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EVALUATION OF PUBLIC INFORMATION PACKETS FOR MOSQUITO SOURCE REDUCTION IN TWO FLORIDA CITIES[1]

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ABSTRACT. The efficacies of induced backyard cleanups of mosquito development sites via 3 different literature treatments were studied in low- and middle-income neighborhoods in Gainesville and Tallahassee, FL, during July and August 1993. Results indicated that 4-color-process literature significantly reduced the number of artificial containers with or without active mosquito development in both economic areas in both geographic locations compared to no literature or black-and-white literature treatments. More importantly, there were no differences between residences receiving the black-and-white literature and residences given no literature.

INTRODUCTION

Low- and middle-income urban areas contain large numbers of artificial containers that are known development sites for *Aedes aegypti* (Linn.), *Aedes albopictus* (Skuse), *Aedes triseriatus* (Say), *Culex nigripalpus* Theobald, and *Culex quinquefasiatus* Say in the southeastern United States (Focks et al. 1981, Schreiber 1992, Schreiber et al. 1992, Schreiber and Cuda 1994). Ground adulticiding, although generally practiced, is only partially effective against diurnally active *Ae. aegypti* and *Ae. albopictus.*

For many urban mosquito species, especially *Ae. aegypti* and *Ae. albopictus,* source reduction, albeit labor intensive and expensive, can significantly reduce potential development sites and, subsequently, adult populations. Source reduction is conducted during residential inspections by mosquito control personnel or by residents after having been given some information, often in the form of a pamphlet.

Low-income areas generally have high incidences of containers that harbor *Ae. aegypti* (Tinker 1964, von Windeguth et al. 1969, Chambers et al. 1986). Detailed surveys conducted by the Centers for Disease Control, DHEW (CDC) during the late 1950s and early 1960s indicated that such areas had consistently higher *Ae. aegypti* incidences. Furthermore, Focks et al. (1981) reported that type, shape, and location of containers influence the number of foci and the magnitude of *Ae. aegypti* infestation in New Orleans. Since the introduction and continued spread of *Ae. albopictus,* via the used tire industry, mosquito surveys in tire piles (Andreadis 1988, Baumgartner 1988) and in urban areas throughout the southeastern United States (Moore et al. 1990) have become more common. The relative importance of containers in arboviral outbreaks has received some attention (Hansen et al. 1976, Hedberg et al. 1985). However, a paucity of studies on *Ae. albopictus* and their relation to urban habitats in Florida exists (Schreiber et al. 1992), despite the nuisance and disease transmission potential of this mosquito species.

Little information exists on the effectiveness of repeated source reduction campaigns (surveys) or the practice of leaving public education pamphlets with the resident, despite their widespread distribution by mosquito abatement districts (Schreiber 1992). Recent studies conducted in Florida suggest that black-and-white literature has a positive effect, especially in low socioeconomic areas (Schreiber and Cuda 1994). Studies evaluating the impact of providing different types of literature to assist in urban mosquito source reduction have not been attempted. This study compared the number of artificial containers that were current and or potential mosquito development sites remaining around structures within 30 days of initial inspection and distribution of either a black-and-white pamphlet, a color brochure, or no literature to the residents of the selected properties in 2 cites in Florida.

MATERIALS AND METHODS

Study site selection: The study was conducted in Gainesville and Tallahassee, Florida. The 2 cities were selected because they are similar in population size (280,000 in Tallahassee and 212,000 in Gainesville), both have state universities, both are located in the north-central part of the state separated by only 156 mi., both are within the Southern Hardwood Forest Hammock vegetation zones (Myers and Ewel 1990), and both have active mosquito control programs with similar format to their mosquito public education pamphlets. Two areas within each city were selected using tax rolls to determine prop-

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erty values (low property value area: <$30,000; middle property value area: $30,000–$60,000), followed by cursory site visits to ensure that an abundance of artificial containers and *Ae. albopictus* populations were present. Treatments were assigned at random to 6-block areas within each economic zone, which were selected prior to the initial premise survey.

Treatments consisted of no literature (controls), the local mosquito abatement district's current black-and-white public health literature (Fig. 1), or a color brochure. The color brochure measured 11 × 14 in. (28 × 36 cm), and was gate-folded with 4-color processing. This pamphlet contained the same general introduction, the inspection report, and "mosquito prevention at home" section as the black-and-white brochure (see Part IV of Fig. 1). The inside layout contained the following additional information: 1) a general mosquito biology section, 2) information on personal protection repellents, 3) the importance of dog heartworm and prevention, 4) a section on eastern equine encephalitis and horses, and 5) a section on mosquitoes that inhabit bromeliads. Lastly, a computer-generated color graphic depicting a residential yard illustrating potential mosquito container habitats was added. Thus, we have the exact same information and format as the black-and-white pamphlet with additional information and visual reinforcement of container habitats with a graphic color display. Furthermore, to ensure that the color literature was delivered to each residence in a similar fashion as the black-and-white literature (i.e., placed on a residence door knob), the color brochure was placed inside a 12 × 15-in. (30 × 38-cm) low-density white plastic handle bag (International Plastics, Greenville, SC). Although the color and black-and-white literature types are not exactly equal in content the null hypothesis is the same: providing public health literature will have no effect on resident-initiated cleanup. Copies of the color brochure are available upon request from the authors. The number of properties inspected by literature type and city are summarized in Table 1.

