TEST RESULTS

Premier & Alpha prototype outcatches Mosquito Magnet Defender, Dragon Fly, Blue Rhino, Lentek, Flowtron, Coleman Mosquito Deleto and Sonic Web

Premier Test Feb 2004: Dr Scott Ritchie

Mosquito trap testing in far North Queensland - March 2004

A comparison of commercially available mosquito traps in Cairns, Far North Qeensland, Australia: an evaluation of 10 different trap designs

Dr Scott A. Ritchie[1], PhD (University of Florida) & Dr Craig R. Williams[2], PhD (University of South Australia)

1. Tropical Public Health Unit Network, Queensland Health, 19 Aplin St Cairns, Queensland 4870
2. School of Public Health and Tropical Medicine (Cairns, Building E1), James Cook University, PO Box 6811, Cairns, Queensland 4870

Brief Summary

The mosquito-catching efficacy of 10 different mosquito trap designs was compared in a study in tropical Far North Queensland. The Mega-Catch™ 'Premier' was the most effective mosquito trap, followed by a Mega-Catch™ experimental prototype the 'Alpha' and the Mosquito Magnet 'Defender'. Despite the absence of any carbon-dioxide attractant, the Mega-Catch™ 'Premier' was far more efficacious than most traps that used carbon-dioxide. Statistical analysis revealed that this trap performed significantly better than seven other designs.

Introduction

A wide variety of mosquito traps are available to public consumers, particularly in the USA, where emerging fatal mosquito-borne illnesses stimulate the market for such devices. However, there are few scientifically sound comparisons between available traps. In this study, the mosquito catching ability of a series of commercially available mosquito traps was assessed.

Materials and Methods

The study was conducted during late summer 2004 at the Cairns City Council Waste Transfer Facility in Smithfield, a suburb of Cairns. The study site was an open, grassed area featuring large mounds of garden and tree waste, other solid waste (e.g. disposed whitegoods, recyclable containers) and two creeks with little or no littoral vegetation. The site was immediately bordered to the east by a *Melaleuca* forest adjacent to mangroves. Almost all mosquitoes captured in the study are probably from this adjacent forest and marsh.

Commercially available mosquito traps were purchased and/or supplied by EnviroSafe Technologies for use in this study. The 10 traps reported on here are as follows:

