

Scientific Note

Another brick in the wall: new record and key to *Anastrepha* Schiner, 1868 (Diptera, Tephritidae) from Pará, Brazil

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Abstract. Despite advances in studies on fruit flies belonging to the genus *Anastrepha* Schiner, 1868 (Diptera: Tephritidae) in the state of Pará, Brazil, over the past two decades, knowledge of their diversity remains incipient, particularly when considering the vast geographical expanse of the state. Only 35% of the documented species have been associated with their respective hosts. Anyway, for *Anastrepha parishi* Stone, 1942, which is reported for the first time in Pará State, all records of this species in Brazil have been associated with their designated hosts. In addition to this new record, we discuss the distribution of *Anastrepha consobrina* (Loew, 1873) in Pará, whose original description was based on specimens collected in the state in the early 19th century. Since then, *A. consobrina* has not been collected in Pará. A key to the 40 species of *Anastrepha* known in Pará is presented.

Keywords: Fruit fly, host, McPhail-type trap, identification, Brazilian Amazon.

The first records of fruit flies in the state of Pará, Brazil, were obtained primarily from sporadic collections, with a total of 14 species of *Anastrepha* Schiner, 1868 (Diptera: Tephritidae) recorded until the 2010s (Zucchi 2007). However, since then there has been an increase in fruit fly surveys, including collections in national reserves (Norrbon et al. 2021) and fruit sampling in several regions of the state of Pará (Lemos et al. 2023). Consequently, in the last two decades additional records have been known, bringing the total number of recorded species in Pará State to 40 (Zucchi & Moraes 2025).

Knowledge of the hosts of *Anastrepha* species in Pará has also expanded. Initially, eight hosts were found to be attacked by four species of *Anastrepha*. However, by the first decade of the 2000s, this number increased to 51 hosts associated with 12 species of *Anastrepha* (Zucchi & Moraes 2025). The fruit flies with the most known hosts in the state of Pará are *Anastrepha obliqua* (Macquart, 1835) (13 hosts), *Anastrepha fraterculus* (Wiedemann, 1830) (nine), and *Anastrepha serpentina* (Wiedemann, 1830) (eight). Guava (*Psidium guajava* L., Myrtaceae) is the host most attacked by fruit flies, being associated with 10 species of *Anastrepha* in Pará. In contrast, 24 species (approximately 65%) of *Anastrepha*, recorded in the state, have not yet been associated with a specific host (Zucchi & Moraes 2025).

Despite the increase in fruit fly surveys over the past two decades, knowledge of the diversity of fruit flies in Pará State remains relatively limited due to the territorial area (1,245,870.70 km²), representing 14.6% of Brazil's total surface area (the second largest state in Brazil), to the diversity of fruit plants and to several areas of poorly sampled primary forests.

This study aims to report the first record of *Anastrepha parishi* Stone, 1942 in the state of Pará and present an updated key to the *Anastrepha* species known in the state. Furthermore, the only known record of *Anastrepha consobrina* (Loew, 1873) in the state of Pará is discussed.

Guava sampling and collections with PET traps were carried out during fruit fly surveys in the municipality of Itaituba, state of Pará, for the preparation of a monograph by one of the co-authors (ALOF).

The guava fruits were collected from a single tree (04°15'45.57"S 55°59'12.14"W, 28 m.a.s.l.) on December 22, 2023 and transferred to the Biological Sciences laboratory of the Federal Institute of Education, Science and Technology of Pará (IFPA), Campus Itaituba. There, they were packaged in cages with sand in the bottom to facilitate the emergence of fruit flies. The PET trap, which was baited with mango juice, orange juice, sugar, and mango pieces, was hung approximately 2.5 m high from a mango tree in the backyard of an urban residence in Itaituba (04°15'42.9"S 55°58'47.7"W, 22 m.a.s.l.), on February 13, 2024.

