

Engaging in the Quadruple Helix innovation framework: joining citizens, schools, academics and the public health sector in the fight against the Asian tiger mosquito

A. Oltra¹, R. Eritja², M.Torres², S.Escartin³, J.R.B. Palmer⁴, F.Bartumeus^{1,2}

¹ Centre d'Estudis Avançats de Blanes (CEAB-CSIC), ² CREA, ³ Associació Mediambiental Xatrac, ⁴ Universitat Pompeu Fabra

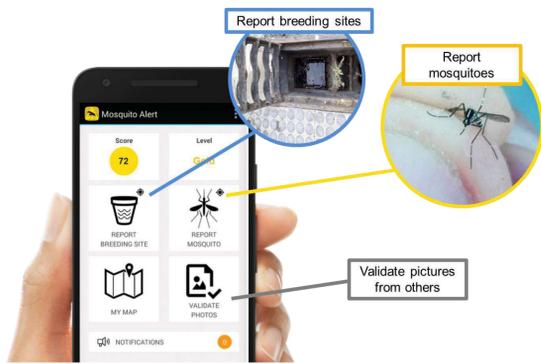


Many new detections in Spain of the tiger mosquito (*Aedes albopictus*), a vector of diseases (dengue, chikungunya, Zika), have been through community notifications. Thus, citizens can play a key role in early warning, together with other actors and stakeholders. Using a citizen science approach, Mosquito Alert proposes an open, collective and standardized tool that makes it possible for all sectors of society to advance the research and management of invasive vector mosquitoes and, at the same time, raise awareness amongst all societal actors.

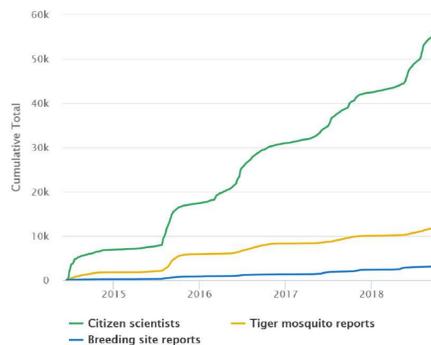


MOSQUITO ALERT

Data collection & citizen involvement



Mosquito Alert app



Cumulative data and registered users since 2014



Schools can join an educational learn-by-doing program that connects them with science practices and evidence-based decision making. Between 2017-18, 21 schools (1000 students) from 7 Spanish provinces were involved.

Citizens & scholars collect mosquito observations and validate observations from others using a free mobile phone app. The project accumulates >15,000 citizen reports.

Expert data validation, data sharing & research



Mosquito Alert online map

DOI: 10.1038/s41467-017-00914-9 OPEN

Citizen science provides a reliable and scalable tool to track disease-carrying mosquitoes

John R.B. Palmer^{1,2,3}, Aitana Oltra^{1,3}, Francisco Collantes⁴, Juan Antonio Delgado⁴, Javier Lucientes⁵, Sarah Delacour⁵, Mikel Bengoa⁵, Roger Eritja³ & Frederic Bartumeus^{1,3,6}

Recent outbreaks of Zika, chikungunya and dengue highlight the importance of better understanding the spread of disease-carrying mosquitoes across multiple spatio-temporal scales. Traditional surveillance tools are limited by jurisdictional boundaries and cost constraints. Here we show how a scalable citizen science system can solve this problem by combining citizen scientists' observations with expert validation and correcting for sampling effort. Our system provides accurate early warning information about the Asian tiger mosquito (*Aedes albopictus*) invasion in Spain, well beyond that available from traditional methods, and vital for public health services. It also provides estimates of tiger mosquito risk comparable to those from traditional methods but more directly related to the human-mosquito encounters that are relevant for epidemiological modelling and scalable enough to cover the entire country. These results illustrate how powerful public participation in science can be and suggest citizen science is positioned to revolutionize mosquito-borne disease surveillance worldwide.

Research article involving project data



Project data (CC0 license) and code is also available in other platforms (GitHub, Zenodo, GBIF).



In GBIF, the project dataset has increased the number of Asian tiger mosquito records for Spain by more than 10,000%.



Data is shared via an online map and on 3rd party platforms, after entomological data validation. Validated data supports research on the species presence and distribution.

Involvement of public health practitioners (public & private sector)

Su incidencia ha sido incorporada en el Programa de Vigilancia y Control del Mosquito Tigre de la ciudad de Barcelona que llevamos a cabo desde el Servei de Vigilancia i Control de Plagues Urbanes de l'Agència de Salut Pública de Barcelona.

La informació que no hem detectat activitat larvaria ni de adults en la via pública ni en la red de alcantarillat. Gràcies per su col·laboració, és important la implicació de los ciudadanos para poder combatir la proliferación de mosquitos, os animamos a continuar informando. ¡Entre todos podemos conseguirlo!

#CLB16

CSB Consorci Sanitari de Barcelona
Agència de Salut Pública

Examples of notifications emitted by the Barcelona Public Health Agency via the project app



Public campaign including Mosquito Alert in Badalona

Project data and tools support public health: from early warning to control actions. Some collaborations are articulated via formal agreements. Practitioners have a communication kit for public campaigns available, a private data portal with real time data visualization, sharing and download tools, and a system that allows direct communication between public health managers and citizens.

New detections are important for public health. If this happens, the project rapidly communicates and teams with the relevant stakeholders.

This occurred when the Asian tiger mosquito was detected for the first time in Andalucía or Aragón via Mosquito Alert, or more recently, after the first detection in Spain of a similar disease vector, *Aedes japonicus*.



The involvement of a wide spectrum of societal actors and stakeholders has proven crucial for the success and long-term maintenance of the initiative. Nevertheless, there are still important technological, conceptual, structural, economic and social barriers that need to be surpassed to fully acknowledge and implement the benefits of engaging the whole societal spectrum in Open Innovation 2.0 initiatives.

Mosquito Alert is coordinated by three public research institutions: CEAB-CSIC, CREA and ICREA. The project has the support from several public and private institutions. Mosquito Alert is supported by Obra Social "la Caixa", co-funded Dipsalut (Organisme Autònom de Salut Pública de la Diputació de Girona) and sponsored by Lokimica S.A.