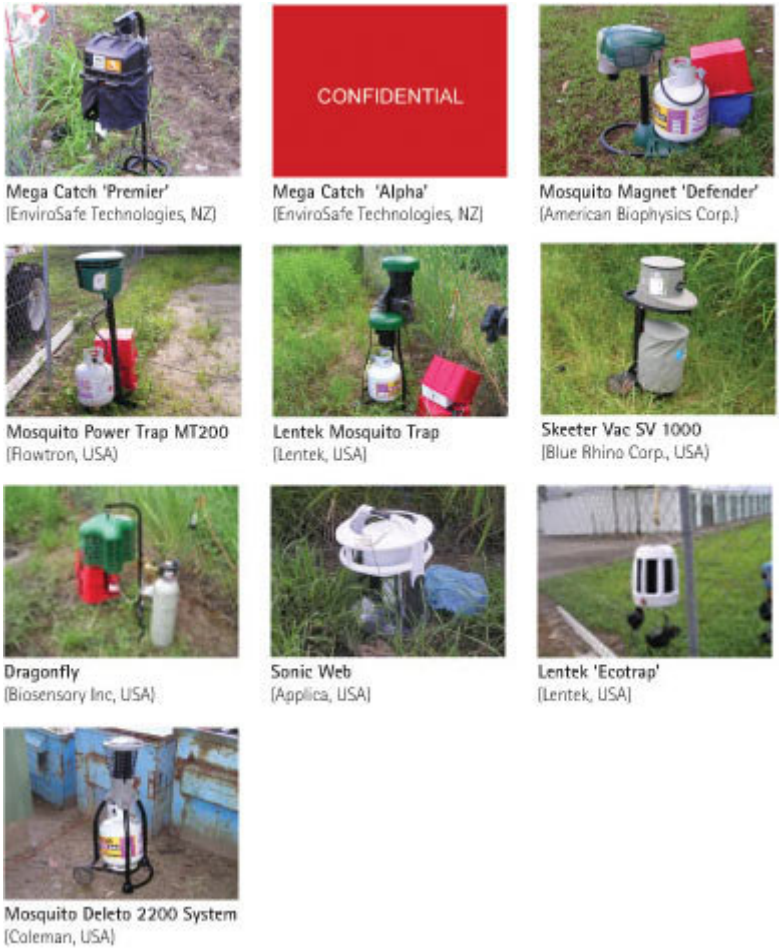

Figure 1. The 10 trap types compared in this study.

The traps (Figure 1) were operated according to the manufacturer's instructions, utilizing octenol lures supplied with the traps when applicable. They were rotated randomly through 12 sites over 12 nights (from approximately one hour prior to sunset until approximately one hour after sunrise). This rotation negated any influence of position on trap performance.

Originally, 11 traps were going to be tested. However, after two nights of operation, the Mosquito Magnet 'Liberty' ceased to function and had to be removed from the study. The traps tested here employ a range of attractants for mosquitoes. These are summarized in Table 1.

Trap type	carbon-dioxide	octenol	heat	lights	other attractants/ features	power requirements
Mega-Catch™ 'Premier'	No	Yes	Yes	Yes	Attractant liquid	Mains power
Mega-Catch™ 'Alpha'	No	Yes	Yes	Yes	Attractant liquid	Mains power
Mosquito Magnet Defender	Yes, from combustion of propane	Yes	Yes	No	-	Mains power
Skeeter Vac	Yes, from combustion of propane	Yes	No	No	-	No
Dragonfly	Yes, from CO_2 cylinder	Yes	No	No	Electrified grid to kill mosquitoes	Mains power

Mosquito Deleto	Yes, from combustion of propane	Yes	Yes	No	Sticky paper	No
Sonic Web	No	Yes	No	No	Sound, sticky paper	Mains power
Mosquito Power Trap (Flowtron)	Yes, from combustion of propane	No	No	No	No	Mains power
Lentek Mosquito Trap	Yes, from combustion of propane	No	No	No	No	Mains power
Lentek 'Ecotrap'	Yes, from fermentation	No	No	No	Attractant liquid, sticky paper	Mains power

Table 1. Attractants and power requirements for the traps compared in this report

Weather conditions during the study

Heavy rainfall was experienced at the study site in the two days prior to the study (243mm in two days), and after five days of trapping (133mm on one day). The latter rainfall event halted trapping for two days. The study can be divided neatly into two halves on the basis of rainfall, with wet conditions during the first six trapping dates (falls totaling 114mm), and relatively dry conditions on the last six (10.4mm). Wind was primarily from the south and east for the duration of the study while relative humidity was generally greater than 70% overnight. The replication employed in this study should have negated any positional effects created by the weather. The heavy rainfall that halted the study halfway probably served to stimulate mosquito host-seeking behavior in the following days, as well as aiding population growth for the weeks that followed.

Results

Mean and total mosquitoes captured

A total of 36,786 female mosquitoes were captured by the traps used in this study (Table 2). The Mega-Catch™ Premier (1343 per night) and Mega-Catch™ 'Alpha' prototype (752 per night) were the two best traps, followed by the Mosquito Magnet Defender (471 per night) (Figure 2). The remaining traps all captured mosquitoes, with means ranging from six to 215 mosquitoes per night.

