

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

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Abstract: *Aedes (Stegomyia) albopictus* is an invasive mosquito native to tropical areas in Southeast Asia. It is an important vector of several pathogens of public and veterinary health significance. In 2004 this mosquito was recorded for the first time in Spain (Catalonia) and detected in Majorca (Balearic Islands) in 2012. In this paper, we report for the first time the presence of *Ae. albopictus* on the island of Ibiza ('Eivissa', Balearic Islands, Spain). The high volume of goods arriving by maritime transport and the increase of commercial trade and visitors during recent years have been identified as the most probable entry routes for the species on the Island. *Journal of the European Mosquito Control Association* 33: 1-4, 2015

Keywords: *Aedes albopictus*, ECDC guidelines, first record, invasive mosquito, entry routes, Ibiza, NSP, Spain.

Introduction

The overseas travelling capability of the Asian tiger mosquito (*Aedes albopictus*) (Skuse, 1894) (Diptera; Culicidae) has been observed throughout its history of expansion. Trading of goods such as used tyres (Knudsen, 1995) or lucky bamboo (*Dracaena* spp.) (Madon *et al.*, 2002; Scholte *et al.*, 2008) have facilitated the global propagation of this species by the transport of its eggs or larvae (Reiter & Sprenger, 1987; ECDC, 2012). It is considered as one of the 100 most invasive species in the world (ISSG, 2009) and transmits important arboviruses for public health in tropical and temperate regions worldwide such as dengue, chikungunya and yellow fever (Gratz, 2004; Eritja *et al.*, 2005), and is also a vector of filarial nematodes (e.g. *Dirofilaria* spp.) (Cancrini *et al.*, 2003). In the recent past, isolated cases of these viruses have occurred in Europe, specifically dengue and chikungunya (Grandadam *et al.*, 2011; Marchand *et al.*, 2013; INVS, 2014; Paty *et al.*, 2014).

Aedes albopictus was detected in mainland Spain in 2004 (Barcelona; Catalonia) (Aranda *et al.*, 2006) and has been recorded along the Mediterranean coast of the Iberian Peninsula to Alicante (Roiz, *et al.* 2007), Castellon (Delacour-Estrella, 2010), Murcia (Collantes & Delgado, 2011), Valencia (Alarcon-Elbal *et al.*, 2013), Andalusia (Delacour-Estrella *et al.*, 2014) and recently in Basque Country (Delacour *et al.*, 2015). In 2012 it was detected in Majorca (Miquel *et al.* 2013), the largest island of the Balearic Islands archipelago. Since 2008, Spain has had a National Surveillance Program (NSP) funded by the Ministry of Health, Social Services and Equality for invasive mosquitoes species in ports and airports, specifically in five civil airports (Barcelona, Madrid, Tenerife, Saragossa and Valencia), three military airports (Saragossa, Madrid and Majorca) and the ports of Barcelona, Majorca and Valencia.

Results from the National Surveillance Programme and actions carried out due to notifications from citizens and detection of *Ae. albopictus* in Ibiza are presented in this paper.

Materials and Methods

The Government of the Balearic Islands received a telephone notification on September 25th 2014 from a citizen of an industrial area of 'Montecristo' in the municipality of 'Sant Antoni de Portmany' (38°56'18.42"N; 01°24'56.56"E, Fig.1, 3) about the direct capture of two mosquito specimens suspected to be *Ae. albopictus*. Also, on November 29th 2014, another individual was collected again in the same municipality by human landing catch. These three samples were sent to the Laboratory of Zoology at the University of the Balearic Islands (UIB) for identification.

