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A COMPARISON OF SEVEN TRAPS USED FOR COLLECTION OF *AEDES ALBOPICTUS* AND *AEDES AEGYPTI* ORIGINATING FROM A LARGE TIRE REPOSITORY IN HARRIS COUNTY (HOUSTON), TEXAS[1]

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ABSTRACT. Among 7 traps tested, significantly higher ($P < 0.01$) mean numbers of *Aedes albopictus* (269) and *Aedes aegypti* (55) females were collected within the Mosquito Magnet® Liberty trap compared with the remaining traps. The second highest mean captures for both species were obtained from omnidirectional Fay–Prince (77 *Ae. albopictus*) and Dragonfly® (13 *Ae. aegypti*) traps, which were not significantly different ($P > 0.01$) from an experimental moving-target trap that produced mean captures of 40 *Ae. albopictus* and 6 *Ae. aegypti* ($\alpha = 0.01$). In terms of *Ae. albopictus* capture, no significant differences ($P > 0.01$) existed between Dragonfly, CDC without light (CDC −), and CDC with light (CDC +) captures, which were significantly different ($P < 0.01$) from Mosquito Deleto™. No statistical significance existed between moving-target, omnidirectional, CDC +, CDC −, and Mosquito Deleto traps in terms of *Ae. aegypti* capture ($P > 0.01$), individual trap positions, or number of *Ae. albopictus* and *Ae. aegypti* females collected throughout the 21-day test ($P > 0.05$). Mosquito Magnet Liberty collected 7,208 *Ae. albopictus,* 1,467 *Ae. aegypti,* and 13 other species representing 5 genera, which comprised the largest total (9,662) and percentage (62.5%) of mosquitoes collected by all traps combined. Omnidirectional and moving-target traps captured 1,941 and 1,050 *Ae. albopictus,* 138 and 220 *Ae. aegypti,* and 2,171 (14.0%) and 1,397 (9.0%) of the total mosquitoes captured by all traps, with 8 and 10 species representing 5 genera, respectively, included in these collections. The Dragonfly captured 476 *Ae. albopictus,* 376 *Ae. aegypti,* and 1,008 total specimens (6.5%) representing 8 species and 4 genera in these collections. CDC + and CDC − traps collected nearly identical numbers of *Ae. albopictus* (431, 450) and *Ae. aegypti* (71, 71) with 537 (3.4%) and 551 (3.5%) total specimens, respectively. Eight species representing 5 genera were captured from CDC +, whereas CDC − captured 6 species representing 4 genera. Mosquito Deleto captured 118 mosquitoes, including 19 *Ae. albopictus* and 62 *Ae. aegypti* females (0.7%), with 6 species representing 4 genera. Battery-powered traps with contrasting color schemes and movement worked considerably better than stationary CDC miniatures without color or movement. Omnidirectional Fay–Prince and moving-target traps without octenol captured *Ae. albopictus* and *Ae. aegypti* females as frequently as some commercial traps. Additionally, costs incurred per mosquito trapped, future trap design, and important consumer-centered issues are briefly discussed.

KEY WORDS *Aedes albopictus, Aedes aegypti,* traps, attractants, carbon dioxide, visual targets

INTRODUCTION

At the beginning of the 2002 mosquito season, Harris County (Houston, TX) Mosquito Control Division (HCMCD) personnel were frequently asked whether or not commercial mosquito traps actually worked and, if so, to what extent. Within the past several years, a number of attractive features have been engineered into insect traps manufactured specifically for consumers rather than for mosquito-surveillance programs.

In general, these traps attract mosquitoes and other hematophagous insects through production or release of heat, water vapor, carbon dioxide, and octenol (1-octen-3-ol). Some of these traps employ mechanisms of capture that include adhesive panels, counter-flow air currents, or electrostatic grids. These stand-alone, low-maintenance mosquito traps, regularly encountered by consumers in department stores and shopping malls or in catalogs, television, and radio advertisements, are commonly described as being able to capture large quantities and a multitude of mosquito or other biting insect species inhabiting consumers' yards.

