

First record of Spotted-wing drosophila *Drosophila suzukii* (Diptera: Drosophilidae) in Martín García Island wildlife refuge, Argentina

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Primer registro de la mosca de alas manchadas *Drosophila suzukii* (Diptera: Drosophilidae) en la reserva natural provincial Isla Martín García, Argentina

RESUMEN. Se reporta la presencia de la drosophila de alas manchadas, *Drosophila suzukii* (Matsumura), por primera vez, en la Isla Martín García, una reserva natural ubicada en el estuario del Río de la Plata, Argentina. La captura de individuos de *D. suzukii* se realizó mediante trampas con banana fermentada con levadura, en arenales con abundante presencia de cactus en el interior de la isla. La ausencia de cultivos de plantas hospedadoras típicas (ej. frutales) y la pequeña población de humanos que habita la isla hacen que la presencia de *D. suzukii* en este refugio de vida silvestre sea inesperada. La detección previa de esta mosca en América del Sur ocurrió en huertos comerciales de frutas y/o campos vecinos.

PALABRAS CLAVE. Invasión biológica. Plaga mundial. Refugio de vida silvestre. Sudamérica.

ABSTRACT. Here we report on the first peculiar detection of the spotted-winged drosophila, *Drosophila suzukii* (Matsumura) on Martín García Island, a wildlife refuge located in the Río de la Plata estuary, Argentina. Flies were collected using banana baited traps fermented with live yeast, in sandy areas with abundant presence of cactus in the interior of the island. The absence of cultivated host plants, e.g., fruit crops, and the small population of humans inhabiting the island make the presence of *D. suzukii* in this wildlife refuge unexpected. Previous detection of this fly in South America happened mostly within commercial fruit orchards and/or neighboring fields.

KEYWORDS. Biological invasion. South America. Wildlife refuge. Worldwide pest.

The spotted-wing drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae), is native to Southeastern Asia (Cini et al., 2012). However, in the last decade it has invaded other regions, e.g., Europe, North America, the Middle East, becoming a worldwide pest of many soft-skinned fruits and causing considerable economic losses outside of Asia (Lee et al., 2011; Walsh et al., 2011; Calabria et al., 2012; Cini et al., 2012; Kinjo et al., 2014; Van Timmeren & Isaacs, 2014). More recently, *D. suzukii* has invaded South America (Deprá

et al., 2014; Vilela & Mori, 2014; Asplen et al., 2015; De la Vega & Corley, 2019), where it has started affecting production of various fruit crops (Deprá et al., 2014; Santos, 2014; Asplen et al., 2015; Andreazza et al., 2017; De la Vega & Corley, 2019).

Drosophila suzukii is capable of infesting many commercial soft-skinned fruits such as blueberries, blackberries, raspberries, cherries, strawberries, among others [reviewed in Poyet et al. (2015)] and, also, non-soft skinned fruits that are damaged, dropped or split

such as apples, loquats, persimmons, tomatoes, figs and kiwis (Kanzawa, 1939). In fact, non-soft skinned fruits such as peaches or grapes, if damaged, can have levels of infection by *D. suzukii* similar to highly susceptible fruits such as strawberries or raspberries (Andreazza et al., 2016; Pelton et al., 2017), making this species a dangerous pest for most of the fruit crops. The severity of this pest not only lies in the fact that it is a generalist fruit fly, but also in its distinctive fruit-penetrating ovipositor (Walsh et al., 2011). *Drosophila suzukii* females, unlike females of other drosophilids, have a serrated ovipositor, capable of puncturing the skin of healthy ripe fruits for oviposition (Atallah et al., 2014). After egg-hatching, larvae start feeding on the fruit pulp producing severe damage that ends in fruit collapse (Asplen et al., 2015). Moreover, the wounds produced by the serrated ovipositor in the epicarp promote the entry of saprophagous microorganisms that decrease the quality of the fruit (Cini et al., 2012) facilitating the arrival of other insects. Besides the large serrated ovipositor in females, a dark spot on the leading wing edge of adult males, the number of teeth on the foreleg of males' sexual combs (three to six in each of the two combs) and the orientation of these combs (parallel to the leg) are key morphological features commonly used to easily differentiate *D. suzukii* from other drosophilids (Kikkawa & Peng, 1938; Walsh et al., 2011).