Morphological identification was based on the integrative key of Norrbon et al. (2012). Wing venation follows Cumming & Wood (2017). The names of the wing bands follow Stone (1942). In molecular analysis, genomic DNA extraction was performed with female whole body following the CTAB method (Doyle & Doyle 1987). The first third of the cytochrome c oxidase subunit I (COI) gene was amplified via PCR with universal primers for Insecta (Folmer et al. 1994). The PCR reactions were carried out in a total volume of 25 µL, comprising 10.5 µL of ultrapure water, 2.5 µL of a 10× Mg2+ buffer, and 2 µL of MgCl2 (50 mM), 0.8 µL of dNTPs (10 µM), 2 µL of each primer (5 nM), 3 µL of DNA (40 ng), and 0.2 µL of Taq DNA polymerase (1 U). Primary denaturation was conducted for 3 min at 95°C, followed by 35 cycles of 30 s at 95°C, 30 s at 54°C, and 2 min at 72°C, with final polymerization at 72°C for 10 min. Following the verification of amplification via agarose gel, the PCR solution was purified with the enzyme exonuclease 1 (EXO 1) and thermosensitive alkaline phosphatase (FastAP). Sequencing was carried out using the Sanger method at the Agricultural Biotechnology Center (CEBETEC-ESALQ-USP). Subsequently, the sequences were imported into BioEdit 7.0 software (Hall 1999) to check the quality of the sequencing. Finally, the obtained 654-bp COI gene fragment (BOLD, PV165795) was compared with the sequences deposited in the database (99.54% similarity).

Anastrepha parishi was described based on a single female specimen collected in Bartica, Guyana (Stone 1942). Subsequent records of *A. parishi* were reported from Venezuela (Josefina Caraballo's

1981 unpublished thesis), Costa Rica (González et al. 1988), Colombia (Martínez-Alava 2007) and Brazil (Jesus et al. 2008) (Fig. 1).

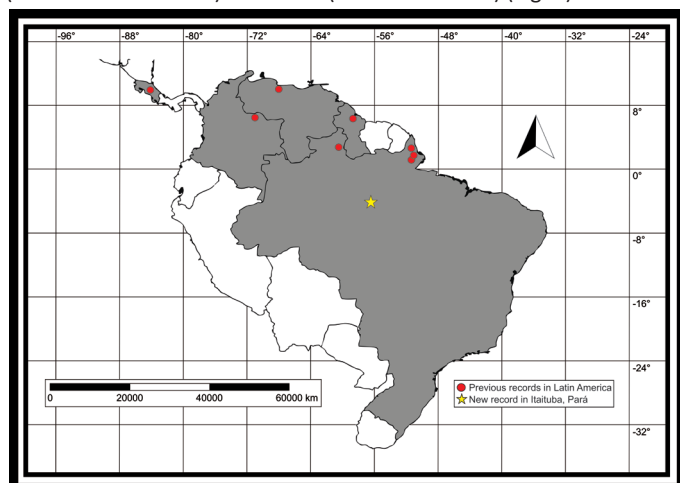


Figure 1. Distribution of *Anastrepha parishi* in Latin America (Figure: M. Savaris).

The first host record of *A. parishi* in Brazil was in bacaba (*Oenocarpus bacaba* Mart., Arecaceae) in the state of Amapá (Jesus et al. 2008). Subsequent findings in Amapá State, Brazil, included specimens obtained from guava (*P. guajava*) and tapir guava (*Bellucia imperialis* Saldanha & Cogn., Melastomataceae) (Jesus-Barros et al. 2012), and *Simaba guianensis* Aubl. (Simaroubaceae) (Deus et al. 2013). In the state of Roraima, Brazil, it was also obtained from camu-camu (*Myrciaria dubia* (Kunth) McVaugh (Myrtaceae) (Adaime et al. 2012). These few records reveal that *A. parishi* is associated with very diverse host plants, as its larvae develop in fruits from four botanical families. *Anastrepha parishi* was included in an illustrated key to species of *Anastrepha* from the Brazilian Amazon (Zucchi et al. 2011) and in an integrative key (Norrbon et al. 2012).

During fruit fly surveys in Itaituba, Pará State, three females were collected (two in guava and one in trap hung from a mango tree). These specimens were identified as *A. parishi*, based on morphological characters (Norrbon et al. 2012), mostly wing and aculeus tip (Fig. 2A-C), and confirmed by molecular analyses. The specimens from Itaituba share 99.20% similarity with a private sequence of *A. parishi* from Bold Systems. The specimens of *A. parishi* obtained in this study showed a remarkable similarity with *Anastrepha rheediae* Stone, 1942 from Ecuador and Peru, having a similarity of 96.25-96.67%. Despite this similarity, both species strongly differ morphologically since *A. rheediae* has an aculeus tip similar to the pattern of species from the *spatulata* group and is closely related to them (Norrbon et al. 1999; Mengual et al. 2017). *Anastrepha parishi* does not fit into any of the established groups within the *Anastrepha* classification system (Norrbon et al. 1999). The specimens are deposited at the Museum of Entomology "Luiz de Queiroz" (MELQ), Department of Entomology and Acarology, Luiz de Queiroz College of Agriculture (ESALQ/USP) (MELQ ESALQENT001842-44).

