

ONE HEALTH ENTOMOLOGY IN THE INSULAR CARIBBEAN: TIME TO BET ON PREVENTION

Pedro M^a Alarcón-Elbal¹ & Simone L. Sandiford^{2,3}

A recent mosquito study conducted in the Dutch Leeward Islands and published in the journal *Contributions to Zoology* focused on the importance of deepening taxonomy, ecology and distribution studies as key elements for disease surveillance and ecosystem health assessments (1). As in many other countries of the insular Caribbean, the last mosquito species inventories were performed several decades ago so the current distribution of potential vector species of these islands is not well known. The main contribution of this study is to improve the understanding of the current situation of local culicid fauna as well as to create an easy-to-use identification key for both the fourth instar larvae and the adults specifically for the species found. Filling these crucial gaps in vector-borne disease (VBD) knowledge will result in more accurate and efficient control activities. This is especially important in the current changing scenario in which globalization affects local disease ecologies and, by extension, human-vector interactions that are directly relevant to emerging infectious diseases (2). Unfortunately, there are still many gaps to be filled and progressively fewer skilled personnel.

The fields of medical and veterinary entomology have included health-related problems involving several arthropod species associated with human and domestic animals, respectively. Medical-veterinary entomology combines these two disciplines (3), but taking into account that the health of humans, animals, and the environment are inextricably linked, it would be better to refer to it as One Health entomology. This discipline plays a major role on the front lines of VBD control, conducting research on the behavior, ecology, distribution, and physiology of the arthropod vectors that carry diseases

and conducting surveillance for emerging threats (4). These entomological studies are particularly needed in regions like the Caribbean islands, which are threatened by the burden of several arthropod species because of their tropical climate and environment compounded by their limited resources for disease diagnosis, surveillance, control, and research (5). Nevertheless, these specialized areas have been a shrinking field for at least two decades, and the lack of researchers is now adversely affecting the ability to respond to infectious disease outbreaks (6), most notably in the countries that constitute the Caribbean region. Among the possible explanations, perhaps young scientists are no longer exposed to the field, or are more seduced by newer technologies and are not interested in working in some classical disciplines such as taxonomy or bio-ecology, which require much expertise and are very time-consuming, so much so that these scientists have become a vanishing species. However, these disciplines remain fundamental and it will be crucial to find the balance to integrate them with newer molecular methods and approaches such as DNA barcoding, sequencing, genetic manipulation, or bacterial infection of vectors, among others.

However, all is not lost. Besides the research undertaken in the former Netherlands Antilles (1) and French Antilles (7), very promising studies have been carried out in other Caribbean countries in recent years. Cuba continues to be at the forefront in the region when it comes to conducting entomological studies in recent decades. Indeed, the first hemorrhagic dengue epidemic in the Americas reported in 1981 in Cuba strengthened the commitment of Cubans to improving the comprehensive surveillance of

¹ Universidad Agroforestal Fernando Arturo de Meriño (UAFAM), Jarabacoa, Dominican Republic. E-mail: pedro.alarcon@uv.es

² Department of Basic Medical Sciences, Pharmacology and Pharmacy Section, Faculty of Medical Sciences, The University of the West Indies, Mona, Jamaica.

³ Mosquito Control and Research Unit, The University of the West Indies, Mona, Jamaica. E-mail: simone.sandiford@uwimona.edu.jm

mosquito-borne diseases (8), turning these entomologists into worldwide references. Furthermore, other Caribbean countries such as Puerto Rico and Trinidad and Tobago have also made considerable research contributions in this field (f.i., 9, 10). In contrast, other islands such as Jamaica and Hispaniola, which have made significant contributions in the latter part of the 20th century, have not been so prolific in past years. Fortunately, a change has been observed and important research has recently been reported. Studies, including a report of *Aedes albopictus* in Jamaica (11), the first findings of *Aedes vittatus* in the Dominican Republic (12) and several interesting contributions on the mosquito fauna of Haiti (f.i., 13), all signify the resurgence and hopeful sustained contribution of these islands to the field of entomology. Promising research on mosquito behaviour patterns and infectivity with novel insect specific viruses are also being realised in countries of the Lesser Antilles such as Grenada and St Lucia (14, 15). However, to sustain and further the advances already made, political will must be enhanced and investment in vector research from a One Health perspective indispensably increased (4).

It is also worth noting that the COVID-19 impact is already proving disastrous for the Caribbean economies, always so dependent on tourism. According to an article written by International Monetary Fund economists, the effect of COVID-19 on Caribbean economies has been compared to a “heart attack” because of the abrupt end to tourist arrivals and local lockdowns (16). This will ultimately result in further weakening of health systems that manage, treat and control VBDs leading to a more vulnerable society. These factors are a perfect hotbed for the proliferation of such diseases which if left unchecked can further exacerbate the economic impact of COVID-19 in the region.