In an effort to answer questions about the new mosquito-trapping devices, a field test was designed and conducted within an area that routinely exhibits high numbers of *Aedes albopictus* (Skuse) and *Aedes aegypti* L. due to the presence of a large commercial tire repository. Because *Ae. albopictus* had been implicated as a potentially important vector for West Nile virus (WNv) in the laboratory and field (Turrell et al. 2001, Holick et al. 2002, Sardelis et al. 2002), this endeavor received high priority by HCMCD, given that *Ae. albopictus* is a very common peridomestic species in Harris County (HCMCD, unpublished data).

The year 2002 marked the 40th anniversary of the original CDC miniature trap design described by Sudia and Chamberlain (1962), which still remains a standard with which other adult mosquito surveillance traps are routinely compared. Since then, numerous traps have been developed for surveillance of peridomestic mosquito species, including the original Fay–Prince trap (Fay and Prince 1970) used historically for *Ae. aegypti,* and more

[1] Mention of commercial products does not imply a recommendation for use or sale by Harris County Public Health and Environmental Services or Harris County Mosquito Control Division.

recently in trapping studies of *Ae. albopictus* through modification into what are now referred to as the bidirectional Fay and omnidirectional traps (Jensen et al. 1994). Further literature review revealed that numerous trap comparison studies varied widely in design, conduct, and analysis of experiments, as selected research summarized in Table 1 suggests. Based on these previous approaches, our study included some attributes of past works built into a final experimental design consisting of 3 different commercial traps, 3 standard mosquito surveillance traps, and an experimental trap that presented movement as an additional attractive stimulus.

MATERIALS AND METHODS

Battery-operated traps

Two CDC Miniature Light Traps (John W. Hock Company, Gainesville, FL), one with a CM-47 incandescent bulb (hereafter referred to as CDC +), the other without (CDC −), and an omnidirectional Fay–Prince trap (John W. Hock Company) were wired for 3.0-VDC operation and outfitted with dual-hoop collection nets. The traps were suspended 61 cm above ground from portable stands fabricated from electrical conduit. Entrance heights for these traps were approximately 46–51 cm above ground. In the CDC miniature and omnidirectional traps, 4 D-cell batteries connected in series–parallel provided 3.0 VDC to power the suction motors. The moving-target trap motor ran off of 4.6 VDC provided by 4 D cells connected in series within a specially modified secondhand baby swing. All batteries were replaced after 48 h continuous use.

Moving-target trap description

A Graco® Battery-Powered Baby Swing (Graco Children's Products Inc., Exton, PA) was modified to provide movement as an attractive stimulus and a means of capturing *Ae. albopictus* and *Ae. aegypti* adults (Fig. 1). Modifications included removing the swing's seat and attaching four panels of 4-mil-thick black polyethylene plastic sheeting to the front, both sides, and rear of the swinging frame. The front panel was attached to the frame by threading heavy nylon twine through a 25-cm length of polyvinyl chloride (PVC) pipe and tying to the distal ends of the swinging frame, prior to placing a sleeve of 36 cm long × 25 cm wide sheeting over the suspended PVC pipe. The plastic sheet was weighted at the bottom by a 25-cm section of PVC pipe inserted into the sleeve and secured by wire ties. Attachment in this manner allowed the panel to pivot freely from front to rear without binding. Side panels consisted of sleeves (36 cm long × 30 cm wide) placed over both lateral arms of the swinging frame weighted with 30-cm lengths of PVC pipe secured by wire ties, thus allowing sideways and slight front to rear movement. The rearmost panel (64 cm long × 23 cm wide) was attached to the upper ends of the swinging frame in a manner similar to the front panel, with the addition of a length of nylon twine tied midlength between both lateral arms of the swinging frame. This provided a breaking point that allowed the sleeve to be deflected from hitting the suction trap suspended from the swing front and 61 cm (entry height) above ground.