This is the first record of *A. parishi* in Pará. This record expands the distribution of *A. parishi*, which now encompasses three Brazilian states (Amapá, Pará, and Roraima). The number of known species of *Anastrepha* in Pará State has risen to 40 (see key).

Considering that the specimens of *A. parishi*, previously collected in Brazil, were merely recorded with no morphological study, we are including the morphological characterization (wing and female terminalia) of the specimens collected in Pará, as follows:

Wings. Length 6.45-7.18 mm, width 2.72 mm, ratio 2.36-2.63. Apex of vein R_1 at 0.55-0.56 wing length, proximal to level of anterior end of crossvein r-m. Cell c 1.00-1.28 times as long as pterostigma; pterostigma 3.50-5.25 times as long as wide. Vein R_{2+3} not sinuous. Crossvein r-m at 0.65-0.68 distance from bm-m to dm-m on vein M_1 . Vein M_1 moderately curved apically; cell r_{4+5} at apex 0.80-0.85 times as wide as at level of dm-m, 0.76 times as wide as maximum subapical width. Cell cua with distal lobe relatively short, length of cua 1.54-1.65 times as long as anterior margin, lobe 1.04 times as long as vein CuA+CuP (Fig. 2A). Wing pattern mostly orange and moderate brown.

C-band mostly orange, most of cell c sometimes paler but without subapical hyaline area, most of pterostigma orange brown, distal margin of cells r_1 and r_{2+3} narrowly brown, fork of vein Rs with ovoid brown spot, junction of costa and crossvein h entirely orange, and cell br with brown mark anterior to proximal end of cell bm and ovoid brown mark on apical margin of band bordering vein R_{4+5} . C-band and S-band narrowly connected along vein R_{4+5} . Basal hyaline area in cell dm relatively small, not extending in more than $\frac{1}{4}$ of the cell length. Cell bm hyaline, microtrichose only on subapical fold. Basal half of S-band mostly orange, anterobasal margin narrowly brown except in cell dm, posterodistal margin narrowly brown, more broadly in cell m_4 , but at most extending to apex of lobe of cell cua, margin without a small incision in cell m_4 ; distal section narrowly brown on most of posterior margin and in cell r_{4+5} ; moderately broad, at apex of vein R_{2+3} 0.63-0.83 times width of cell r_{2+3} , not extended to apex of vein M_1 , without marginal hyaline areas; hyaline area proximal to apex of band extended to vein R_{2+3} . V-band with proximal arm brown in cell m_4 and on most of proximal and distal margins; narrowly connected to S-band along vein R_{4+5} ; on posterior margin extended two-thirds to three-fourths distance to vein CuA+CuP; distal arm mostly brown, connected to proximal arm; hyaline area between arms of V-band and vein M_1 small, one-third width of cell r_{4+5} (Fig. 2B).

Female terminalia. Oviscape 2.54-2.72 mm long, 0.83-0.87 times as long as mesonotum, straight in lateral view; entirely orange; spiracle at basal 0.26-0.40. Eversible membrane with dorsobasal denticles in subtriangular pattern, with approximately 65 relatively short, slender hooklike denticles in 4 V-shaped rows. Aculeus slightly ventrally curved in lateral view, 2.36-2.45 mm long, 0.90-0.92 times oviscape length; in ventral view base expanded, triangular, 0.21 mm wide, shaft 0.09-0.11 mm wide at midlength; tip 0.23-0.24 mm long, 0.09-0.10 times aculeus length, 0.09-0.11 mm wide at base, 0.11 mm wide preapically, 2.06-2.13 times as long as preapical width; in ventral view gradually tapered, almost entirely serrate, serrate part 0.87-0.97 times tip length, lateral margin straight (Fig. 2C). Spermathecae sclerotized, spherical to elongated.

