First record of *Aedes albopictus* (Skuse, 1894) (Diptera; Culicidae) from Minorca (Balearic Islands, Spain).

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Abstract: The Asian tiger mosquito is an invasive species showing a continuous expansion in the Mediterranean basin in general and in Spain in particular. The first detection of *Aedes albopictus* in mainland Spain was reported in 2004. Eight years later, in 2012, this mosquito species was detected in the Balearic archipelago, specifically on Majorca. In 2014 it was detected on Eivissa, another island from this archipelago. In this paper we report for the first time the presence of *Ae. albopictus* on the island of Minorca. ***Journal of the European Mosquito Control Association* 34: 5-9, 2016**

Keywords: *Aedes albopictus*, first record, invasive mosquito, entry routes, Minorca, Balearic Islands, Spain.

Introduction

The Asian tiger mosquito *Aedes albopictus* (Skuse, 1894) is an invasive mosquito species which has been present in Europe since the 1970s (Adhami & Reiter, 1998) and it is listed among the 100 most invasive species in the world (ISSG, 2009). Its capacity to colonise new environments has been extensively recorded in North and South America, Europe, and islands of the Indian and Pacific Oceans (Kraemer et al., 2015). This species was first detected in Spain in 2004 in San Cugat del Vallés (Barcelona) (Aranda et al., 2006) and recent work from Collantes et al. (2015) has described the expansion capacity of *Ae. albopictus* in Spain over 10 years following its first detection. In 2012 and 2014 the tiger mosquito was also detected in the Balearic Islands of Majorca (Miquel et al., 2013) and Eivissa (Barceló et al., 2015), respectively. Therefore, geographical isolated areas such as islands do not provide protection from *Ae. albopictus* invasion, since transportation of goods appears to be the main source of invasion into new areas (Reiter & Sprenger, 1987; ECDC, 2012; Miquel et al., 2013; Barceló et al., 2014).

The tiger mosquito is an anthropophilic species that can act as vector of pathogens such as dengue or chikungunya viruses, as was observed e.g. during outbreaks in Croatia, France and Italy (Rezza et al., 2007; Schmidt-Chanasit et al., 2010; Marchand et al., 2013; Delisle et al., 2015). This aedine species is also considered a vector of Zika virus in South East Asia (Wong et al., 2013) and has been mentioned as a potential vector in Africa (Grard et al., 2007). Recent experimental studies of Italian populations of *Ae. albopictus* demonstrate their susceptibility to Zika virus (Di Luca et al., 2016). However, *Ae. albopictus* and *Ae. aegypti* show unexpectedly low competent vectors for Zika virus in the Americas (Chouin-Carneiro et al., 2016). Control of this species is therefore relevant not only because of its invasive behaviour but also because of its important role as vector of pathogens causing human diseases.
Since 2008, Spain has implemented a National Surveillance Programme for invasive mosquito species at Ports and Airports, supported by the Ministry of Health, Social Services and Equality. This programme has facilitated the detection of the presence of the *Ae. albopictus* in additional areas of Spain. Passive surveillance of *Ae. albopictus* via citizen notifications (Kampen et al., 2015; Barceló et al., 2015) in combination with recent development of mobile apps such as Atrapaeltigre (Delacour-Estrella et al., 2014; Delacour-Estrella et al., 2016) has contributed also to the detection of new locations and in raising public awareness about this mosquito species.

Following the first detection of *Ae. albopictus* in Majorca in 2012 and in Eivissa in 2014, here we report the first detection on Minorca island and provide information about the current situation in the Balearic archipelago.

Materials and Methods

Under the framework of the Spanish National Surveillance Programme for Invasive Mosquitoes in Ports and Airports, from July 30th to October 23rd 2015, ten oviposition traps (ovitraps) were placed in what are considered hot spots for mosquito entry in Minorca such as the port (3 ovitraps), the airport (2 ovitraps), a residential area (1 ovitrap) and the industrial areas (4 ovitraps) (Fig 1). The ovitraps consist of black plastic containers of 650 ml capability filled with 400 ml of water and provided with a 20 x 3 cm wood tongue depressor as a substrate for *Aedes* spp. female oviposition. These ovitraps were placed according to general European guidelines (ECDC, 2012) and trap collection was conducted approximately every 15 days by the *Observatori Socioambiental de Menorca* (OBSAM). Ovitraps samples (tongue depressors) were sent to *Consultoria Moscard Tigre* located in Majorca for eggs identification. In addition, on September 9th, two BG-Sentinel traps using BG-Lure as attractant (Biogents GmbH, Regensburg, Germany) were placed in the port of Maó (39,89466525 N; 4,264647141 E) and the airport (39,8642604 N; 4,227819927 E) of Minorca for 24 hours (Fig 1).