The suction trap, consisted of 1) a motor housing fabricated from a 10-cm length of thin-wall PVC pipe, a sheet metal motor mount, and a 6-VDC motorized fan (# 4.10, John W. Hock Company); and 2) a collection container fabricated from a 15-cm length of thin-wall PVC pipe having a lengthwise split covered with fiberglass screening fastened with aluminum duct tape and a bottom end covered with fiberglass screening fastened with a PVC collar coated with hot-melt glue. Lateral screening had enough slack to permit expansion of the container top end, thus allowing insertion of the suction trap. Both sections were pinned together by inserting a slightly bent finishing nail into two holes that matched up during the mating of both sections. An electrical umbilical, connected in parallel between the swing motor and suspended suction trap, was constructed from a polarized automotive electrical cable (RadioShack®, cat. no. 270-1975) and effectively served as an electrical switch. Upon retrieving a daily collection, the fan was left running and both sections unmated slightly before placing an 8-cm PVC pipe cap over the collection container for transport. Cost of fabrication based on mentioned materials and a second-hand swing was approximately $75.00 (US).

Commercial traps

Three commercially available traps were used during the course of testing, including propane, electrostatically charged grid, and propane/electrically powered traps. The Mosquito Deleto (The Coleman Co., Inc., Wichita, KS) used open-flame combustion of propane to generate heat, moisture, and carbon dioxide to attract insects to adhesive panels, whereas the 500-cc Dragonfly Biting Insect Trap (BioSensory, Inc., Willimantic, CT) used household current to drive a carbon dioxide release solenoid and impart an electrostatic charge to a grid, which killed insects upon entry. The Mosquito Magnet Liberty (American Biophysics Corporation, East Greenwich, RI) used household current to power the unit's 12-VDC supply that initiated catalytic combustion of propane for heat, moisture, and carbon dioxide generation and ran a counterflow suction fan for insect entrapment. Additionally, the attractiveness of these traps was augmented with replaceable octenol lures. In the Mosquito Deleto and Mosquito Magnet Liberty traps, propane was stored in 18-kg refillable tanks. All 3

Table 1. Experimental methodologies used during comparison of mosquito traps based upon selected research conducted from 1983 to 1999.

Author(s)	No. different traps tested	No. trapping stations	Trap assignment	Trap separation distance (m)	Collection period (h)	No. trap days/nights	Statistics	Test dates	Attractants
Freier and Francy (1991)[1]	9	9	Random	20	6 (0900–1500)	24	Mean/SD	June–August	CO_2 (1 kg)
Jensen et al. (1994)[2]	4	4	Random	25 (1 m above ground)	24	28	Latin square Analysis of covariance Analysis of variance (ANOVA) Fisher's least significant diference	July–August	CO_2 (2 kg)
Kline (1999)[3]	2	2	Rotation	50	Unknown (nightly)	12	$\log(n + 1)$; t-test	April–May	CO_2 (500 ml/min) octenol (0.5 mg/h)
Kloter (et al. (1983)[4]	6	6	Rotation	5 (2 m above ground)	2	24 h (day) 24 h (night)	Percentage capture arcsine transformed, ANOVA; Duncan's Multiple Range Test	June–July	CO_2 (300 g)
Wilton and Kloter (1985)[2]	2	2	Rotation	2 (1 m above ground)	24	21	Untransformed mean, t-value, confidence interval	August–September	None

[1] Collection of *Aedes albopictus.*
[2] Collection of *Ae. albopictus* and/or *Ae. aegypti.*
[3] Collection of species other than *Ae. albopictus* or *Ae. Aegypti.*
[4] Collection of *Aedes aegypti.*

Fig. 1. Moving-target trap fabricated from a battery-powered baby swing.

commercial traps were assembled, operated, and maintained in accordance with original manufacturer's instructions for maximum efficiency. For commercial traps, the maximum trap height/distance to trap entrance were 89 cm/51 cm, 114 cm/84–109 cm, and 53 cm/28–48 cm for the Mosquito Magnet Liberty, 500-cc Dragonfly Biting Insect Trap, and Mosquito Deleto, respectively. The Dragonfly and Mosquito Magnet Liberty traps were provided household current via heavy-duty outdoor extension cords, whereas the Mosquito Deleto trap did not require an external power source due to a self-contained piezo-electric ignition system.

