

A comparison of four commercially available adult mosquito traps.

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Introduction

A wide range of commercial trapping units are available that purport to kill mosquitoes and reduce the impacts of nuisance biting in residential and recreational areas. These traps utilise attractants (e.g. light, heat, carbon dioxide, odour etc) to draw in and catch or kill adult mosquitoes. There are many different types of units available and, while many will collect mosquitoes, there is no quantitative evidence that they can significantly reduce nuisance biting impacts or public health risks in areas close to productive mosquito habitats.

The traps with the greatest potential are those that use carbon dioxide as the main attractant, have a relatively high release rate of the gas and incorporate a suction fan to collect mosquitoes. Units that use light alone to attract mosquitoes (e.g. blue light electrocutors) have been shown to have little impact on nuisance biting rates and often kill many more harmless, and environmentally beneficial, insects than mosquitoes.

The aim of this investigation was to compare the number of mosquitoes and non-target insects collected by four commercially available mosquito traps. It was beyond the scope of this investigation to determine the direct impact of trap operation on nuisance biting rates.

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Methods

The study site was a forested area close to estuarine and freshwater wetlands at Homebush Bay, Sydney. The site provided an ideal location to evaluate the response of a range of mosquitoes to the traps as over 30 mosquito species have been identified from this region including major pest and vector species such as *Ochlerotatus vigilax*, *Ochlerotatus notoscriptus*, *Coquillettidia linealis* and *Culex annulirostris*.

Four types of commercially available mosquito trap were used in this study:

- **MOSQUITO MAGNET® (MM) PRO Trap**
The MM Pro creates carbon dioxide by catalytically converting LPG from a standard 9Kg bottle. The unit is self powered and the carbon dioxide that is generated attracts host-seeking mosquitoes that are drawn into a catch bag by a fan.
- **MOSQUITO MAGNET® (MM) LIBERTY Trap**
The MM Liberty uses Counterflow Technology that emits a plume of CO₂, heat, and moisture to attract and collect mosquitoes. The trap is powered by a 12 volt power cord.
- **BUG EATER Trap**
Bug Eater Insect Traps are designed to work by using a black light to attract mosquitoes and a fan creates a down draft sweeping insects into soapy water solution inside the trap tray. The trap is recommended to be operated for 21 days to achieve maximum results to interrupt the 'breeding cycle' of pest mosquitoes.
- **BLACK HOLE Trap**
The Black Hole Trap is designed to attract mosquitoes by generating odour and carbon dioxide, via a photo-catalysis process, and UV light. A relatively large fan sucks mosquitoes into a collection basket.
- **ENCEPHALITS VECTOR SURVEILLANCE (EVS) Trap**
The fifth trap used as a 'control'. The EVS trap is specifically designed for the collection of female, host seeking mosquitoes and is used extensively for mosquito population monitoring, research and arbovirus surveillance in NSW. Carbon dioxide, in the form of dry-ice is used as the attractant and, as mosquitoes are drawn to the trap by the flume of carbon dioxide, are drawn into a catch bag by a small battery operated fan. These traps are designed for portability and for operation within a trapping network to compare the relative diversity

A 5x5 latin-square design was used with one of each trap used per night over five nights between Monday 24 March and Tuesday 30 March 2005. Each trap was rotated between the five fixed trap sites over the five nights. This experimental design ensures that variation in the spatial abundance of mosquitoes resulting from

environmental (i.e. closer to larval habitats or adult harbourage sites) and climatic (i.e. wind) factors does not result in disproportionate mosquito collections independent of trap design. The fixed sites were at least 100m apart but could not be randomly selected across the site, or operated at equal distances, as three of the units required an external power supply.

Each trap was set up, positioned and operated according to the manufacturer's recommendations. The Bug Eater unit, however, would normally collect mosquitoes in a soap solution in the catch tray. Preliminary collections indicated that the identification of specimens would be difficult if they had been immersed in water so an adhesive sheet of 'sticky paper' specifically designed for collecting mosquitoes and other insects was used. A fresh sheet each night was placed within the catch tray and was shown to be effective at collecting insects drawn into the trap.