In early February 2020, our group performed a collecting trip to Martín García Island wildlife refuge (34°11'00"; 58°15'10"), a small island (1.84 km²) in the Río de la Plata estuary, Argentina (Fig. 1). The original purpose of the campaign trip was to sample cactophilic flies of the *repleta* group. Flies were collected using banana baited traps fermented with live yeast. Traps were placed on the ground near cacti that presented detached and rotten branches nearby. On the island, we recorded the presence of two cactus species: the large columnar cactus identified as *Cereus uruguayanus* Kiesling (Haene & Roget, 2015) and the prickly pear *Opuntia aurantiaca* Lindley (Moran et al., 1976). Collections took place in the morning, between 9:00 and 11:00, and just before nightfall between 18:00 and 20:00 over the course of three days (February 2-4, 2020). The average daily temperature in that month is about 23 °C, but it was approximately 28 °C during this trip. The collecting site on the island is known as "Arenal Grande" (34°10'49.5"S 58°15'01.7"W), a small sandy terrain surrounded by a dense sandy xerophilous forest near the center of the island. This site has low vegetation that includes, aside from the above-mentioned cacti, some trees such as *Sesbania punicea* (Cav.) Benth and many shrubs among which *Sebastiania schottiana* Müll and *Cephalanthus glabratus* Schum stand out (Ferretti et al., 2010).

During the expedition, we collected adult flies from

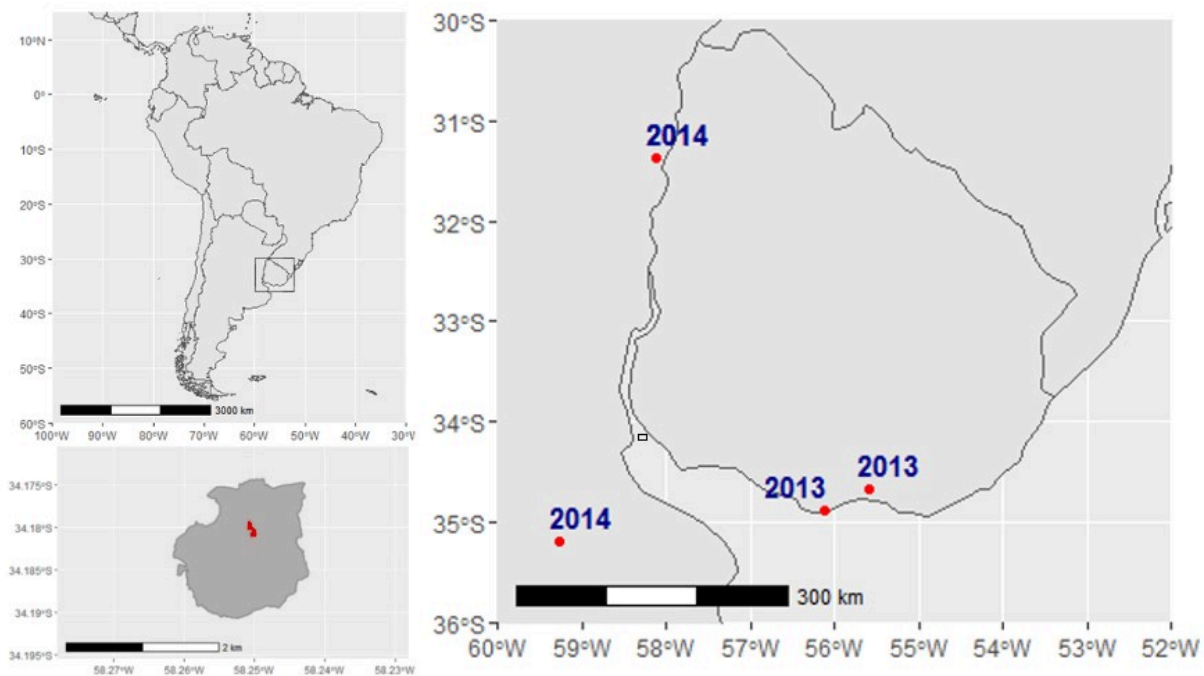


Fig. 1. Map showing the location of Martín García Island and the surrounding areas where the spotted-wing drosophila has been previously seen. Insets show the location of the island in South America (upper left) and the geography of the island itself (lower left). In red, the collection site: Arenal Grande. The year and location of the first records of *Drosophila suzukii* in the area are also shown (red dots) (2013 Montevideo, Uruguay; 2013 Canelones, Uruguay; 2014 Buenos Aires Argentina; 2014 Entre Ríos, Argentina).

the *Drosophila melanogaster* Meigen and *Drosophila repleta* Wollaston species groups (Table I). Members of these groups can be readily identified in the field by their characteristic body color. Therefore, all *repleta* group fly samples were taken to the lab, whereas most of the *melanogaster* flies were released on the island right after being captured, with the notable exception of two males that were distinguished by spots on their wings, which made us think that they were *D. suzukii* males. Consequently, while the frequencies here reported for the *repleta* flies correspond to their abundance relative to the collecting effort, those of the *melanogaster* group do not.