Attractants

Beverage coolers (1.9 liter), with five 0.6-cm holes drilled in the bottom, were filled daily with approximately 2 kg of dry ice and individually positioned on the ground horizontally within 31 cm of each battery-powered trap. All cooler lids were oriented downwind of CDC miniatures, omnidirectional Fay–Prince, and moving-target traps. The Mosquito Deleto and Mosquito Magnet Liberty traps produced carbon dioxide through combustion of propane, whereas the Dragonfly trap released 500 cc of carbon dioxide per minute from a 9-kg aluminum cylinder. Replaceable octenol cartridges (American Biophysics Corporation [1.7-g cartridge], and BioSensory, Inc. [3.7-g cartridge]) were placed in all 3 commercial traps; a single 1.7-g cartridge in the Mosquito Magnet Liberty; and single 3.7-g cartridges for the Mosquito Deleto and Dragonfly traps. No octenol lures were used with any of the battery-powered traps.

Location

The test site chosen was a privately owned 0.7-ha lot adjacent to an approximately 1.2–1.6-ha commercial tire repository in southeastern Harris County. The test site was separated from the repository by chain-link fencing and mature pine trees on the western side, scattered residences along the southern and eastern sides, and a fallow field to the northernmost boundary. Two wood-frame houses, 3 storage sheds, 2 trailers, and a large shop were located primarily in the northeastern quadrant of the lot. Overgrown areas containing dilapidated vehicles, and equipment provided ideal harborage for mosquitoes, as verified by landing rate counts on several occasions prior to testing. Vegetation in these areas consisted primarily of Johnsongrass (*Sorghum halepense* (L.) Pers.) in highly sunlit openings, and a combination of Texas swampprivet (*Forestiera angustifolia* Torr.) and common elderberry (*Sambucus nigra* L.) within shaded overstory. The highest landing rate counts were obtained in or around overgrown areas under mature American elm, *Ulmus americana* L., overstory within the northeastern quadrant.

Experimental design

Experimental design consisted of establishing 7 trapping positions on the test site based on pretesting landing rate counts and assigning traps to each position randomly. Three separate 7 × 7 Latin squares (7 traps vs. 7 positions) were used for trap assignment over 3 separate weeks for a total of 21 days of trapping. With this design, each trap visited a single position only once during a particular week. Trapping positions averaged 21 m (straight-line distance) apart and were physically and visually separated from each other by buildings, artificial structures, or vegetation. Ambient temperature and relative humidity were recorded on site through use of Oakton® 35710-series data loggers (Model CP650; Cole-Parmer Instrument Company, Vernon Hills, IL), and wind speed was taken using a Turbo Meter® electronic wind speed indicator (Davis Instruments, Hayward, CA).

During daily trap transfer, all traps were temporarily shut down, relocated to predesignated positions, and completely set up prior to establishing power to traps beginning with position 1 and ending with position 7. After initial power up, dry-ice containers were placed at positions having battery-powered traps prior to leaving the site. Trap collections were immediately transported back to the lab-

Table 2. Efficacy of 7 mosquito traps used for collection of *Aedes albopictus* females on property adjacent to a large tire repository in Harris County (Houston), Texas, May 16 through June 17, 2002.[1]

Trap used[2]	Mean number[3,4] collected	99% confidence limits[3] (lower, upper)
CDC (+)	12.05D	(6.30, 23.07)
CDC (−)	15.17D	(8.72, 26.36)
Mosquito Deleto™	1.65E	(1.19, 2.31)
Dragonfly®	18.85CD	(12.07, 29.42)
Mosquito Magnet™ Liberty	269.33A	(169.86, 427.07)
Moving target	40.98BC	(26.08, 64.38)
Omnidirectional	77.62B	(51.40, 117.21)

