



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

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**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 Calyptratae 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

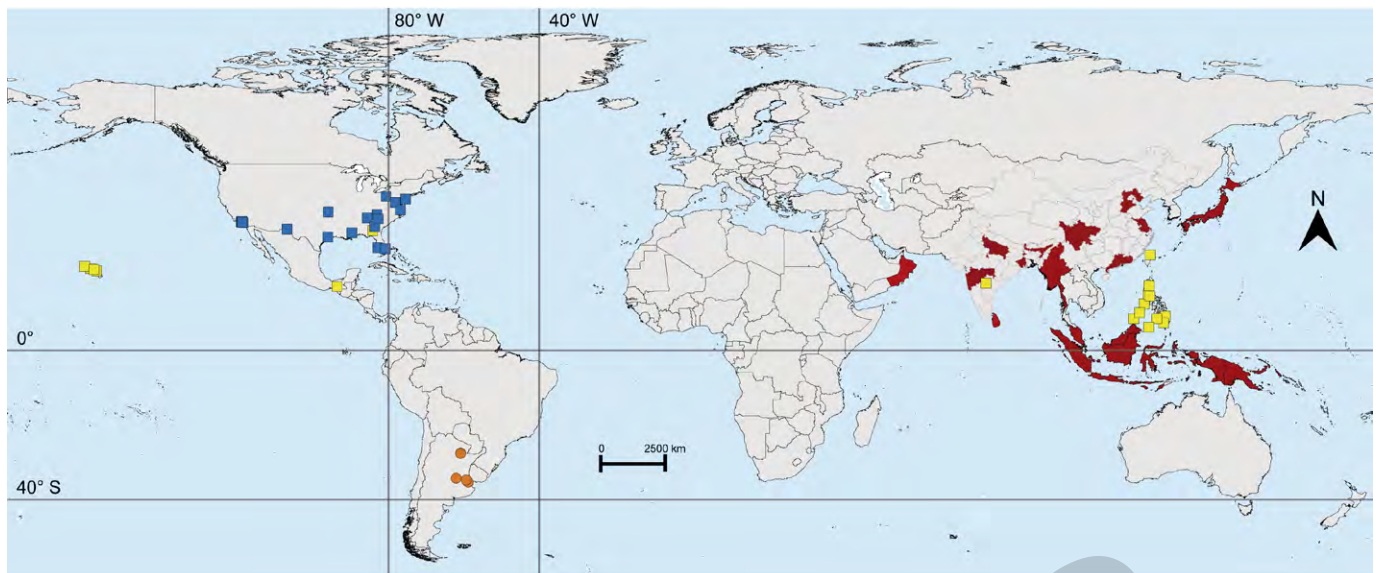
Isabel, Santa Fe province (Figure 1). These catches were obtained during July 2015 and December 2014, respectively (Table 2). We obtained the georeferences from bibliographic and internet sources (Table 1). If localities were only mentioned without coordinates in

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 & Magpayo 1995         |
| Asia          | Philippines      | Luzon Is.,  | Mayoyao  | 16°57'04.73"N | 121°13'00.65"E | Pont & Magpayo 1995         |
| Asia          | Philippines      | Luzon Is.,  | Laguna Liliw   | 14°08'11.22"N | 121°26'23.65"E | Pont & Magpayo 1995         |
| Asia          | Philippines      | Mindanao  | Agusan River   | 08°55'13.02"N | 125°31'50.57"E | Pont & Magpayo 1995         |
| Asia          | Philippines      | Mindanao  | Cotabato   | 07°06'30.79"N | 125°02'19.77"E | Pont & Magpayo 1995         |
| Asia          | Philippines      | Mindanao  | Zamboanga  | 08°09'09.44"N | 123°15'40.59"E | Pont & Magpayo 1995         |
| Asia          | Philippines      | Palawan Is.   | Puerto Princess  | 09°48'33.61"N | 118°44'35.12"E | Pont & Magpayo 1995         |
| Asia          | Philippines      | Sulu Is.  | —  | 05°58'16.53"N | 121°07'20.97"E | Pont & 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  | Shipley 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 & 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).