Premise surveys: Surveys consisted of intensive premise-by-premise searches for artificial containers that were actually or could potentially be utilized as development sites by mosquitoes (i.e., contained water). The number, shape, size, and treatment assignment were recorded using a classification scheme similar to that of Chambers et al. (1986). Water and mosquitoes, if present, were put back into their respective containers following inspection. A maximum of 10 larvae/container was collected and preserved in 70% ethyl alcohol for transport and subsequent identification in the laboratory. The 2 surveys were conducted approximately 1 month apart. After each survey, the assigned literature treatment was placed on the front door knob of each residence.

Statistical analysis: The data were evaluated by an analysis of variance to determine differences between the treatments, and the effect on container cleanup. Mean separations of the treatments were done using orthogonal contrasts (SAS Institute 1985). To measure differences in numbers of potentially positive and/or positive containers, a modification of the per capita change values was employed. Per capita change of the number of containers with water and/or mosquito larvae per residence was calculated as: $(N_t - N_{t-1})/N_{t-1}$, where N_t is the number of potential containers per residence at time t (second survey), and N_{t-1} is the number of potential containers per residence at time $t - 1$ (first survey) (Reeve and Murdoch 1986). This analysis has been used in evaluating predator effects on mosquito larval populations in California (Walton et al. 1990) and in Florida (Schreiber and Hunter 1993). In this case the resident is the generalized "predator." For example, if the initial survey found 10 containers and the 2nd survey found 5 containers, then the per capita value was 50% reduction. Modifications made to these calculations were: 1) homes without containers at both surveys were scored 100%, and 2) homes in which the number of containers increased between surveys (n = 10 total residences) were given zeros instead of minus values. Thus, a bias was made in favor of premises that were "mosquito free." Percentages were then subjected to an arcsine transformation to normalize the data prior to statistical analysis (Steele and Torrie 1980).

RESULTS

No significant differences were noted between the amount of rainfall 1 wk prior to and during each survey in the Gainesville low-income area ($F = 0.04$, $df = 1$, $P = 0.84$), the Gainesville middle-income area ($F = 1.19$, $df = 1$, $P = 0.30$), or in the Tallahassee middle-income area ($F = 3.33$, $df = 1$, $P = 0.12$). Differences in rainfall amounts were detected in the low-income area of Tallahassee ($F = 8.62$, $df = 1$, $P = 0.03$). There was no rainfall 1 wk prior to and during the 2nd survey.

Differences were noted between the 2 cities. Gainesville had a significantly higher mean per capita change (95%) than Tallahassee (59%) ($P < 0.001$). There were no significant differences between property value areas in either city. There were differences between treatments (Table 2). Significant differences were confined to the color literature presentation versus no literature or the currently employed black-and-white literature.

Leon County Mosquito Control Was Here!

Inspector _____

I. We are responding to a mosquito problem in your area.

II. We found the following conditions:
☐ Mosquito larvae (wigglers) breeding on your property in:
☐ artificial containers (cans, tires, etc.) ☐ ditches ☐ pond
☐ other _____
☐ No mosquitoes ☐ Adult mosquitoes
☐ Other _____

III. We will take the following action:
☐ Perform surveillance on your property to determine what types of mosquitoes exist and the extent of the problem. This information will assist in determining control measures.
☐ Larvicide (spray standing water)
☐ Recommend treatment by fogging trucks
☐ Other _____

IV. To help reduce your mosquito problem we recommend that you do the following:
☐ Empty all containers that hold water or change water every 3 days and ask your neighbors to do the same.
☐ Remove debris from your ditches.(Trash, leaves, grass cuttings, and other vegetation create ideal mosquito breeding areas.)
☐ Make sure all window and door screens are in good condition to help prevent mosquitoes from entering your home.
☐ Other _____

V. If you are a pet owner, make sure your dog is on preventive heartworm treatment and vaccinate your horses against eastern equine encephalitis.

If you have any questions or would like additional information, please call our office:

Leon County Mosquito Control
2965 Municipal Way
Tallahassee, FL 32304
Telephone: 487-3174

Fig. 1. The black-and-white brochure currently in use by the 2 mosquito districts.