[1] Based on three replicates of a 7 × 7 Latin square design with all traps running 23 h per sampling interval (n = 21).
[2] Two standard CDC miniature light traps with and without bulbs (+, −), an unmodified omnidirectional trap, and an experimental moving-target trap baited with 2 kg dry ice in 1.91-liter coolers; 3 commercially available traps that generate CO_2 (Mosquito Deleto and Mosquito Magnet Liberty) or release CO_2 (500 cc Dragonfly) augmented with octenol lures.
[3] Back-transformation of values after analysis of variance of log (Y + 1) transformed data.
[4] Mean number of mosquitoes collected within specific traps followed by the same uppercase letters are not significantly different from one another ($P > 0.01$) using Tukey–Kramer honestly significant difference means separation.

oratory for separation and identification using appropriate taxonomic keys. All traps were run continuously during each sampling day (23 h), allowing 1 h each morning (09:30–10:30) for rotation of traps to assigned positions, replacement of collection nets, batteries, propane tanks, and carbon dioxide sources as necessary. Testing began on 16 May and ended on June 17, 2002. Trapping efforts were continuous except during periods of inclement weather.

Data analysis

Trap collection data were transformed using log(Y + 1) prior to data analysis as suggested by Bidlingmayer (1969). Afterwards, an analysis of variance of transformed collection means was performed using JMP® (SAS Institute Inc., Cary, NC) to detect differences in trap performance ($\alpha = 0.01$) and trap position ($\alpha = 0.05$). Trap collection means were separated using Tukey–Kramer honestly significant difference tests and presented as back-transformed means and 99% confidence limits (Steel and Torrie 1980, Sokal and Rohlf 1981, SAS Institute 2002).

RESULTS

Among 7 traps tested, significantly higher ($P < 0.01$) mean numbers of *Ae. albopictus* and *Ae. aegypti* females were collected in the Mosquito Magnet Liberty trap (269 and 55, respectively) as compared with the remaining traps. The mean numbers of *Ae. albopictus* and *Ae. aegypti* females captured in omnidirectional (77 and 4, respectively), and Dragonfly traps (18 and 13, respectively), were statistically different from one another. The omnidirectional trap captured significantly more ($P < 0.01$) *Ae. albopictus,* while the Dragonfly trap captured significantly more ($P < 0.01$) *Ae. aegypti* females (Tables 2 and 3). Interestingly, collections in the moving-target trap were not significantly different ($P > 0.01$) from those within the omnidirectional and Dragonfly traps, with average captures of 40 *Ae. albopictus* and 6 *Ae. aegypti* females being recovered from the moving-target trap (Tables

Table 3. Efficacy of 7 mosquito traps used for collection of *Aedes aegypti* females on property adjacent to a large tire repository in Harris County (Houston), Texas, May 16 through June 17, 2002.[1]

Trap used[2]	Mean number[3,4] collected	99% confidence limits[3] (lower, upper)
CDC (+)	3.19C	(1.98, 5.14)
CDC (−)	2.99C	(1.65, 5.41)
Mosquito Deleto™	2.50C	(1.38, 4.54)
Dragonfly®	13.67B	(7.27, 25.70)
Mosquito Magnet™ Liberty	55.20A	(35.18, 86.63)
Moving target	6.53BC	(3.01, 14.16)
Omnidirectional	4.76C	(2.65, 8.54)

[1] Based on 3 replicates of a 7 × 7 Latin square design with all traps running 23 h per sampling interval (n = 21).
[2] Two standard CDC miniature light traps with and without bulbs (+, −), an unmodified omnidirectional trap, and an experimental moving-target trap baited with 2 kg dry ice 1.9-liter coolers; 3 commercially available traps that generate CO_2 (Mosquito Deleto and Mosquito Magnet Liberty) or release CO_2 (500 cc Dragonfly) augmented with octenol lures.
[3] Back-transformation of values after analysis of variance of log (Y + 1) transformed data.
[4] Mean number of mosquitoes collected within specific traps followed by the same uppercase letters are not significantly different from one another ($P > 0.010$ using Tukey–Kramer HSD means separation.