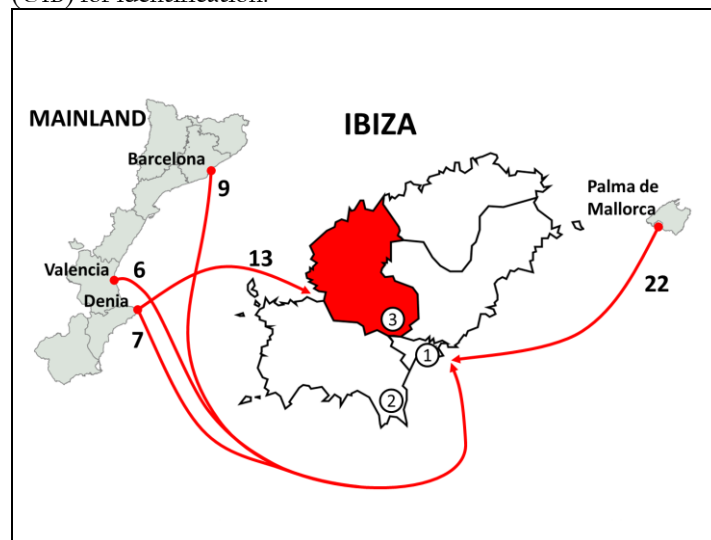


Figure 1: Sampling sites and transport routes per week in Ibiza Island. 1: Ibiza Port; 2: Ibiza Airport; 3: 'Montecristo, Sant Antoni de Portmany'. Source: www.directferries.es. Ibiza is not in the same scale.

Parallel to these, sampling procedures of the NSP for detecting invasive mosquito species in ports and airports were implemented. According to the number of samples decided for the NSP, one researcher from the Laboratory of the UIB visited

Ibiza and placed two battery powered light traps (CDC-Miniature, John W. Hock®) baited with CO₂: one in the Port of Ibiza (Ibiza, 38°54'32.00"N; 01°25'58.00"E, Fig.1, 1) and the other one in the Airport of Ibiza (located within the Natural Park of 'Ses Salines d'Eivissa i Formentera' in 'San Josep de sa Talaia', 38°52'22" N; 01°22'2"E, Fig. 1, 2). Traps were placed on 9th October 2014 during two consecutive nights from sunset to sunrise. No further trapping was carried out owing to CO₂ limitations. In addition, 11 oviposition traps (ovitraps) consisting of black plastic containers with 400 ml capability filled with 250 ml of water and provided with a 20 x 3 cm Unidix® wood tongue depressors as a substrate for *Aedes* spp. mosquitoes oviposition, were placed from 9th to 13th of October at different points of the 52.76 hectares of Ibiza port and also seven ovitraps in the 151 hectares of Ibiza airport. Surveys in 'Montecristo' (the municipality of the possible *Ae. albopictus* notification) were not carried out due to logistical problems.

Table 1: Survey methods for *Aedes albopictus* in Spain

Location	Year	Resident comm.	Survey method	Reference
Sant Cugat del Vallés (Barcelona)	2004	x		Aranda <i>et al.</i> , 2006
Orihuela (Alicante)	2005		Larvae survey; Adult traps	Roiz <i>et al.</i> , 2007
Torreveija (Alicante)	2009	x		Delacour <i>et al.</i> , 2009 Bueno <i>et al.</i> , 2009
Benicàssim (Castellón)	2010	x		Delacour-Estrella <i>et al.</i> , 2010
Murcia	2011	x		Collantes & Delgado 2011
Majorca (Balearic Islands)	2012	x		Miquel <i>et al.</i> , 2013
Sueca, Cullera, Gandía (Valencia)	2013		Ovitraps	Alarcón-Elbal <i>et al.</i> , 2013
Málaga (Andalusia)	2014	x*		Delacour-Estrella <i>et al.</i> , 2014
Ibiza (Balearic Islands)	2014	x		Present paper

(*)= Communication through 'Tigertrapp' smartphone app.