No significant differences in per capita change were noted between the black-and-white literature and the control literature groups.

There was a significant interaction between location and property value (Table 3). The Tallahassee middle-income area had lower per capita change than the middle-income area in Gainesville.

Table 1. Number of residents per literature treatment, city, and property value area, June–July 1993.

City	Property value	Literature treatment: Control	Black and white	Color
Tallahassee	Low	31	31	29
	Middle	35	36	39
Gainesville	Low	39	35	39
	Middle	53	54	49

DISCUSSION

In this study we present a scientific evaluation of the effects of public health literature on resident-initiated source reduction of potential or actual containers for larval mosquitoes. The treatments employed in this study were not exactly the same in content nor are they direct, but must be assimilated by the reading public and then put into action by them. This study has more of a sociological element to it than normally ascribed to the majority of mosquito control evaluations. Due to its inherent sociological nature, this study does not make many allowances for the selectivity of the experimental material. In sociology and economic studies it is difficult to avoid the nonselectivity aspect of experimental material (Cochran and Cox 1957). Thus, a common practice, which reflects the notion that different investigators may hold different views as to the loss or gain involved in implementing or interpreting a social scientific finding, is to simply report the probability level associated with findings, indicating that the null hypothesis may be rejected at that level (Siegel 1956).

Our study demonstrated that the distribution of color literature to residents caused actions that significantly reduced the number of backyard containers actually or potentially (potentially defined in this study as at least containing water) capable of supporting mosquito development compared to black-and-white literature, or no literature at all. The most important finding of this study was that results of distribution of black-and-white literature were not significantly different ($P > 0.05$) from not putting out any literature at all. This means that black-and-white literature pamphlets currently used by the examined districts may be inadequate to stimulate the intended response, that is, residents cleaning up their own yards of artificial containers actually or potentially capable of supporting mosquito

Table 2. Analysis of variance and the orthogonal contrasts of the 3 literature types per capita change of actual or potential containers that could be utilized as mosquito development sites in Tallahassee and Gainesville, FL, 1993.[1]

Source	df	F value	$P > F$
Location (LOC)	1	34.42	0.0001
Property value (ECON)	1	0.03	0.86
Treatment (TRT)	2	2.74	0.07
Color vs. others	1	4.93	0.03
No literature vs. black-and-white literature	1	0.53	0.47
LOC × ECON	1	4.00	0.04
LOC × TRT	2	0.75	0.47
ECON × TRT	2	1.29	0.27
LOC × ECON × TRT	2	0.11	0.89

[1] $R^2 = 0.096$; CV = 82.05.

development. If we define potential mosquito development containers as all available containers the results may even have been less satisfactory.

A significant location effect was also detected. Gainesville residents responded more favorably to the distribution of public health literature, regardless of literature type, than Tallahassee residents. No readily apparent differences can be ascertained except that Leon County Mosquito Control (Tallahassee) had a major public information campaign on television and radio prior to and during our study, whereas the City of Gainesville Mosquito Control program did not. Further work is needed to assess if media saturation may influence this result.

The one significant interaction between the main effects was the location by property value status. Tallahassee's middle-income area residents reduced the container population less than those in the lower-income area, whereas in Gainesville the opposite was true. Only one identifiable reason can explain this result, rainfall. The amount of rainfall in Tallahassee differed from one survey to the next in the low-income area. Indeed, the low-income area received no rain 1 wk prior to or during the follow-up survey, whereas the middle-income area, albeit minor, did receive rain (0.17 cm). As a result, the low-income area's containers may have had a greater probability of drying up and appearing "controlled" than the middle-income area, because, although the rainfall amounts were low, containers would concentrate the rain water into a amount perhaps suitable for mosquito development.

Urban mosquitoes, which inhabit artificial and natural containers, are not easily controlled with chemicals. Mosquitoes that lay eggs and develop in these artificial habitats must survive in ephemeral and unpredictable niches. Thus, even biological control agents, unless tightly coexisting with these mosquito species and having great elasticity in both behavioral and ecological attributes, are probably no better than conventional chemicals. Only through public education and the use of source reduction techniques can mosquito control workers achieve some measure of success in reducing artificial mosquito habitats. As we have shown, the type and presentation of public information literature can have differing impacts on residents, leading them to clean up their own yards.

Table 3. Least square means of the per capita change in actual or potential mosquito development sites by location and by property value interactions following surveys in Tallahassee and Gainesville, FL, in 1993.

Location	Property value	Mean ± SE[1]
Tallahassee	Low	65.7 ± 0.07
	Middle	52.3 ± 0.06
Gainesville	Low	89.6 ± 0.06
	Middle	99.0 ± 0.05

[1] Percent of containers not containing water or mosquitoes. Houses without containers received a 100% score.

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