First Occurrence of the Pest *Drosophila suzukii* (Diptera: Drosophilidae) in the Comoros Archipelago (Western Indian Ocean)

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Short title: *Drosophila suzukii* in the Comoros archipelago

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Abstract

Drosophila suzukii (Matsumura, 1931) is an Asian pest of grapes and other soft fruits that has invaded North America and Europe during the last decade. Here we report its recent occurrence in two islands of the Comoros archipelago in the Mozambique Channel, namely Mayotte and Ngazidja (Grande Comore), in April 2017 and November 2018, respectively. We also document its absence from other African islands of the Mozambique Channel and the Western Indian Ocean including Mayotte until 2013. *Drosophila ashburneri* Tsacas, 1984 is the only member of the *suzukii* species subgroup known from the Comoros, but it is morphologically distinct and likely distantly related to *D. suzukii*. *Drosophila suzukii* has likely been recently introduced to the Comoros archipelago, perhaps from La Réunion island where it first appeared in November 2013. In all these tropical islands, *D. suzukii* was found in high-altitude habitats in agreement with its adaptation to cold environments. These results suggest the high susceptibility of highlands in Eastern and Southern Africa to be infested by this pest in a near future.

Keywords

Biological invasion; island biogeography; spotted-wing *Drosophila*; ecology; taxonomy.

INTRODUCTION

The spotted wing drosophila, *Drosophila suzukii* (Matsumura, 1931), is a serious agricultural pest of cherries, berries, grapes and other soft fruits (Karageorgi *et al.* 2017). Of South Asian origin, it has expanded its range during the last decade in the Americas and Europe (Gibert *et al.* 2016; Fraimout *et al.* 2017). In Africa, the species was only reported from La Réunion Island where it was first detected in November 2013 (Fraimout *et al.* 2017). Having inspected several islands of the Western Indian Ocean during the last decade, we report here the occurrence of *D. suzukii* in two islands of the Comoros archipelago in the Mozambique Channel. The archipelago consists of four volcanic islands, of which three belong to the Union of the Comoros, namely (with French names given in parentheses) Ngazidja (Grande Comore), Mwali (Mohéli) and Nzwani (Anjouan). The fourth island, Mayotte, is a French department. To allow future investigations of the spread of this pest into the Western Indian Ocean, we also indicate localities that were prospected during the last decade and at which *D. suzukii* was not detected.

Lachaise *et al.* (1997) provided a taxonomic inventory of drosophilid species known from the Comoros, Seychelles, Madagascar, La Réunion and Mauritius. Of the 128 enlisted species, only *D. ashburneri* Tsacas, 1984, a species endemic to Ngazidja was cited from the *suzukii* species subgroup Hsu, 1949, which is a member of the large *melanogaster* group Sturtevant, 1927 of the subgenus *Sophophora* Sturtevant, 1939. That means that up to 1997, *D. suzukii* was not present in this area.

MATERIAL AND METHODS

Flies were collected using standard fermented banana traps hung from tree branches, net sweeping over fallen rotting fruits and directly aspirating flies over fruits,

flowers and fungi. *D. suzukii* males were identified by the characteristic double sex combs on the first two tarsomeres of the proleg and the presence of one dark spot on the wing tip. Females were identified by the particular dark pigmentation of the last abdominal tergites and the characteristic strongly toothed oviscapt (Figure 1). The fly collecting authors are abbreviated in the Results section by their initials. Specimens of *D. suzukii* are preserved in absolute alcohol in INRAPE and MNHN.

RESULTS

Madagascar: not detected

A first trip was conducted in February 2008 by JRD, LHRR and AY in Antananarivo, Mandraka and Andasibe. This was followed by a second trip by JRD, VD, LHRR and AY in October 2010 to Antananarivo and Ranomafana. JRD prospected Nosy Be island in July 2009. *D. suzukii* was not detected in samples collected by either fermented banana traps or via net sweeping.