Aerial and maritime transport routes and information on commercial transport (e.g.: goods; total weight of shipments; number of vehicles and passengers) arriving at Ibiza between 2010 and 2014, were obtained to identify likely entry routes for invasive mosquitoes into the Island. The information was acquired from "Ports de Balears" (Port Authority of Balearic Islands) and the Statistical department of AENA (Spanish Airports and Air Navigation).

Climate information was also obtained from the Agroclimatic Information System for the Irrigation (SiAR) of the Ministry of Agriculture, Education and Environment (Government of Spain) to determine possible weather disturbances which could facilitate the introduction of *Ae. albopictus* onto Ibiza Island.

Results

The two samples sent from Ibiza by the resident from 'Montecristo' in September and the sample sent in November, were identified as *Ae. albopictus* according to an identification

key (Schaffner *et al.* 2001). Specimens were preserved and kept in the Laboratory of Zoology (UIB). No *Ae. albopictus* were recorded in the ovitraps and Mini-CDC traps from the National Surveillance Program conducted in October at the port and airport of Ibiza. Only native European species were collected with a total of 14 individuals of *Culex pipiens* L. and 27 individuals of *Ochlerotatus caspius* (Pallas). It should be highlighted that the majority of first detections in Spain, except the Valencian Community and the Basque Country (Table 1), were from resident communications.

Table 2: Ibiza port and airport activity between 2013 and 2014. Source: *Autoritat portuaria*.

Transport trade		Mean 2010-2013	2014	Variation (%)
Maritime transport	Ship (num.)	12,013 ± 1,232	15,632	30.1
	Goods (t)	1,494,708 ± 62,302	2,017,205	35.0
	Containers (TEU's)*	11,232 ± 3,910	11,699	4.2
	Passengers (num.)	443,810 ± 69,221	464,201	4.6
Air transport	Private cars (num.)	35,940 ± 6,444	62,655	74.3
	Goods (t)	2,215 ± 360	1,670	-24.6
	Passengers (num.)	2,732,121 ± 153,198	3,091,901	13.2

(*)= Twenty-foot Equivalent Units (1 TEU= 6.1 m).

According to the route and commercial transport data analysed in Ibiza, there were 3,092,799 air passengers to Ibiza in 2014, which represented the 85% of the total visitors to the island and an increase of 13.2% from 2010 to 2014 (Table 2). Passengers with a private vehicle that arrived by maritime transport increased by 74.3% from 2010 to 2014 (Table 2). With respect to transport of goods, the main proportion of commercial transport including goods (2,017,205 tonnes) and containers (11,699 TEU's*) came from maritime trades in 2014 and only 0.08% (1,670 tonnes in 2014) arrived through air transport, which has decreased by 24.6% since 2010 (Table 2). With regard to the origin of the commercial goods and passengers that arrived by maritime transport in 2014, 26 weekly ferries came from Valencian Community (Valencia and Denia), 22 from Majorca (Balearic Islands Community) and 9 from Barcelona (Catalonian Community) (Fig.1).

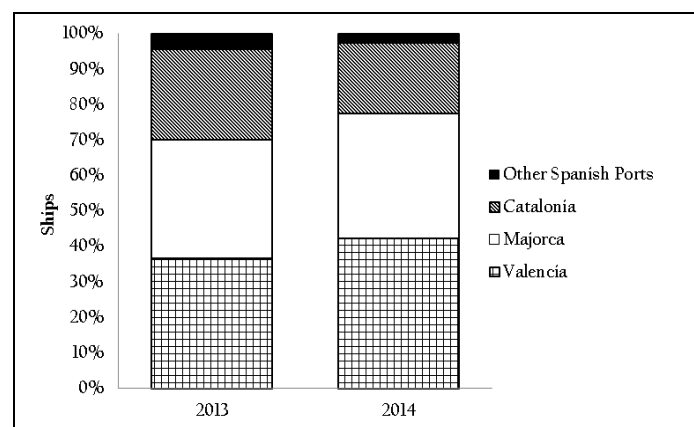


Figure 2: Port of origin and percentage of ships arrived to Ibiza in 2013 and 2014. Source: *Autoritat portuaria. Ministerio de fomento. Gobierno de España*.