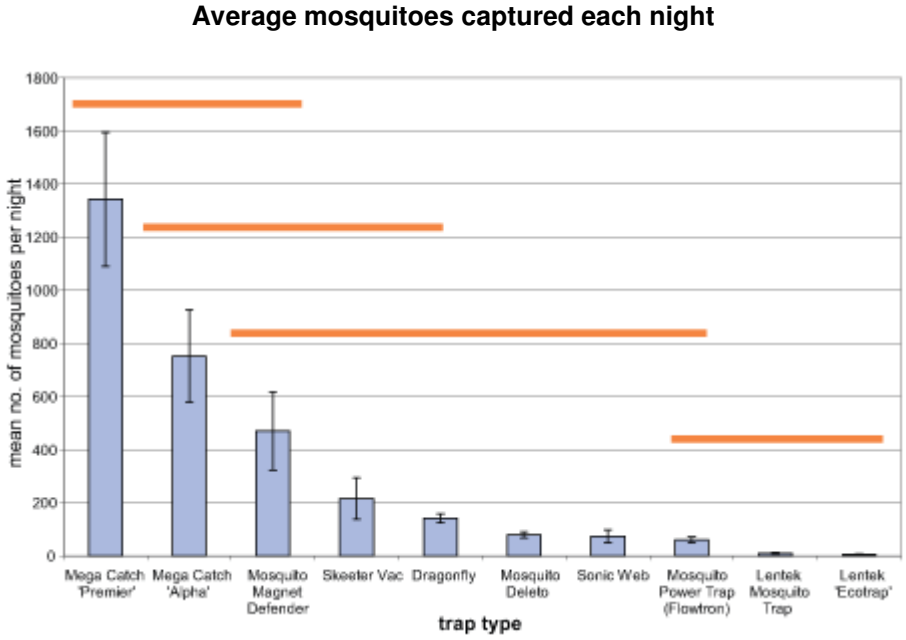

Figure 2. Graph showing average female mosquitoes caught by each trap per night (± SEM). The traps are ordered in descending performance from left to right. The orange lines indicate groups of traps whose performance cannot be distinguished using statistical tests (as determined by ANOVA and Tukey's *post hoc* testing).

TRAP TYPE	TOTAL MOSQUITOES
Mega-Catch™ 'Premier'	16120
Mega-Catch™ 'Alpha'	9022
Mosquito Magnet 'Defender'	5179
Skeeter Vac	2370
Dragonfly	1551
Mosquito Deleto	870
Sonic Web	883
Mosquito Power Trap (Flowtron)	600
Lentek Mosquito Trap	123
Lentek 'Ecotrap'	68

Table 2. Total mosquitoes caught by each trap for the duration of the study

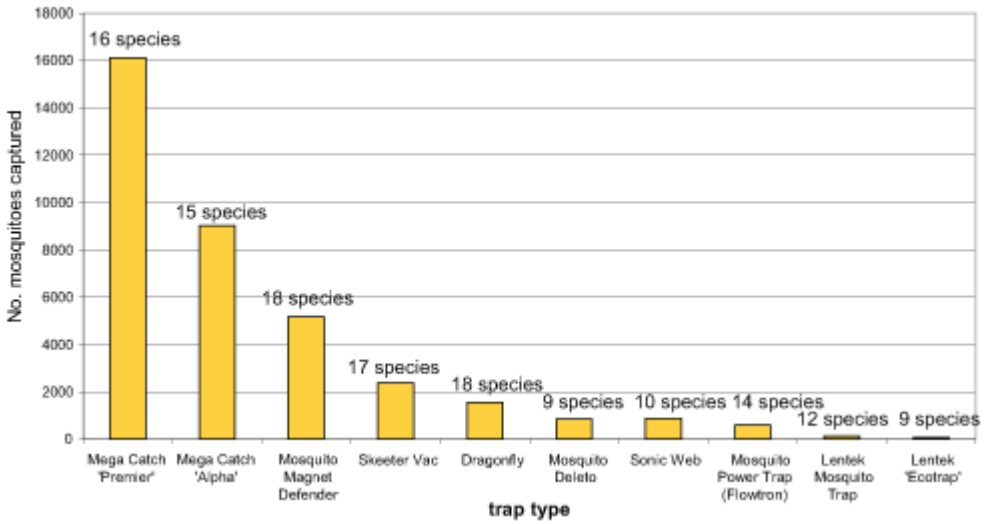

Figure 3. Total mosquitoes caught by each trap over the 12 nights of the study. Also shown is the number of mosquito species caught in each trap.