During the 2008 and 2010, JRD and AY also prospected the Acalyprate collection at the Bibekely Biodiversity Institute at Antananarivo. This project conducts monthly prospection of the insect fauna using unbiased Malaise traps placed at multiple localities on the island. None of the samples at this time contained specimens of *D. suzukii*.

Eparses (Scattered) islands: not detected

JRD, NG and AY explored the French Eparses (Scattered) islands in the Indian Ocean on board of the Marion Dufresnes rotation of March-April 2011. On the four islands (Europa, Juan de Nova, Glorieuses and Tromelin), *D. suzukii* was not detected (Yassin *et al.* 2012).

95 *Mayotte: detected*

96 JRD, VD and NG prospected the northern part of the Grande Terre island of
97 Mayotte in January 2013. Of the 4,502 collected specimens, none corresponded to *D.*
98 *suzukii* (David *et al.* 2014). In April 2017, JRD, AS and AY explored several sites
99 throughout Grande Terre and Petite Terre islands. They found a two *D. suzukii* males
100 and one female on Mont Combani (400 m) at a locality that was also inspected during
101 the 2013 expedition (Figure 2). This suggests that *D. suzukii* has been introduced
102 between the two dates.

103
104 *Ngazidja: detected*

105 Of all the islands of the Western Indian Ocean, Ngazidja is the most interesting
106 because it is the endemic area of *D. ashburneri*, the only African member of the Asian
107 *suzukii* species subgroup. However, unlike *D. suzukii*, *D. ashburneri* males do not have
108 dark spots on their wings and have sex comb on only the first tarsus of the male prolegs
109 (Tsacas 1984) (Figure 3). *Drosophila ashburneri* females are not known, but we checked
110 the Comoros pinned material in MNHN and found no females having *D. suzukii*
111 characteristic morphological diagnostics. *Drosophila ashburnier* is morphologically most
112 similar to the widespread Asian species *D. unipectinata* Duda, 1924 (Tsacas 1984),
113 which is a flower-specialist (Mitsui *et al.* 2010). Molecular phylogenetic analyses suggest
114 the *suzukii* subgroup to be polyphyletic (Russo *et al.* 2013). *Drosophila ashburneri* and *D.*
115 *unipectinata* hence might be not closely-related to *D. suzukii* and be placed in the future
116 in another subgroup of the *melanogaster* species group.

117 *Drosophila ashburneri* was collected by Loïc Matile in the Convalescence shelter
118 on the Karthala mountain (1,640-1,680 m) and on the Grille massive (850-900 m) in
119 1973 and 1974, respectively (Tsacas 1984). It was also collected in the Convalescence

shelter (1,650-1,750 m) and Mount Limba Manda (900-1,200 m) by Léonidas Tsacas in 1982 (Tsacas 1984). In November 2018, EB, JRD, IMH and AY prospected the island. We were not able to access the Convalescence shelter, because the closest village to its track, Boboni, and the road to it were abandoned. We, however, investigated 12 localities, including the Grille massive and did not collect *D. ashburneri*. Nonetheless, to our surprise, we collected *D. suzukii* in six localities (Table 1; Figure 2). Flies were collected by either net sweeping over fallen fruits (mostly mangos and lychees) or using fermented banana traps. In all localities, sporadic growths of wild strawberry shrubs were found but no direct link (e.g., fruit infestation with larvae) between *D. suzukii* and this fruit was detected.

DISCUSSION

We provide further evidence that *D. suzukii* is expanding its distribution westward into the Afrotropical region since its first detection in La Réunion Island in November 2013 (Fraimout *et al.* 2017). Two islands of the Comoros archipelago (Mayotte and Ngazidja) are currently being colonised. In both islands, *D. suzukii* was always detected in moderately high elevations (400-1000 m), similar to observations made in la Réunion. Such a distribution is expected for a temperate, cold-adapted species like *D. suzukii* (Tochen *et al.* 2014) when establishing in a tropical environment (dos Santos *et al.* 2017; Fraimout & Monnet 2018). All localities at nearly sea level (<100 m) that were prospected on both islands (Figure 2), where average temperature ranges from 29 to 32°C, did not contain *D. suzukii* samples. Mayotte is the oldest of the four islands of the archipelago, with its highest peak reaching 660 m at Mont Benara, a mountain that was prospect in neither 2013 nor 2017. On the other hand, Ngazidja, which is the youngest of the four islands, has its culminating point on the volcano of

