The Zumba™ Mosquito Trap:

A Novel Surveillance Tool for Host-Seeking Mosquitoes

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INTRODUCTION

Since the detection of West Nile virus (WNV) in Fairfax County in 2000, an intensive mosquito surveillance program has been established. With a variety of WNV vector species in the area, it is essential to utilize a more efficient trap to collect the maximum number and variety of mosquitoes.[1,2]

In the past four years, Fairfax County has detected WNV in several mosquito species, namely *Culex pipiens, Cx. restuans, Cx. erraticus, Cx. salinarius, Aedes albopictus and Ae. vexans.* Our current routine surveillance system consists of a Reiter gravid trap paired with a CDC Miniature Light trap at 70 trap sites located around Fairfax County.

WNV-infected *Cx. pipiens* and *Cx. restuans* are predominantly collected in the Gravid traps. This trap attracts oviposition site-seeking mosquitoes, and have a high WNV infection rate in our area. On the other hand, the CDC trap collects host-seeking mosquitoes; however, the WNV infection rate is low.

Our study evaluated a novel mosquito trap, the Zumba Mosquito Trap [ISCA Technologies, Riverside, CA] , against three existing mosquito traps (BG-Sentinel, CDC Miniature Light, CDC Fay-Prince).[3,4,5] Based on the findings of a previous study, all four trap types were baited with the BG-Lure and CO_2.[6]

The research question for our study was as follows:

> *Which trap is most efficient in collecting host-seeking WNV vector species, Cx. pipiens, Cx. restuans and Ae. albopictus in Fairfax County?*

METHODS

- Traps were set out in a 4x4 Latin square configuration. All traps were baited with the BG-Lure and CO_2 (dry ice in a cooler).
- Trapping began on July 24, 2007 (EPI week 30), and continued for 13 weeks.
- Traps were set out every Monday and rotated every 24 hours. Traps were picked up on Friday mornings after they had passed through all four sites in the Latin square.
- Traps were set in a peri-urban habitat located in Fairfax County, VA.

Zumba Mosquito Trap

Trap types

Zumba™ Mosquito Trap: Uses visual and chemical stimuli including color, human-like size and shape as well as odor plume dissemination and direction. Lure placed inside trap. CO_2 disseminated directly into the catch area via rubber tubing.

BG-Sentinel™ Mosquito Trap : Uses convection currents, visual cues and releases attractants through a large surface area. Lure placed inside trap. CO_2 placed next to trap.

CDC Miniature Light Trap: Uses a small light bulb. Lure and CO_2 hung beside the trap.

CDC Fay-Prince Trap: Uses contrasting black and white panels in addition to a wind orienting cover. Lure and CO_2 hung beside the trap.

Statistical Analysis

- Analyzed using SPSS, ANOVA and Chi-square (with Bonferroni *post hoc* correction) performed.
- Infection rate, Maximum Likelihood Estimate (MLE), calculated using PooledInfRate, v3. The MLE is the maximum number of infected mosquitoes (per 1000) that are estimated to be in a given population.[7]

RESULTS

	Zumba	BG	CDC	FP
Average # Species	4.16	3.93	3.27	2.02
Average # Mosquitoes	35.51	29.02	7.96	6.73
Average # *Ae. albopictus*	11.93	22.33	3.12	5.70
Average # *Culex**	20.60	3.24	1.20	0.86

Table 1: Trap Performance Summary

On average, the Zumba trap collected the greatest number of species and mosquitoes per trap period. The Zumba trap collected significantly more ($p < 0.01$) host-seeking *Culex** mosquitoes than the other trap types. The BG-Sentinel trap collected the most *Ae. albopictus* per trap period; however, the Zumba trap still collected significantly more *Ae. albopictus* ($p < 0.01$) than the CDC and Fay-Prince traps.

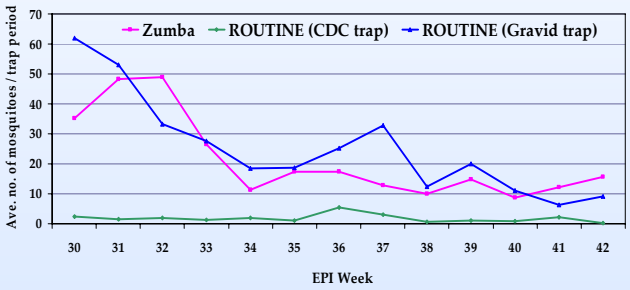

Chart 1: Relative Mosquito Abundance for Culex* Mosquitoes in the Zumba Trap vs. Routine Surveillance, 2007

The collection of host-seeking *Culex** mosquitoes in the Zumba trap was comparable to the collection of oviposition site-seeking *Culex** mosquitoes in the routine Gravid traps. Both of these trap types collected significantly more ($p < 0.01$) *Culex** mosquitoes than the routine CDC trap.