A key for the 40 species of *Anastrepha* known in the state of Pará was elaborated, with the objective of amending and updating the key presented by Lemos et al. (2023). This key is intended for non-taxonomist researchers and agricultural entomologists; therefore, an attempt was made to construct a practical key based on some morphological characters. Illustrations of the characters and measurements mentioned in the key can be found in Norrbon et al. (2012). However, as a standard procedure when using any key, once the identification of the species has been obtained, it must be confirmed through the literature (description, redescription, or diagnosis) (see Norrbon et al. 2012) or with the collaboration of a taxonomist. It is imperative to acknowledge that the process of identification does not culminate solely with the acquisition of the specific name from the key. This is particularly relevant when one lacks familiarity with the identification of fruit flies or when a species is identified for the first time and associated with a novel host plant. The erroneous association of a species of fruit flies with a particular host fruit can result in serious quarantine problems (Zucchi 2023).

The record of *A. consobrina* in Pará was based on Norrbon (1997), who examined specimens described by Loew, deposited in the collection of the Zoological Museum of the Humboldt Universität, Berlin. According to Norrbon (1997), Loew described *Trypeta consobrina* from an unstated number of specimens of both sexes from Brazil. Among these specimens, Norrbon (1997) found a single female, fitting the original description of *A. consobrina* and designated it as neotype, noting that Loew could have examined this specimen, and the neotype may have been a syntype. The female has a label with "Brasilien Para Sieber S.", without information about the location where Sieber collected the specimen. This is the only known record of *A. consobrina* in Pará. Despite several surveys of *Anastrepha* fruit flies carried out, in the last two decades, in the state of Pará (Lemos et al. 2023) and in other states the North region (Acre, Amapá, Amazonas, Rondônia, Roraima and Tocantins) (see Zucchi et al. 2023), *A. consobrina* has not been collected in the North region. Nevertheless, *A. consobrina* has been recorded in the northeastern, southeastern, and