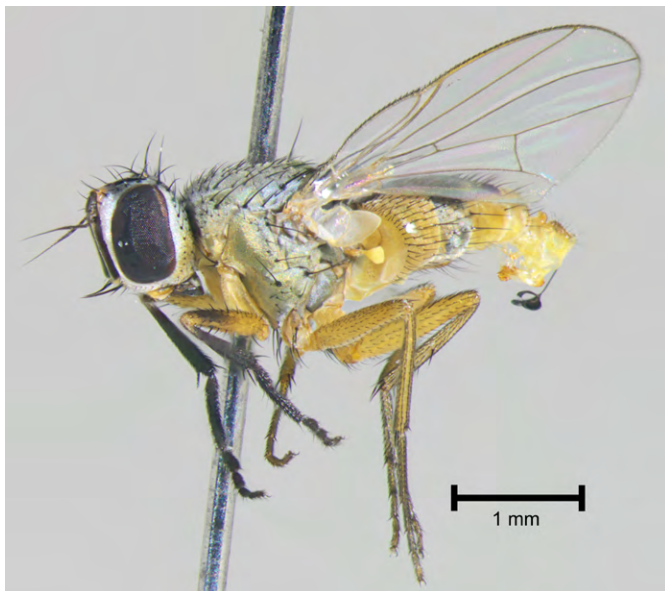
The first occurrence of *A. reversura* in Argentina was recorded in Santa Isabel (Santa Fe) in December 2014, followed by almost simultaneous records in the provinces of Buenos Aires (April and May 2015) and

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.

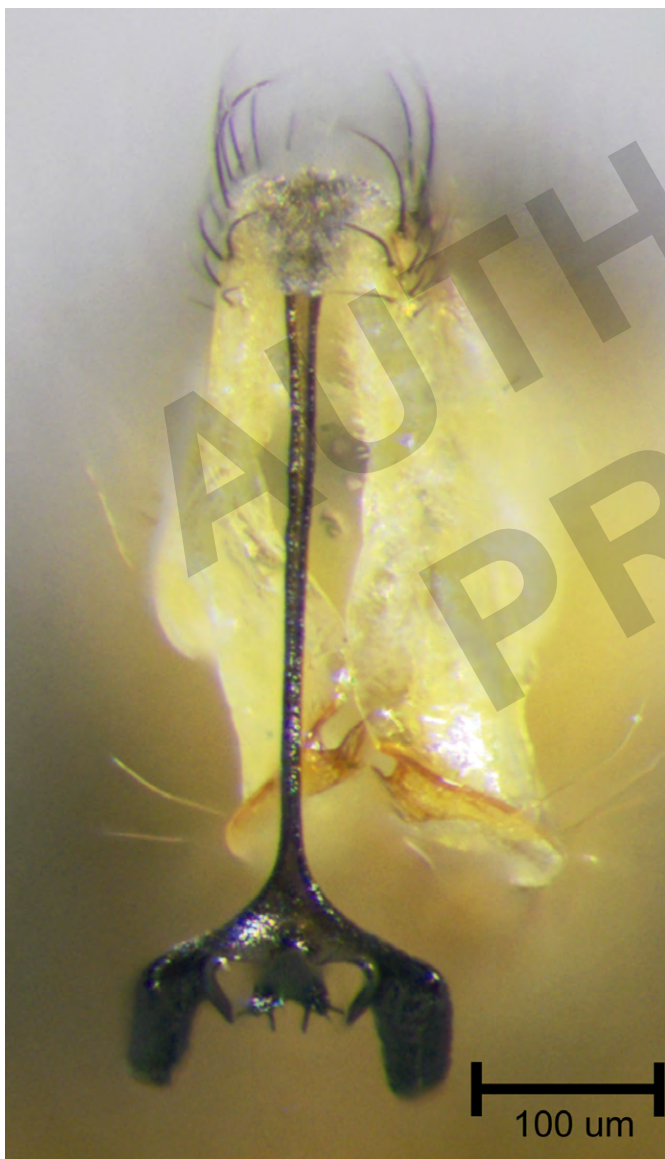
Specimens of *A. reversura* were collected in several sites including different kinds of habitat. These new records are dispersed in a wide geographical area of temperate and subtropical regions of eastern Argentina. This species was found inhabiting private gardens in an urbanized area and in a grassland 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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