Relative abundances of *repleta* group species are shown in Table I. For the *melanogaster* specimens, a total of 35 individuals were brought to the lab. Three of them (two males and a female) were identified as *D. suzukii* based on the male's spotted wings and sex combs, and the female's ovipositor morphology (Fig. 2), this being the first report of this species on the Martín García Island. These flies were placed in a vial with instant *Drosophila* medium to initiate an isofemale line. Both, the collected individuals and the isofemale line are deposited in the Laboratorio de Evolución, Departamento de Ecología Genética y Evolución, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. The other 32 specimens were not identified and were placed in a vial with *Drosophila* instant medium and the genital morphology of 72 F1 males were inspected for species identification. Twenty-eight male flies (41.6%) were identified as *D. melanogaster*, 41 (59.4%) as *Drosophila simulans* Sturtevant and the other three males, whose genitalia were damaged, as well as the 75 F1 females, were not identified. The relative species abundances of the original 32 unidentified flies were estimated assuming the same 28:41 proportion observed among F1 males (Table I).

Species	Total	%
<i>Drosophila antonietae</i>	15	78.95
<i>Drosophila buzzatii</i>	4	21.05
<i>Drosophila repleta</i> species group Total	19	
<i>Drosophila suzukii</i>	3	8.57
<i>Drosophila melanogaster</i>	13	37.10
<i>Drosophila simulans</i>	19	54.33
<i>Drosophila melanogaster</i> species group Total	35	

Table I. Species abundance of flies of the *repleta* and *melanogaster* groups collected in the field and bred in the lab.

Drosophila suzukii was first found in South America in 2013 along the southern shore of Brazil, 900 km away from Martín García Island (Deprá et al., 2014). However, as soon as February 2013, it was also found in Montevideo, Uruguay (200 km east of Martín García Island) (Gonzalez et al., 2015). In November 2014, the fly was seen in Lobos (Buenos Aires, Argentina; Santadino et al., 2015), 135 km southwest of Martín García Island, and in December of same year, it was found in Concordia (Entre Ríos, Argentina; Lavagnino et al., 2018), 311 km upstream from Martín García Island. Thus, it is possible that *D. suzukii* specimens were passively transported in the vegetation floating downstream along Uruguay river to the island. In addition, many tourists (a few thousand) visit the island every year; thus, it is quite possible that human activities introduced *D. suzukii* unintentionally, along with fruits meant for human consumption. Finally, it is not unlikely that spotted wing flies got to the island by active dispersal from the Uruguayan coast which is less than 3.5 km away.

Given the absence of agricultural activities and the small size of the human population (less than 160 residents), the presence of *D. suzukii* in Martín García Island wildlife refuge was unexpected. Apart from a few exotic blackberry bushes, the island lacks the characteristic vegetation where *D. suzukii* usually thrives, such as cherry, blueberry, plum, etc. The fruit of the prickly cacti *Opuntia streptacantha* Lem. (of the same genus as one of the cacti present in the island) has been shown to serve as a breeding host for *D. suzukii* (Wang et al., 2019). However, since females can only oviposit on damaged cacti fruit, it is unlikely that a population of spotted-wing flies will subsist only on this host. Nonetheless, the native "higuerón", *Ficus luschnathiana* (Miq.) Miq. (Rosales: Moraceae), whose small and turgent fruits may provide in summer suitable oviposition sites for the spotted-winged drosophila, is abundant in the island, although it was not detected at the collection site. The presence of *D. suzukii* has been reported in the common fig *Ficus carica* L. (Yu et al., 2013; Kenis et al., 2016), which belongs to the same genus as the *higuerón*. If this plant can host and sustain a *D. suzukii* population, it needs to be investigated.

The presence of *D. suzukii* in Martín García Island is remarkable because most of the previous detections in South America have been near fruit crops and these common hosts are absent on the island. However, surveys in Europe were able to find *D. suzukii* in semi-natural and urban landscapes with non-crop hosts, such as wild or ornamental plants (Kenis et al., 2016), but none of these previously reported host plants are known to occur on the island (Lee & Sial, 2016). Given the great adaptability of *D. suzukii*, it is possible that it has already invaded several natural areas in South America where it has not yet been reported. Thus, it is important for natural areas to be monitored, in addition to fruit growing areas, to assess the presence of *D. suzukii* and



Fig. 2. *Drosophila suzukii* individuals collected on Martín García Island. A. Male, characterized by a dark spot on the distal part of each wing. B. Female, possessing a large serrated ovipositor detailed in (C).

its impact on the ecosystem.

Further work is needed to determine whether the few specimens collected represent an established population or are derived from unsettled seasonal colonization. An option to elucidate this could be a seasonal monitoring on the island. In addition, molecular work can help identify the continental population of origin of the *D. suzukii* population from Martín García Island. In this way, the mechanism that these flies used to reach the island could also be inferred. Finally, laboratory/field studies are necessary to explore potential feeding/breeding plant hosts.

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