Mont Karthala at nearly 2,361 m, where temperature could approach 0°C at summit (Charahabil & Akpo 2018). *D. suzukii* therefore may be also present at elevations higher than 1,000 m and future research should focus on unexplored high-altitude localities on both islands.

The economic impact of *D. suzukii* and its favourite host plants in Mayotte and Ngazidja remain to be determined. Possible host plants on the islands could include wild-growing raspberries (*Rubis rosifolius*), cultivated strawberries (*Fragaria ananassa*), the occasionally-grown strawberry guava (*Psidium cattleianums*) or even tomato (*Solanum lycopersicumin*). Molecular population genetics has suggested that la Réunion's propagule was of a European (French) origin (Fraimout *et al.* 2017). Future molecular analyses of the Comorian flies may shed further light on the possible geographical origins of *D. suzukii* in Mayotte and Ngazidja. The drosophilid fauna of the two other islands of the Comoros archipelago, namely Mwali and Nzwani, is completely unknown and further taxonomic investigations are urgently needed to determine the extent of *D. suzukii* in this area. Besides, inspection should be continued on neighbouring islands such as Madagascar, Eparses (Scattered) Islands, Mauritius and the Seychelles wherein *D. suzukii* was previously not detected. The rapid spread of *D. suzukii* into sub-Saharan Africa could lead to serious economic impacts, especially in temperate countries with important grape production such as South Africa (dos Santos *et al.* 2017; Fraimout & Monnet 2018). Utmost caution and frequent prospections should be undertaken in these countries.

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Figure legends

Figure 1 – Habitus of *Drosophila suzukii* (Matsumura, 1931) male and female collected on Ngazidja. Arrows indicate characteristic pigmentation traits. The male protarsal sex combs and the female oviscapt valve are shown in inlets. Scale bar = 1.0 mm.

Figure 2 – Map of the Comoros archipelago showing localities in Mayotte and Ngazidja where *D. suzukii* specimens were collected (solid circles) and those prospected but no *D. suzukii* was found (empty circles). Grey shades refer to vegetation density. Localities are numbered as in Table 1.

Figure 3 – Habitus of *Drosophila ashburneri* Tsacas, 1984 male paratype conserved in MNHN. Arrows indicate the lack of *D. suzukii* characteristic pigmentation traits. The male protarsal sex comb is shown in inlet. Scale bar = 1.0 mm.

250 **Table 1** – Distribution of collected specimens of *D. suzukii* on Mayotte and Ngazidja
 251 islands (Comoros archipelago). Locality numbers refer to Figure 2. F = females, M =
 252 males, T = total.

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No.	Island	Locality (altitude)	Date	F	M	T
1	Mayotte	Mt Combani (450 m)	17-IV-2017	1	1	2
2	Mayotte	Mt Combani (450 m)	19-IV-2017	0	1	1
3	Ngazidja	La Grille (850 m)	21-XI-2018	0	4	4
4	Ngazidja	Camp militaire d'Itsoundzou (520 m)	23-XI-2018	0	3	3
5	Ngazidja	Belvédère (400 m)	23-XI-2018	2	2	4
6	Ngazidja	Nioumamilima (760 m)	25-XI-2018	0	9	9
7	Ngazidja	Nioumbadjou (650 m)	26-XI-2018	2	7	9
8	Ngazidja	Mt Nima Limba (1000 m)	26-XI-2018	0	1	1
9	Ngazidja	Mt Nima Limba (1000 m)	28-XI-2018	0	2	2
	Total			5	30	33

254

Figure 1

Figure 2

Figure 3