellow palpi and fore tarsomeres with elongated hairs and trifoliate process (Figure 3).

The first occurrence of *A. reversura* in Argentina was recorded in Santa Isabel (Santa Fe) in December 2014, followed by almost simultaneous records in the provinces of Buenos Aires (April and May 2015) and

Chaco (March 2015). The absence of collected specimens in the RNE Otamendi during the winter months (July) but their presence in areas close to Villa Berthet (June to August) is interesting to highlight. This may be because this species is active throughout the year in northeastern Argentina.

Specimens of *A. reversura* were collected in several sites including different kinds of habitat. These new records are dispersed in a wide geographical area of temperate and subtropical regions of eastern Argentina. This species was found inhabiting private gardens in an urbanized area and in a grassland protected area in Buenos Aires; it was also recorded in crop edges in Santa Fe province. In the case of samples from Chaco province, *A. reversura* was recorded in gardens of a small village (Villa Berthet) and in crops and cattle farms adjacent to this location. The fact that the co-generic species *A. orientalis* was also found in Villa Berthet, sharing the same habitats, is important to point out.

The main host species of *A. reversura* is the bermuda-grass *Cynodon dactylon*. This grass, which is native from the Old World, was introduced to all tropical and

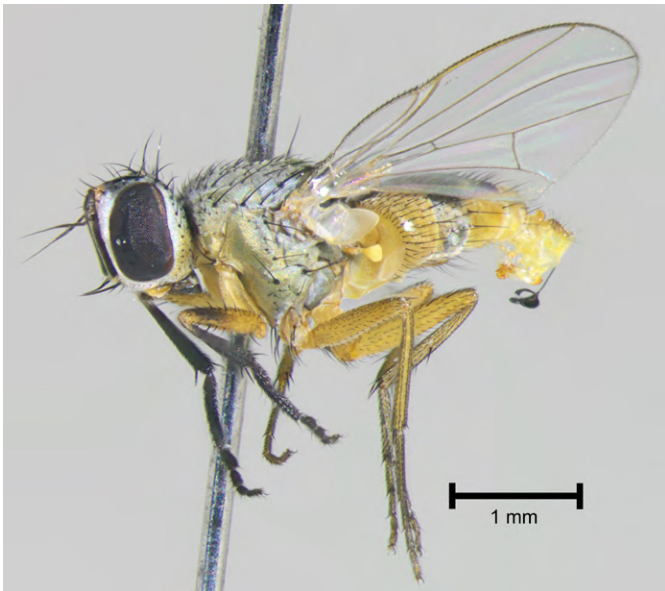


Figure 2. Male of *Atherigona reversura*, lateral view. Photo by P.R. Mulieri.

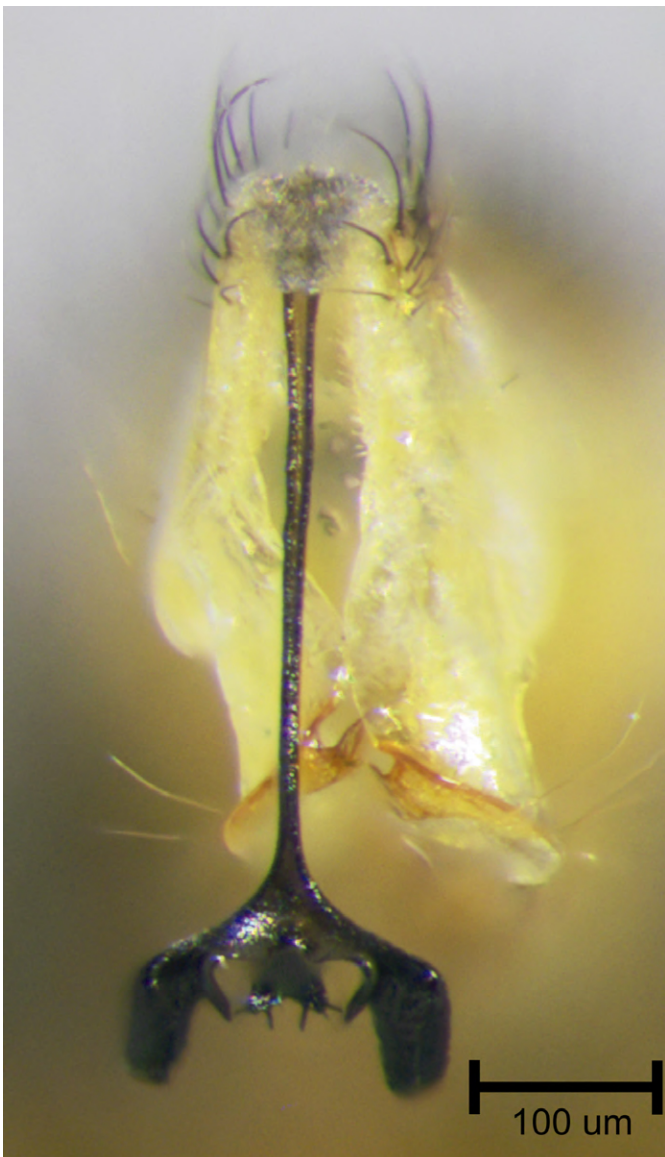


Figure 3. Male of *Atherigona reversura*, posterior view of trifoliate process. Photo by P.R. Mulieri.

subtropical areas and is now common in grasslands, lawns, pastures, roadsides, sea-coast sandy dunes, irrigated land and along rivers (Heuzé et al. 2015). In Argentina, this grass species is considered a pest and is widely distributed (SINAVIMO 2015). Damage to *C. dactylon* by larvae of *A. reversura* is frequently mistaken with stress, nutrient deficiency, bermudagrass leaf spot, and/or leaf rust, which can result in discolored plant material. Larvae of *A. reversura* only produce chlorosis in the top two to three leaves of the plant (Baxter et al. 2014). Recently, the Bermudagrass Stem Maggot has become a pest for cattlemen and hay producers across the USA (Hudson and Hancock 2013). Although there is no published work on the biology of adults of *A. reversura*, Baxter et al. (2014) suggested these adult flies may feed on sugar exudates from grass.

Considering the distribution of bermudagrass in South America, establish the actual distribution of *A. reversura* is important because it may be being dispersed to some regions of neighboring countries with similar climates such as Brazil, Paraguay and Uruguay. Simultaneously with this report we have informed local authorities.

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