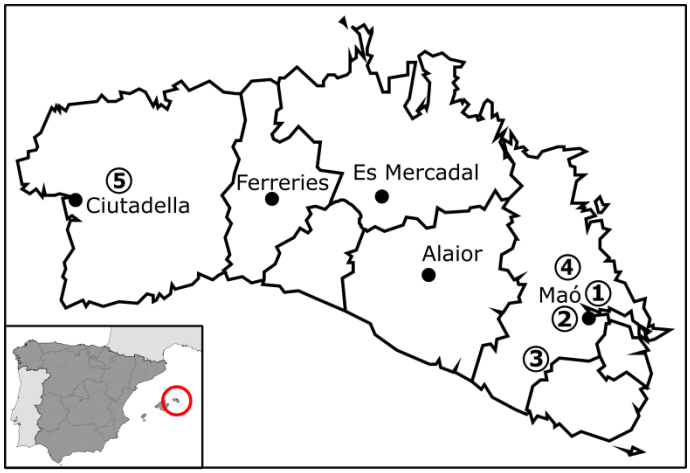

Figure 1: Location of the sampling areas on Minorca Island. ①- Maó port, 3 ovitraps (OVI 01, OVI 02 and OVI 03), one BG Sentinel; ②- Maó industrial area, 3 ovitraps (OVI 04, OVI 05 and OVI 06); ③- Minorca airport, 2 ovitraps (OVI 07 and OVI 08), one BG Sentinel; ④- Residential area of Maó, one ovitrap (OVI 09);⑤- Ciutadella industrial area, on ovitrap (OVI 10). .

Parallel to our sampling, on September 8th 2015 the Department of Environment at the Government of the Balearic Islands received directly from Minorca three specimens of adult mosquitoes suspected to be *Ae. albopictus.* These specimens were captured by a citizen in a warehouse located in the industrial area of the city of Maó (Fig. 1), which is the capital and administrative centre of Minorca. Based on the information provided by the local authorities, on September 10th, an inspection of potential *Ae. albopictus* breeding sites (e.g. catch basins, used tyres) took place in the industrial area of Maó, starting at the location where the above mentioned specimens were captured. It is worth mentioning that an important goods distribution dealer company is located in the surroundings of the area.

Results

The three specimens sent from Minorca were confirmed to be *Ae. albopictus* by both the Laboratory of Zoology of the University of the Balearic Islands and the *Consultoria Moscard Tigre* according to the identification key by Schaffner *et al.* (2001).

From the 10 ovitraps (Fig 1), only two (OVI 02 and OVI 06) were found positive for *Ae. albopictus* eggs on September 16th and October 6th (Table 1). OVI 02 was placed in the Port of Maó while OVI 06 was placed in the industrial area of Maó, distant by 1,190 m from each other. On October 23th, only OVI 06 was positive. A total of 319 eggs were obtained from both traps: 14 from OVI 02 and 305 from OVI 06. Eggs were reared according to the methodology described by Alarcon-Elbal *et al.* (2010) and emerged larvae and adults were identified according to Schaffner *et al.* (2001).

No adults of *Ae. albopictus* were captured in any of the BG-Sentinel traps sampling, whereas two female *Culex pipiens* were captured at the Maó airport and one at the port of Maó. Analysis of 40 catch basins of the industrial area of Maó showed no positive presence of *Ae. albopictus* larvae. No larvae were found in any other water container such as stored used tyres, plastic waste, or any container susceptible to become a breeding spot.

Discussion

The presence of *Ae. albopictus* has been confirmed in Minorca, thanks to citizen's collaboration (adults sample) and to ovitraps positive for mosquito eggs. It is likely that we have detected the colonisation of Minorca at an early stage, since eggs were detected few days after the adults capture and no further communications or samples have been received from other municipalities in Minorca.

Table 1: Placement of ovitraps and number of eggs collected. D: ovitrap dry, L: ovitrap lost, R: ovitrap removed.