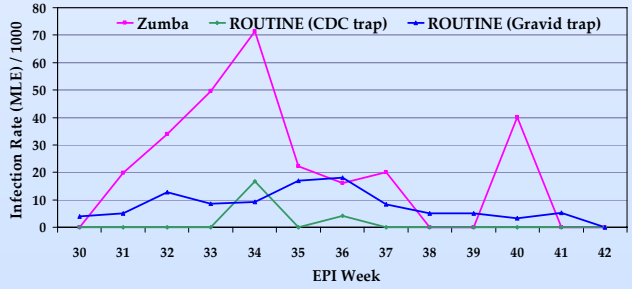

Chart 2: Infection Rate for Culex* in the Zumba Trap vs. Routine Surveillance, 2007

The Zumba trap collected WNV-positive host-seeking *Culex** mosquitoes. The WNV infection rate of the *Culex** mosquitoes collected in the Zumba trap were consistently higher than the infection rate in host-seeking *Culex** mosquitoes found in routine CDC traps during the peak transmission season.

WNV infection rate of the *Culex** mosquitoes collected in the Zumba trap were comparable to the infection rate in oviposition site-seeking *Culex** mosquitoes found in routine Gravid traps during the peak transmission season.

Table 2: Latin Square Analysis

The mean number of female *Culex** and *Ae. albopictus* mosquitoes collected is significantly affected by trap type, and is not affected by trap location or trap day.

	F-test	p-value
Culex*	43.929	< 0.01
Ae. albopictus	47.614	< 0.01

	Zumba	BG	CDC	FP
Culex*	19 ($p < 0.01$)	3	1	1
Ae. albopictus	4 ($p < 0.01$)	7 ($p < 0.01$)	1	2

Table 3: Relative Mosquito Abundance

The Zumba trap was the most effective trap, collecting 19 times the number of female *Culex** mosquitoes than the other trap types. There was no significant difference in the collection of female *Culex** mosquitoes between the other trap types (BG-Sentinel, CDC, Fay-Prince). The Zumba trap collected four times and the BG-Sentinel trap collected seven times as many female *Ae. albopictus* mosquitoes than the CDC or Fay-Prince traps. There was no significant difference in the collection of female *Ae. albopictus* mosquitoes between the CDC and Fay-Prince traps.

SUMMARY OF RESULTS

- The Zumba trap was the most productive and diverse trap—averaging 35.51 mosquitoes and 4.16 species per trap period.
- The Zumba trap collected significantly more *Culex** mosquitoes than the other trap types in the study area.
- The Zumba trap was the only trap type to collect WNV-positive host-seeking *Culex** mosquitoes in the study area.
- The Zumba trap, as well as the BG-Sentinel trap, collected significantly more *Ae. albopictus* mosquitoes than CDC and Fay-Prince traps.
- Both the Zumba and BG-Sentinel traps collected WNV-positive *Ae. albopictus* mosquitoes in the study area.
- The WNV infection rate in the *Culex** and *Ae. albopictus* mosquitoes collected in the Zumba trap was consistently greater than the infection rates for these species collected in the routine CDC traps.

* *Cx. pipiens and Cx. restuans*

CONCLUSIONS

1. **The Zumba mosquito trap, baited with the BG-Lure and CO_2, is a superior surveillance tool for host-seeking mosquitoes compared to the BG-Sentinel, CDC Miniature Light and the CDC Fay-Prince traps.**
2. **The relative mosquito abundance of the host-seeking *Cx. pipiens* and *Cx. restuans* mosquitoes collected in the Zumba mosquito trap was comparable to the oviposition site-seeking *Cx. pipiens* and *Cx. restuans* mosquitoes collected in the Reiter Gravid trap.**
3. **The WNV infection rate (MLE/1000) of host-seeking *Cx. pipiens* and *Cx. restuans* mosquitoes collected in the Zumba mosquito trap was consistently higher than the infection rate of these mosquitoes collected in the CDC Miniature Light trap.**
4. **Incorporating the Zumba mosquito trap may be a valuable addition to WNV surveillance and control programs in the area.**

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