2 and 3). In terms of mean *Ae. albopictus* captured, there were no significant differences ($P > 0.01$) between the moving-target and Dragonfly traps, although the Dragonfly, CDC −, and CDC + captures (18, 15, and 12, respectively) were significantly different ($P < 0.01$) from those of the Mosquito Deleto, with only 1 mosquito captured in this latter trap (Table 2). No statistical significance ($P > 0.01$) in terms of mean *Ae. aegypti* captured existed between the moving-target (6), omnidirectional (4), CDC + (3), CDC − (2), and Mosquito Deleto (2) traps (Table 3). No significant differences ($P > 0.05$) were detected between individual trap positions and the average number of *Ae. albopictus* and *Ae. aegypti* females collected throughout the 21-day test ($\alpha = 0.05$). Southerly winds predominated on the test site throughout the testing period, with an average wind speed of 2.7 kph. Mean ambient temperature and relative humidity were 24.5°C and 78.5%, respectively.

The Mosquito Magnet Liberty collected a total of 7,208 *Ae. albopictus,* 1,467 *Ae. aegypti* specimens, as well as specimens of 13 additional mosquito species representing 5 genera. Collecting in this trap type comprised the largest total number (9,662 out of 15,444) and percentage (62.5%) of mosquitoes captured, compared with the other traps tested (Table 4). Omnidirectional and moving-target traps captured 1,941 and 1,050 *Ae. albopictus,* 138 and 220 *Ae. aegypti* specimens, respectively. Overall, these traps captured 2,171 (14.0%) and 1,397 (9.0%) of the total mosquitoes collected by all traps combined, with 8 and 10 species representing 5 genera included in the collections of these other traps, respectively (Table 4). Dragonfly captured 476 *Ae. albopictus* and 376 *Ae. aegypti* specimens and a total of 1,008 specimens (6.5%) containing 8 species representing 4 genera (Table 4). CDC + and CDC − traps collected comparable numbers of *Ae. albopictus* (431, 450, respectively) and *Ae. aegypti* (71, 71, respectively) with 537 (3.4%) and 551 (3.5%) total mosquito specimens collected, respectively. Eight species representing 5 genera were captured from the CDC +, whereas the CDC − accounted for 6 species representing 4 genera included in the collections from this trap (Table 4). Mosquito Deleto collected 118 mosquito specimens, including 19 *Ae. albopictus,* with a majority (62) being *Ae. aegypti* females, resulting in 0.7% of total number of mosquitoes collected, with 6 species representing 4 genera (Table 4).

Table 4. Species, number, and overall percentage of 15,444 mosquitoes collected by 7 mosquito traps on property adjacent to a large tire repository in Harris County (Houston), Texas, May 16 through June 17, 2002.

Species	Trap used							
	CDC (+)	CDC (−)	Mosquito Deleto®	Dragonfly®	Mosquito Magnet® Liberty	Moving target	Omnidirectional
Aedes aegypti	71	71	62	376	1,467	220	138
Aedes albopictus	431	450	19	476	7,208	1,050	1,941
Aedes vexans	—	—	—	—	5	—	—
Anopheles crucians	—	—	—	—	1	1	—
Anopheles quadrimaculatus	1	1	—	—	30	2	5
Ochlerotatus fulvus pallens	—	—	—	1	9	—	1
Ochlerotatus taeniorhynchus	10	9	26	98	647	5	55
Ochlerotatus triseriatus	—	—	—	—	2	1	—
Ochlerotatus sollicitans	2	—	—	7	38	2	—
Culex quinquefasciatus	14	12	6	20	170	74	21
Culex salinarius	4	8	4	26	71	41	9
Psorophora ciliata	—	—	1	—	1	—	—
Psorophora columbiae	—	—	—	—	2	—	—
Psorophora cyanescens	4	—	—	4	9	1	1
Psorophora ferox	—	—	—	—	2	—	—
No. in column (percent of total)	537 (3.4)	551 (3.5)	118 (0.7)	1,008 (6.5)	9,662 (62.5)	1,397 (9.0)	2,171 (14.0)

