Evaluation of sticky traps for adult *Aedes* mosquitoes in Malaysia: a potential monitoring and surveillance tool for the efficacy of control strategies

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ABSTRACT: The present study compared the performance of sticky traps in order to identify the most effective and practical trap for capturing *Aedes aegypti* and *Aedes albopictus* mosquitoes. Three phases were conducted in the study, with Phase 1 evaluating the five prototypes (Models A, B, C, D, and E) of sticky trap release-and-recapture using two groups of mosquito release numbers (five and 50) that were released in each replicate. Similarly, Phase 2 compared the performance between Model E and the classical ovitrap that had been modified (sticky ovitrap), using five and 50 mosquito release numbers. Further assessment of both traps was carried out in Phase 3, in which both traps were installed in nine sampling grids. Results from Phase 1 showed that Model E was the trap that recaptured higher numbers of mosquitoes when compared to Models A, B, C, and D. Further assessment between Model E and the modified sticky ovitrap (known as Model F) found that Model F outperformed Model E in both Phases 2 and 3. Thus, Model F was selected as the most effective and practical sticky trap, which could serve as an alternative tool for monitoring and controlling dengue vectors in Malaysia. ***Journal of Vector Ecology* 42 (2): 298-307. 2017.**

Keyword Index: *Aedes aegypti*, *Aedes albopictus*, sticky traps, monitoring, surveillance, Malaysia.

INTRODUCTION

Aedes aegypti and *Ae. albopictus* are two principal vectors responsible for the transmission of dengue, chikungunya, yellow fever, and most recently, Zika virus that have contributed significantly to higher morbidity and mortality rates among the human population (Gubler 2002, Bhatt et al. 2013, Dyer 2015). Difficulties in deploying vaccines, especially in dengue endemic regions, indicate that vector surveillance and control will continue to play a significant role in integrated prevention and control programs (Paz-Soldan et al. 2016).

Current methods such as larvicides, adulticides, and biological approaches for controlling dengue vectors are known to be inadequate, suggesting a need to develop new approaches to monitor these vector populations (Paz-Soldan et al. 2016). Several techniques for the surveillance and control of *Aedes* mosquitoes have been developed and employed, but their utilization is limited to sampling the immature forms of *Aedes* such as eggs, larvae, and pupae (Paz-Soldan et al. 2016). Entomological indices such as the Breteau index (BI), house index (HI), and container index (CI) are among the indicators that have been used to monitor the *Aedes* populations, especially in residential environments. Unfortunately, such indices are insufficient to investigate the density and distribution of the adults. Integration among methods of dengue surveillance and indices allow the estimation of critical thresholds for a better understanding of its transmission dynamics (Rodrigues et al. 2015). In addition, monitoring the abundance of adult females by evaluating their distribution and density are important aspects for the development of control strategies (Rodrigues et al. 2015).

Ovitraps are considered to be the most convenient sampling tool to detect the presence of adult mosquito populations (Service 1974, Cheng et al. 1982). Since 1965, ovitraps have been deployed for routine egg and larval surveys due to their high sensitivity and cost effectiveness (Fay and Eliason 1966, Reiter et al. 1991, Chang et al. 2011). Despite their role as both surveillance and monitoring tools for *Aedes*, they also have limitations. First, the number of eggs deposited in individual traps may be affected due to the skipping oviposition behavior by *Aedes* females (Macial-de-Freitas et al. 2006, Facchinelli et al. 2008, Gama et al. 2007, Chadee 2009). Second, the availability of local habitats may compete with the ovitrap by affecting the deposition of eggs in the trap (Codeco et al. 2015). Most importantly, ovitraps may influence estimates of adult abundance derived from egg counts (Codeco et al. 2015).

Mechanical devices to collect adult populations provide reliable adult specimens, but most of them are highly labor intensive, may require electricity, and are impractical to be applied in dengue monitoring and surveillance (Facchinelli et al. 2007, 2008). Therefore, there is a need to identify alternative tools that are more practical and affordable. Recently, several mosquito traps have been developed specifically to catch adult *Aedes* mosquitoes. For example, ovitraps can also be modified to capture gravid female mosquitoes by incorporating an adhesive capture surface, known as sticky ovitraps (Vartak et al. 1995). In addition to conventional sticky ovitraps, a variety of different designs have been developed and evaluated to capture dengue vectors. Facchinelli et al. (2007) used a novel sticky trap for monitoring *Ae. albopictus* populations in Italy. In Australia, Ritchie et al (2003) demonstrated the efficacy of an adulticidal sticky ovitraps to collect *Ae. aegypti* and other container-breeding mosquitoes. Additionally, Eiras et al. (2014) developed and tested the gravid *Aedes* trap to capture adult female container-exploiting mosquitoes, with both studies conducted in Cairns, Queensland. In Brazil, a number of low-cost sticky traps to be used as detecting and monitoring tools for *Ae. aegypti* populations include Adultrap (Donatti and Gomes 2007), MosquiTRAP™ (Gama et al. 2007), and *AedesTrap* (de Santos et