The main ports of origin of the commercial ships were also from Valencian Community with 36.7-42.2% of ships in 2013 and 2014 respectively, 33.4-35.5% from Majorca and 25.5-19.9% from Catalonia (Fig 2). It should be noted that the above mentioned Autonomous Communities are currently positive for the presence of *Ae. albopictus*. The remaining ports of origin include ships from other Spanish ports such Andalusia, Murcia, Minorca, Ceuta and Melilla.

The mean temperatures in Ibiza during November 2012 and November 2013 were 14.0°C and 12.8°C respectively. In November 2014 the mean temperature on Ibiza Island was 15.2°C (SiAR).

Discussion and conclusion

The absence of positive ovitraps and adult traps from the National Surveillance Programme does not allow the confirmation of the presence of *Ae. albopictus* in the Port and the Airport of Ibiza Island. Despite this, the three individual mosquitoes collected by human landing catch in the area of 'Montecristo' confirm the first detection of this mosquito on Ibiza Island.

Despite the National Surveillance Programme in Majorca running for 6 years, *Ae. albopictus* was first detected by citizen notification more than 20 km away from the original sampling points in the port and airport (Miquel *et al.*, 2013). This has also been confirmed elsewhere in Spain, where most detections were from resident communications (Table 1), demonstrating the difficulty of the early detection of invasive species by a surveillance programme. The Valencian community and the Basque Country were the only areas where *Ae. albopictus* was detected by sampling methods such as larval search, ovitraps or adult traps (Roiz *et al.*, 2007; Alarcón-Elbal *et al.*, 2013; Delacour *et al.*, 2015). These experiences show the importance of resident communications and accordingly, citizen education is also important to ensure that invasive mosquito species are rapidly recognised, such as in the case of *Ae. albopictus*.

The finding of *Ae. albopictus* in an industrial area in Ibiza suggests the probable introduction of this mosquito from transport trade, and the maritime route is the most likely pathway, given the high percentage of containers and goods transported by ships (Table 2). The number of direct ferries per week (Fig.1) and commercial ships crossing from zones where *Ae. albopictus* is currently present indicates the most probable origin of introduction of this mosquito is either from Valencia, Catalonia or Majorca (Fig 2). Furthermore, the number of ships and goods have increased since 2010, especially tourist passengers with their vehicles which have increased significantly in 2014 (Table 2) giving more opportunities for the introduction of this mosquito onto Ibiza Island. In fact, in other countries such as Germany, it was demonstrated that *Ae. albopictus* can be transported long distances by vehicles (Pluskota *et al.*, 2008).

We did not detect high variations in the mean temperature in Ibiza from 2012 to 2014; however, the exceptional warmer temperatures in November 2014 likely extended the biting activity of *Ae. albopictus* in the area and favoured its detection through citizen communication.

The future spread of the tiger mosquito in Ibiza Island is unclear. In other Mediterranean islands such as Sardinia, the eradication of *Ae. albopictus* was possible (Nuvoli & Pantaleoni, 2003) thanks to the prompt intervention of the local public health agency. To date, there is no systematic mosquito surveillance programme in Ibiza and *Ae. albopictus* could be

present in other municipalities. In addition to aforementioned unusual high temperatures during autumn months which could favour the spread of the mosquito on the island.

Therefore, in order to monitor the mosquito spread on the Island, the authors recommend an immediate implementation of the "Guidelines for the surveillance of invasive mosquitoes in Europe" from the European Centre for Disease Prevention and Control (ECDC). According to the guidelines, a surveillance plan for *Ae. albopictus* in the first recorded area (in this case the municipality of 'Sant Antoni de Portmany') and the surrounding area in addition to inspections in the Port and the Airport of Ibiza would be basic actions to be taken.

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