Types of mosquitoes captured: For the purposes of comparison, we grouped the mosquito species captured during the study into the following categories: total *Anopheles*, total *Culex*, total *Ochlerotatus vigilax* and the total of other species. These categories serve to divide up the most important mosquitoes according to their ecological requirements and disease-carrying abilities. These are described in Table 3.

Mosquito group	Breeding sites	Disease vector capabilities
Anopheles	Ground pools (fresh and brackish)	Malaria
Culex	Ground pools (fresh, occasionally brackish)	Arboviruses (Ross River, encephalitides e.g. MVE, JE)*
Ochlerotatus vigilax	Ground pools (brackish and saline), esp. samphire and mangrove swamps	Arboviruses (e.g. Ross River)
other species including: *Och. kochi, Och. notoscriptus, Verallina carmenti, Cx. gelidus*	A variety of types	Some of these other species may be a biting nuisance or may transmit disease at times

* In the USA, Culex species are the main vectors of West Nile virus

Table 3. Ecological and disease-carrying characteristics of mosquito groups reported on for this study.

The proportion of each mosquito category captured by each trap was calculated (Figure 4). These graphs show that a great deal of variation exists between the traps with regards to the type of mosquitoes they collect most often. Of particular note are the differences in the species catch of the Mosquito Magnet 'Defender' when compared to the Mega-Catch™ traps. The 'Defender' catches proportionally fewer *Oc. vigilax* and *Culex*.

Other features of this data include the relatively high proportion of *Anopheles* captured by the Flowtron. Also of interest is the relatively high proportion of *Culex* captured by the three traps that use sticky paper (Mosquito Deleto, Sonic Web and Lentek Ecotrap).

Figure 4. Groups of mosquitoes captured as proportions of the mean nightly catch.

Statistical analysis

Comparing the mean catch for the ten traps permits an evaluation of their effectiveness. However, to determine whether the differences seen in Figures 2 and 3 are valid, we have employed an Analysis of Variance test (ANOVA). Put simply, this test estimates the chances that the differences seen in Figures 2 & 3 are actually real, and not simply due to chance. In general, if the probability that the differences shown in Figures 2 & 3 are due to chance or fluke is 5% or less, we consider that the differences between the traps are most likely real.

Statistical test	Result	Probability of effect seen due to chance alone (P)	Significant difference between traps?
ANOVA	F = 35.8116, d.f. 115	P < 0.0001	Yes

Table 4. Results of statistical tests on data for the 10 traps compared here.

The ANOVA test has revealed that significant differences exist between the traps in terms of performance. Further testing (using a Tukey's *post hoc* test) revealed exactly which traps have performed differently from each other. These groupings are indicated by the orange lines in Figure 2. Traps that share an orange line do not have significantly different performance from each other.

Based on this analysis (Figure 2), it can be seen that the Mega-Catch™ 'Premier', Mega-Catch™ 'Alpha' prototype and the Mosquito Magnet 'Defender' are grouped together in terms of performance. However, the Mega-Catch™ 'Premier' has significantly better performance than seven other traps.

Discussion

The Mega-Catch™ 'Premier' not only caught the most mosquitoes of the traps discussed here, but also did so without the use of carbon-dioxide as an attractant. This trap consistently out-performed six other traps that released carbon-dioxide. Such mosquito-catching properties are rare in a trap that does not use carbon-dioxide.

Most of the traps tested here are marketed as devices that will reduce the number of mosquitoes biting humans in domestic situations. Although no traps were specifically assessed for this property during this study, it is probable that some of the poorer performing devices (as reported here) would provide little benefit to consumers in this regard.

It should be stressed that the relative importance of the various design features of these traps was not tested. Furthermore, the ability of these traps to reduce the rate of mosquito attack on humans was also not tested in this study.