Traps were operated for approximately 24hrs at each site and collections were returned to the laboratory for identification and sorting using taxonomic keys and illustrations. Mosquito species were identified to species while all other insects were sorted to order.

Results and discussion

A total of 13 mosquito species was collected over the five days with the most commonly collected species being *Cq. linealis*, *Cx. annulirostris*, *Oc. notoscriptus* and *Oc. vigilax* (Table 1). Insects belonging to eight orders were collected representing a wide range of individual species. The most common non-target insects collected were Dipterans (not including mosquitoes) and Lepidopterans (moths & butterflies).

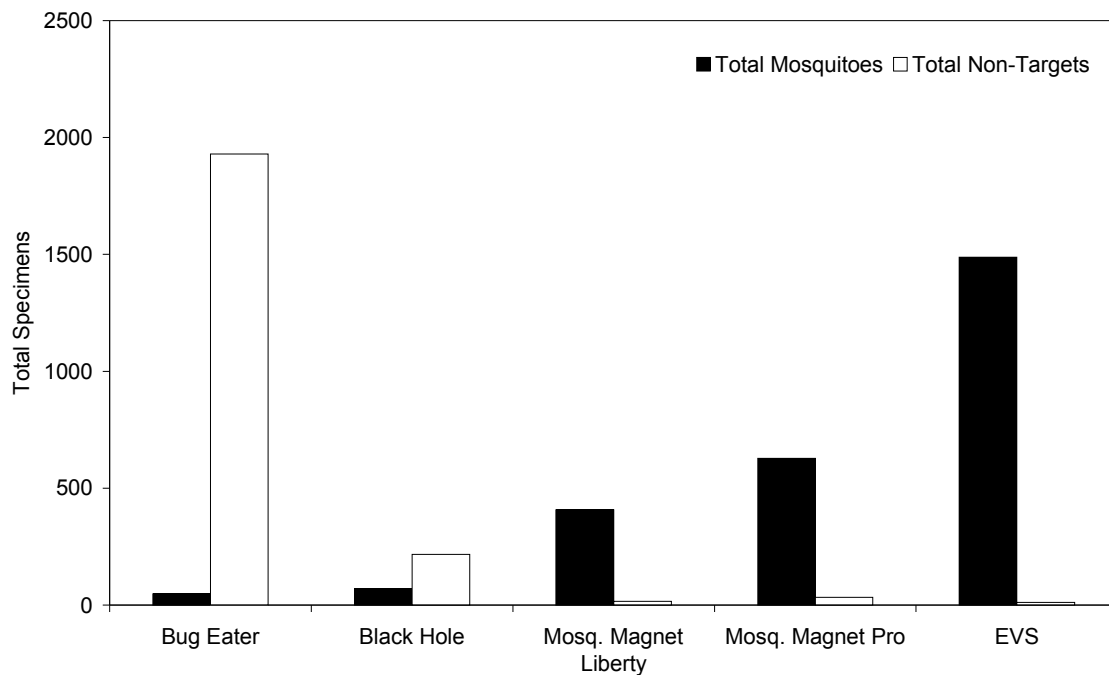
The greatest number of mosquitoes was collected by the EVS trap representing 59.3% of all mosquitoes collected. The MM Pro (23.8%) and MM Liberty (15.4%) collected similar numbers of mosquitoes. The Black Hole and Bug Eater traps collected only small numbers of mosquitoes with 2.6% and 1.8% of total mosquitoes collected respectively.

The most striking difference between the five traps was the large number of non-target insects collected by the Bug Eater and Black Hole traps (Figure 1). These traps collected a large number of Dipterans including large numbers of Chironomids, Tipulids and small, identified non-biting flies. There were very few biting midges (Ceratopogonids), blow flies, house flies or bushflies collected. There were also a number of small, medium and large moths collected in these two traps, particularly by the Bug Eater trap that collected a number of large specimens. Small numbers of Lepidopterans were also collected in the MM Liberty, MM Pro and EVS traps but these units do not feature strong light sources as a component of their design.