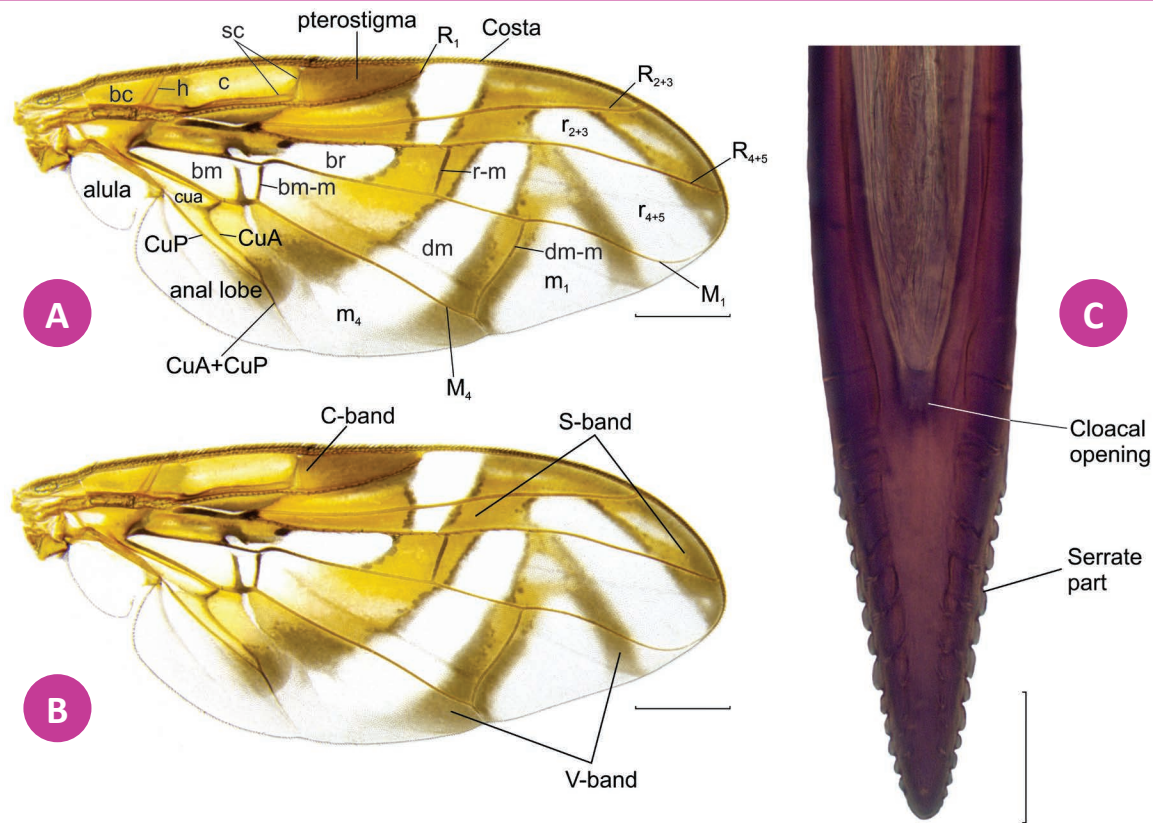


Figure 2. *Anastrepha parishi* Stone, 1942. A. Wing venation. B. Wing pattern. C. Aculeus tip (ventral view). Scale bar: 1.0 mm (wings); 0.1 mm (aculeus tip) (Photo: A. S. Araújo).

southern regions in Brazil (Zucchi & Moraes 2025).

This new record of *A. parishi* in Pará State is "another small brick in the wall of knowledge" about the distribution of *Anastrepha* fruit flies in the Brazilian Amazon.

Key to the *Anastrepha* species (female) from Pará, Brazil

- 1 C-band covering the anterior margin; aculeus tip not serrate
..... *Anastrepha atrigona* Hendel, 1914
- 1' C-band interrupted near the apex of vein R_1 2
- 2(1') Cell bm entirely infusate *Anastrepha obscura* Aldrich, 1925
- 2' Cell bm with hyaline area 3
- 3(2') Mesonotum and abdomen dark with yellow vittae 4
- 3' Mesonotum and abdomen mostly yellowish 5
- 4(3) Aculeus 2.6 - 3.8 mm long; aculeus tip serrate
..... *Anastrepha serpentina* (Wiedemann, 1830)
- 4' Aculeus 5.0 - 6.8 mm long; aculeus tip not serrate
..... *Anastrepha aithogaster* Norrbom, 2021
- 5(3') Oviscape spiracle near the base (at 0.06-0.15 basal)
..... *Anastrepha curitis* Stone, 1942
- 5' Oviscape spiracle far from the base (over 0.15) 6
- 6(5') Scutum with U-shaped mark interrupted at transverse suture
..... *Anastrepha striata* Schiner, 1868
- 6' Scutum without U-shaped mark 7
- 7(6') Dark brown wing bands 8
- 7' Light brown and/or yellowish wing bands 11
- 8(7') Aculeus 1.5 - 2.6 mm long 9
- 8' Aculeus at least 3.5 mm long 10
- 9(8) Aculeus tip not serrate *Anastrepha furcata* Lima, 1934
- 9' Aculeus tip serrate *Anastrepha fenestrata* Lutz & Lima, 1918
- 10(8') Aculeus tip with lateral expansion
..... *Anastrepha tenebrosa* Norrbom, 2021
- 10' Aculeus tip without lateral expansion *Anastrepha concava* Greene, 1934
- 11(7') Mediotergite not darkened laterally 12
- 11' Mediotergite dark brown laterally 30
- 12(11) C and S bands separate or narrowly connected 13
- 12' C and S bands connected or narrowly separate 16
- 13(12) Aculeus tip with serrations over less than apical half
..... *Anastrepha barnesi* Aldrich, 1925
- 13' Aculeus tip with serrations over more than apical half 14
- 14(13') Vein M_1 strongly curved apically, reaching apex of S-band
..... *Anastrepha leptozona* Hendel, 1914
- 14' Vein M_1 moderately curved apically, not reaching apex of S-band 15
- 15(14') Aculeus tip serrations extending onto dorsal side basally
..... *Anastrepha pseudoparallela* (Loew, 1873)
- 15' Aculeus tip serrations not extending onto dorsal side basally
..... *Anastrepha chiclayae* Greene, 1934
- 16(12') Aculeus tip with two pairs of small lateral protuberances
..... *Anastrepha binodosa* Stone, 1942
- 16' Aculeus tip with no lateral protuberances 17
- 17(16') Aculeus 4.5 - 5.5 mm long *Anastrepha townsendi* Greene, 1934
- 17' Aculeus less than 4.0 mm long 18
- 18(17') Aculeus tip not serrate or with indistinct serrations 19
- 18' Aculeus tip serrate 21
- 19(18) Aculeus tip with indistinct serrations *Anastrepha sodalis* Stone, 1942
- 19' Aculeus tip not serrate 20
- 20(19') Cell bm yellowish; aculeus tip with no constriction
..... *Anastrepha flavipennis* Greene, 1934
- 20' Cell bm hyaline; aculeus tip with constriction
..... *Anastrepha belenensis* Zucchi, 1979
- 21(18') Aculeus with distinct constriction before serrations 22
- 21' Aculeus without distinct constriction before serrations 23
- 22(21) Aculeus tip with short constriction before serrations
..... *Anastrepha zaccharyi* Norrbom, 2015
- 22' Aculeus tip with long constriction before serrations
..... *Anastrepha fuscoalata* Norrbom, 2021
- 23(21') Aculeus tip with serrations beyond level of the cloacal opening 24
- 23' Aculeus tip with serrations at most nearly to the level of the cloacal opening 26
- 24(23) Aculeus tip with slight constriction before serrations
..... *Anastrepha manihoti* Lima, 1934
- 24' Aculeus tip with no constriction before serrations 25
- 25(24') Aculeus 1.2 - 1.5 mm long *Anastrepha pickeli* Lima, 1934
- 25' Aculeus 2.0 - 2.3 mm long *Anastrepha limae* Stone, 1942
- 26(23') Aculeus tip with few large serrations ... *Anastrepha antunesi* Lima, 1938
- 26' Aculeus tip with many serrations 27
- 27(26') Serrate part almost as long as wide
..... *Anastrepha juxtalanceola* Norrbom, 2021
- 27' Serrate part longer than wide 28
- 28(27') Aculeus 6.2-6.7 mm long; tip with fine serrations
..... *Anastrepha consobrina* (Loew, 1873)
- 28' Aculeus 2.0-2.3 mm long; tip with large serrations 29
- 29(28') Aculeus tip slightly curved laterally
..... *Anastrepha ethalea* (Walker, 1849)
- 29' Aculeus tip not curved laterally *Anastrepha parishi* Stone, 1942
- 30(11') Subscutellum not darkened laterally 31
- 30' Subscutellum darkened laterally 33