In summary, it is time to include One Health entomologists as part of preventive medicine teams in Caribbean countries. Just as important as the professional who is able to cure a disease is the one who is able to prevent it. In fact, the cost of VBD prevention is usually less than the cost of vector control after an epidemic begins. After all, like the proverb aptly says, prevention is better than cure. However, without the involvement of these essential professionals we will lack the appropriate “weapons” to combat VBDs in the different scenarios. We have an obligation to be better prepared to confront any new health challenges in the future and One Health entomology must play a leading role in this. Otherwise we

will probably continue shooting in the dark.

References

1. van der Beek JG, Dijkstra KB, van der Hoorn BB, Boerlijst SP, Busscher L, Kok ML, et al. Taxonomy, ecology and distribution of the mosquitoes (Diptera: Culicidae) of the Dutch Leeward Islands, with a key to the adults and fourth instar larvae. *Contrib Zool.* 2020;89(4):373–392.
2. Mayer JD. Appendix C, Changing Vector Ecologies: Political Geographic Perspectives. In: Knobler S, Mahmoud A, Lemon S, Pray L (Eds.). *The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities: Workshop Summary.* Washington (DC): National Academies Press (US); 2006.
3. Mullen GR & Durden LA (Eds.). *Medical and Veterinary Entomology.* Second Edition. Amsterdam: Academic Press. 2009. 637 pp.
4. Wilson N. Medical Entomologists: A Vanishing Species: Experts needed to combat vector-borne diseases in North America, *BioScience.* 2020;70(4):281–288.
5. Caribbean Public Health Agency (CARPHA). Overview. [Internet]. 2020 [cited 2020 Sep 30]. Available from: <https://carpha.org/What-We-Do/VBD/Overview>
6. Time. Health > Public Health > Fewer scientists are studying insects. here's why that's so dangerous. [Internet]. 2018 [cited 2020 Sep 30]. Available from: <https://time.com/5144257/fewer-scientists-studying-insects-entomology/>
7. Gustave J, Fouque F, Cassadou S, Leon L, Anicet G, Ramdini C, et al. Increasing Role of Roof Gutters as *Aedes aegypti* (Diptera: Culicidae) Breeding Sites in Guadeloupe (French West Indies) and Consequences on Dengue Transmission and Vector Control. *J Trop Med.* 2012;2012:249524.
8. Guzmán MG. Thirty Years after the Cuban Hemorrhagic Dengue Epidemic of 1981. *MEDICC Review.* 2012;14(2):46-51.
9. Barrera R, Amador M, Acevedo V, Beltran M, Muñoz JL. A comparison of mosquito densities, weather and infection rates of *Aedes aegypti* during the first epidemics of Chikungunya (2014) and Zika (2016) in areas with and without vector control in Puerto Rico. *Med Vet Entomol.* 2019;33:68–77.

10. Mohammed A, Chadee DD. Effects of different temperature regimens on the development of *Aedes aegypti* (L.) (Diptera: Culicidae) mosquitoes. *Acta Trop.* 2011;119(1):38–43.
11. Ali I, Mundlee M, Anzinger JJ, Sandiford SL. Tiger in the sun: A report of *Aedes albopictus* in Jamaica. *Acta Trop.* 2019;199:105112.
12. Alarcón-Elbal PM, Rodríguez-Sosa MA, Newman BC & Sutton WB. The First Record of *Aedes vittatus* (Diptera: Culicidae) in the Dominican Republic: Public Health Implications of a Potential Invasive Mosquito Species in the Americas. *J Med Entomol.* 2020;57(6):2016–2021.
13. Samson DM, Archer RS, Alimi TO, Arheart KL, Impoinvil DE, Oscar R, et al. New baseline environmental assessment of mosquito ecology in northern Haiti during increased urbanization. *J Vector Ecol.* 2015;40(1):46–58.
14. Fitzpatrick DM, Hattaway LM, Hsueh AN, Ramos-Niño ME, Cheetham SM. PCR-Based Bloodmeal Analysis of *Aedes aegypti* and *Culex quinquefasciatus* (Diptera: Culicidae) in St. George Parish, Grenada. *J Med Entomol.* 2019;56(4):1170–1175.
15. Jeffries CL, White M, Wilson L, Yakob L, Walker T. Detection of a novel insect-specific flavivirus across ecologically diverse populations of *Aedes aegypti* on the Caribbean island of Saint Lucia. *Wellcome Open Res.* 2020;5:149.
16. International Monetary Fund > Pandemic Persistence Clouds Latin America and Caribbean Recovery. [Internet]. 2020 [cited 2020 Oct 30]. Available from: <https://blogs.imf.org/2020/10/22/pandemic-persistence-clouds-latin-america-and-caribbean-recovery/>