Table 1. The total number of mosquitoes and non-target insects collected by the Bug Eater, Black Hole, Mosquito Magnet Liberty, Mosquito Magnet Pro and EVS traps operated over five nights.

Specimens Collected		Bug Eater	Black Hole	Mosquito Magnet Liberty	Mosquito Magnet Pro	EVS
Mosquitoes	<i>An. annulipes</i>	2	1	6	6	56
	<i>Cq. linealis</i>	0	0	53	14	268
	<i>Cx. annulirostris</i>	6	4	19	121	281
	<i>Cx. australicus</i>	0	0	0	0	6
	<i>Cx. molestus</i>	0	0	1	16	5
	<i>Cx. quinquefasciatus</i>	2	5	33	2	4
	<i>Cx. sitiens</i>	2	0	13	2	5
	<i>Ma. uniformis</i>	0	0	0	0	1
	<i>Oc. alboannulatus</i>	0	0	1	1	3
	<i>Oc. alternans</i>	0	0	2	11	6
	<i>Oc. notoscriptus</i>	2	15	23	164	102
	<i>Oc. vigilax</i>	33	45	257	291	751
	<i>Oc. vittiger</i>	1	0	0	0	0
	Total	48	70	408	628	1488
	Coleoptera	Beetles	15	2	0	0
Diptera	non-mosquito flies	1476	64	10	30	9
Hemiptera	Bugs	2	0	0	0	0
Hymenoptera	Wasps, Bees & Ants	52	3	0	0	0
Lepidoptera	Moths & Butterflies	379	148	6	4	10
Neuroptera	Lacewings	2	0	0	0	0
Odonata	Dragonflies & Damselflies	2	1	0	0	0
Orthoptera	Crickets	1	0	0	0	0
Total non-target insects		1929	218	16	34	12

Figure 2. The total number of mosquitoes and non-target insects collected by the Bug Eater, Black Hole, Mosquito Magnet Liberty, Mosquito Magnet Pro and EVS traps over five nights.



These results indicate that each of the four commercially available traps can collect mosquitoes. However, the MM Liberty and MM Pro collected substantially more mosquitoes than the Bug Eater and Black Hole traps. The difference in catch effectiveness between the four traps is most likely due to the release of carbon dioxide from the MM Liberty and MM Pro that offers much great attractiveness to host seeking female mosquitoes.

The Bug Eater and Black Hole traps do collect mosquitoes but only a small proportion of those collected by the other traps. Notwithstanding the low mosquito collections, the large number of non-target insects collected is a concern. These insects pose no nuisance or public health risk to humans and may provide a beneficial contribution to the local environment (eg. pollination, food for birds, spiders, frogs etc). It is important to note that, while during this trial, the Black Hole collected fewer non-targets than the Bug Eater, there were often exceptionally large collections of Lepidopterans collected in this trap during preliminary trials.

While the EVS trap collected the most mosquitoes, these units hold less potential for domestic use as the running costs associated with the purchase of dry-ice and batteries is potentially excessive. The two MM traps hold potential for reducing nuisance biting impacts under some circumstances although it is difficult to assess their effectiveness when located close to an area of high mosquito activity.

The greatest potential for the traps will be, primarily, in urban or semi-rural locations where the most common biting mosquitoes are present in low numbers. The

reduction in nuisance biting problems can be further improved if strategies are undertaken to reduce the availability of potential mosquito breeding sites around the property (e.g. removing water holding containers, placing mesh of water tanks and placing native fish in ornamental ponds).

In residential areas located close to wetlands, it should be expected that some mosquitoes will be active during the summer months and the use of personal protection measures, in combination with the use of commercial mosquito traps, should be undertaken to minimise exposure to mosquitoes. It is advisable to avoid wetland and bushland areas during the peak periods of mosquito activity (ie. dusk and dawn) and the use of personal insect repellents (formulations containing DEET or Picaridin or mosquito coils containing insecticide) are highly recommended.

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