31(30) Aculeus tip without or with tiny serrations.....	31
..... <i>Anastrepha neptis</i> Norrbom, 2021	
31' Aculeus tip with distinct serrations	32
32(31') Aculeus tip with slight constriction before serrations.....	32
..... <i>Anastrepha obliqua</i> (Macquart, 1835)	
32' Aculeus tip with strong constriction before serrations.....	32
..... <i>Anastrepha sobrina</i> Norrbom, 2021	
33(30') Aculeus tip with serrations over less than apical half	34
33' Aculeus tip with serrations at least up to apical half.....	35
34(33) Aculeus less than 2 mm long.....	35
..... <i>Anastrepha bahiensis</i> Lima, 1937	
34' Aculeus at least 2 mm long.....	35
..... <i>Anastrepha distincta</i> Greene, 1934	
35(33') Aculeus tip with distinct constriction before serrations.....	36
35' Aculeus tip with slight constriction or without constriction serrations before	37
36(35) Aculeus tip long (length/width at cloacal opening about 1.9)	37
..... <i>Anastrepha fraterculus</i> (Wiedemann, 1830)	
36' Aculeus tip short (length/width at cloacal opening about 1.4)	37
..... <i>Anastrepha sororcula</i> Zucchi, 1979	
37(35') Aculeus tip with large serrations.....	37
..... <i>Anastrepha coronilli</i> Carrejo & González, 1993	
37' Aculeus tip without large serrations.....	38
38(37') Aculeus tip minutely serrate	38
..... <i>Anastrepha oiapoquensis</i> Norrbom & Uchôa, 2011	
38' Aculeus tip not minutely serrate	39
39(38') Aculeus tip with serrations at most up to the apical half.....	39
..... <i>Anastrepha turpiniae</i> Stone, 1942	
39' Aculeus tip with serrations beyond the apical half.....	39
..... <i>Anastrepha zenildae</i> Zucchi, 1979	

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RAZ: Conceptualization, Formal Analysis; Methodology; Writing - original draft, Writing - review and editing. ASA: Formal Analysis; Methodology; Writing - review and editing. ALOF: Methodology, Investigation. ISP: Methodology, Investigation, Writing - review and editing. MSLA: Methodology, Investigation. MS: Formal Analysis; Methodology; Writing - review and editing.

Conflict of Interest Statement

The authors declare no competing interests.

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