DISCUSSION

Battery-powered traps, such as the omnidirectional Fay–Prince and moving-target traps with contrasting glossy white and black color schemes, worked considerably better than CDC miniatures without contrasting patterns. Constant movement appeared to augment attractiveness of color patterns in the moving-target trap by providing mosquitoes

additional visual cues during appetitive and attraction flight (Bidlingmayer 1994). In general, collections of *Ae. albopictus* and *Ae. aegypti* agreed with previous work performed by Jensen et al. (1994) in that the omnidirectional Fay–Prince trap worked better than the CDC miniatures. Interestingly, the omnidirectional Fay–Prince and moving-target traps without octenol captured *Ae. albopictus* and *Ae. aegypti* females in numbers comparable with or better than a majority of the commercial traps tested (i.e., Mosquito Deleto and Dragonfly traps).

The Mosquito Magnet Liberty clearly outperformed other traps tested, both in overall captures and number of species collected. In our study, the counterflow air currents used in the system were highly effective in generating an attractive, odor-rich effluent and necessary air influx needed to collect and hold numerous specimens, which is consistent with findings of other studies (Kline 1999, 2002; Burkett et al. 2001).

At the time of testing, an omnidirectional Fay–Prince and Mosquito Magnet Liberty traps cost approximately $154.00 and $479.00 per unit, respectively. Based on test data, not including daily ancillary costs, the omnidirectional Fay–Prince collected a total of 2,171 female mosquitoes compared with 9,662 female mosquitoes captured by the Mosquito Magnet Liberty, or approximately 7 and 5 cents per mosquito, respectively. These approximations are based solely on initial trap cost and do not include additional costs of household current, propane, extension cords, replacement nets, and octenol cartridges (Mosquito Magnet Liberty trap), nor costs of dry ice, coolers, batteries, and replacement nets (omnidirectional trap), which are necessary for continuous operation. The highest and lowest costs incurred per mosquito based on initial trap expense ranged from $1.60 and $0.05 for the Mosquito Deleto and the moving-target traps, respectively. Based on overall performance of commercial traps, consumers could possibly reduce initial expense and increase mosquito captures through use of simple, battery-powered traps placed at several locations throughout a property. Our data suggest that future battery-powered trap designs could employ moving visual targets as an attractive stimulus that may limit the need for additional olfactory attractants, including carbon dioxide and octenol.

Undoubtedly, some commercial traps available to homeowners can be productive in terms of capturing a number of mosquitoes within an area. Additionally, some traps will work better than others with specific mosquito species. If homeowners live within areas that routinely exhibit high numbers of one or more mosquito species, the chances of reducing those populations to personally acceptable levels would be extremely low. During the course of our tests with two *Aedes* spp., some of the commercial traps were efficient in capturing mosquitoes, but daily visual observations suggested that traps were also efficient in attracting mosquitoes that were never captured. Based on this fact, it is possible that traps attract more mosquitoes than they can actually capture, increasing overall mosquito abundance within an area.

For example, the landowner of our test site was asked on a daily basis "Has there been a noticeable drop in the number of mosquitoes biting you over the last day or so?" The standard reply was a stern "No!" While our test site was not typical in terms of what a majority of homeowners face, the misconception of eliminating mosquitoes by simply trapping them off one's property is relatively commonplace and raises some interesting consumer-centered issues.

If consumers develop complacent attitudes toward mosquitoes, arising from a sense of security generated by owning and operating traps on their property, they are far more likely not to use personal protective measures, including properly worn clothing, deet and permethrin repellent applications, avoidance of times and places with peak mosquito activity, and prevention of insect entry into households. Traps are not the sole solution sought after by many homeowners to control local mosquito problems; however, they remain instrumental in an integrated approach toward mosquito reduction through arthropod-borne disease threat identification, countermeasure implementation, and thorough routine mosquito surveillance by mosquito abatement districts.

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