	Location			Placement Date	Sampling Date				
Sample	Longitude	Latitude	Sampling area		13/8/2015	28/8/2015	16/9/2015	06/10/2015	23/10/2015
OVI 01	4.264801	39.894885		30/7/2015	0	0	0	0	0
OVI 02	4.256399	39.896794	Port of Maó	30/7/2015	0	0	**7**	**7**	0
OVI 03	4.275179	39.889890		30/7/2015	0	0	0	0	0
OVI 04	4.239437	39.884493		30/7/2015	0	0	0	L	0
OVI 05	4.246205	39.887509	Industrial area of Maó	30/7/2015	L	L	R	R	R
OVI 06	4.250313	39.887258		30/7/2015	0	0	**27**	**125**	**153**
OVI 07	4.226489	39.862088	Residential area in Maó	30/7/2015	D	D	0	0	0
OVI 08	4.226669	39.866945	Industrial area of Ciutadella	30/7/2015	0	0	0	D	0

BG-Sentinel traps are widely used to catch *Ae. aegypti* and *Ae. albopictus* mosquitoes (Bhalala & Arias 2009; Obenauer *et al*., 2010), however, no adults of *Ae. albopictus* were captured after 24 hours sampling in two locations (port and airport). This could be due the absence or low presence of the species in the area.

Introduction of *Ae. albopictus* into Minorca can be related to goods transportation, as in the case of other islands from the Balearic archipelago such as Majorca (Miquel *et al*., 2013) and Eivissa (Barceló *et al*., 2015). Transport of goods to Minorca is mainly through the port of Ciutadella where ferries arrive mainly from Majorca (34 weekly cruises) and Barcelona (14 weekly cruises) (source: www.directferries.es), both areas where *Ae. albopictus* is well established (CAES 2015). After arrival into Ciutadella, most of the commodities are transported and unloaded in the industrial area of Maó, the most important of such sites in Minorca, where the species was detected.

The first detection of *Ae. albopictus* adults in Minorca was achieved by citizen participation. Resident communication has been pointed out as one of the most common methods for the detection of *Ae. albopictus* in several areas of Spain (revised in Barceló *et al*., 2015), as for example in Andalusia, Catalonia, Majorca, Eivissa and recently in Huesca province (Delacour-Estrella *et al*., 2016). In this sense, availability of communication tools (e.g. phone number, email, social networks) supported by official awareness campaigns to the general public is a crucial cornerstone in promoting new findings of mosquito invasive species. In addition, tools designed for citizen science, such as *Atrapaeltigre.com* in Spain, recently renamed as Mosquito Alert (www.mosquitoalert.com), or the Muckenatlas.de in Germany (Kampen *et al*., 2015) could also facilitate new findings.

The expansion of *Ae. albopictus* in Minorca could be similar to that observed in other islands of the Balearic archipelago. In Majorca it was first detected in 2012 in five municipalities (Miquel *et al*., 2013), seven in 2013, eleven in 2014 (Bengoa, 2015), and 16 in 2015 (Collantes *et al*., 2016). In Eivissa, where the first detection occurred in 2014, the presence of *Ae. albopictus* has been expanded up to four municipalities in 2015 (Collantes *et al*., 2016). Further surveillance in Minorca is needed in order to confirm the establishment and the speed of colonisation of new areas. Application of control methods may play a crucial role in precluding its spread on Minorca. Public communication campaigns to obtain support of local communities for the reduction of breeding sites in public and private areas (WHO 2006) is the baseline of an integrated control strategy for *Ae. albopictus* (Abramides *et al*., 2011). Other Mediterranean Islands, such as Sardinia, succeeded in controlling *Ae. albopictus* after early detection (Romi *et al*., 1999). In addition, other strategies such as the Sterile Insect Technique (SIT) (Oliva *et al*., 2012; Bellini *et al*., 2013) and the Auto-Dissemination of Larvicides (ADL) (Caputo *et al*., 2012; Suman *et al*., 2014) could be complementary control methods that deserve future exploration. Islands in particular are highly indicated for the elimination of exotic insect species by using SIT due to the less probability of introduction of new populations compared to mainland areas (Curtis 2002), as observed on Seahorse Key (an island of the coast of Florida) (Patterson *et al*., 1970) or Cayman Islands (Harris *et al*., 2011). Finally, legal and financially supported instruments, such as national and local eradication programmes of invasive mosquito species would be of great support to avoid the rapid expansion of this species and its possible impact on the tourism industry of the Balearic Islands.

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