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Vector Burden of *Aedes aegypti* and *Aedes albopictus* Populations in Residential Versus Non-Residential Areas of the Urban Environment in Tapachula, Chiapas, Southeastern Mexico

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Simple Summary

Dengue is a mosquito-borne disease that continues to affect many cities in Latin America. Most control efforts focus on houses, because the mosquito *Aedes aegypti*, the primary dengue vector in towns, often breeds in water containers found in and around homes. In this study, we placed ovitraps in residential neighborhoods and at different non-residential sites in the city of Tapachula, southern Mexico, to measure egg productivity and identify which species are present. We found that houses produced more mosquito eggs, principally *Ae. aegypti*, but non-residential places also contributed many eggs and were especially important for the tiger mosquito *Ae. albopictus*. Our results show that both residential and non-residential areas support vector burden capable of transmitting dengue. Therefore, control programs should not limit their actions to houses, but need to include schools, cemeteries, parks, vacant lots, and other similar sites in their routine inspections and vector control programs to protect the human population from dengue virus transmission.

Abstract

Dengue outbreaks highlight the need to quantify how environments sustain populations of the mosquito vectors *Ae. aegypti* and *Ae. albopictus*. Most control activities focus on households, while non-residential premises receive little attention. We conducted a cross-sectional ovitraps survey in August 2025 in Tapachula, Chiapas, Mexico, deploying 593 ovitraps: 297 in residential neighborhoods and 293 in non-residential sites. We collected 42,758 eggs; 61.5% (n = 26,316) came from residential areas and 38.5% (n = 16,442) from non-residential areas. Ovitrap positivity was higher in residential versus in non-residential areas (92.6% vs. 87.0%; $p = 0.025$), and the mean number of eggs per ovitrap (88.6 ± 5.1 vs. 56.1 ± 3.3 eggs; $p < 0.001$), yielding 298.0 vs. 175.3 eggs/ha, respectively. From a subsample of 16,965 eggs, 7,543 adults emerged (44.5%), dominated by *Ae. aegypti* in residential areas (83.3%) and *Ae. albopictus* in non-residential areas (80.0%). Vector burden differed by species: *Ae. aegypti* densities were higher in residential areas (51.0 vs. 4.5 adults/ha), whereas *Ae. albopictus* densities were higher in non-residential sites (18.2 vs. 10.2 adults/ha). These patterns show that both residential and non-residential premises are important sources of dengue vectors and should be included in integrated surveillance and control strategies.

Keywords: *Aedes aegypti*; *Ae. albopictus*; Dengue; entomological surveillance; oviposition; ovitraps; vector control

1. Introduction

In 2024, Latin America experienced the largest dengue outbreak on record, with 13,063,434 suspected cases, while Mexico reported 558,846 cases of which 125,160 were confirmed [1,2]. The factors attributed to these alarming results include a lack of effective vaccines, limited development of antiviral drugs, and climate change [3]. However, we must also recognize that field methods for controlling the *Ae. aegypti* and *Ae. albopictus* vectors typically result only in temporary reductions in their populations [4]. This is likely due to insecticide resistance in dengue vectors, *Ae. aegypti* and *Ae. albopictus* [5–7]. In addition, many non-residential areas, such as parks, cemeteries, and schools, are never treated with insecticides. These areas are vast and complex to access. These residual populations in non-residential areas often re-infest the same areas and the residential area in subsequent seasons. Few studies have quantified the epidemiological impact of domestic or household vector populations, and even fewer have examined populations outside of human dwellings [8]. A likely reason why these vectors persist in non-residential urban areas is that, in the past, entomological indices, such as the House Index used during yellow fever campaigns, focused exclusively on mosquito populations inside homes [9]. These Aedine indices, along with Container and Breteau indices, were incorporated as dengue epidemics emerged at the end of the 1970s. Today, many programs still believe that dengue transmission only occurs within households, leading most control efforts to focus there. In recent years, reports on outdoor cases and vectors have increased. For example, [10] collected *Ae. aegypti* in school classrooms infected with Dengue serotype 2 in Mérida, Yucatán, Mexico. [11] documented a high prevalence and productivity of *Ae. aegypti* pupal populations in non-residential sites in Iquitos, Peru, such as markets and riverboats, with values comparable to or higher than those in residential areas (≈122–213 vs. 122–161 pupae/ha). In Monterrey, Mexico, Zarate-Nahon et al. (2013) found that 94. 3% of *Ae. aegypti* were present at non-residential sites such as schools, commercial areas, churches, tire repair shops, factories, bus stations, meat processing facilities, libraries, and recreational sites. Finally, [12] found that non-residential environments were more likely to be productive sites for *Ae. aegypti* than residential sites. Vacant lots are often located near homes, have abundant vegetation, and contain discarded items that retain water and can serve as breeding grounds for *Ae. aegypti* larvae.

Considering the potential significance of uncontrolled vector populations outside homes, this study aimed to: 1) compare the egg productivity of *Aedes spp.* between residential and non-residential areas; 2) identify and compare the species composition of *Ae. aegypti* and *Ae. albopictus* in residential and non-residential neighborhoods; 3) Compare the vector burden of *Aedes* species between residential and non-residential sites.

2. Materials and Methods

2.1. Study Area

This study was conducted in Tapachula, Chiapas, a city located in southeastern Mexico with 353,706 inhabitants (2020 census) (Figure 1). Between the parallels 14°37′ and 15°15′ N, the meridians 92°09′ and 92°28′ W, altitude between 0 and 2,700 m, and it borders Guatemala to the south. The region has a humid tropical climate, with an average annual temperature of 28°C and a relative humidity of 80%. Annual rainfall is characterized by a rainy season from May to October and a dry season from November to April, with annual precipitation ranging between 1,200 – 5,000 mm [13]. In addition to its geographic location, which favors the reproduction and spread of the *Ae. aegypti* mosquito, resulting in annual outbreaks of dengue fever, this region has been characterized by intense migratory movements from Central and South America to the United States [14].

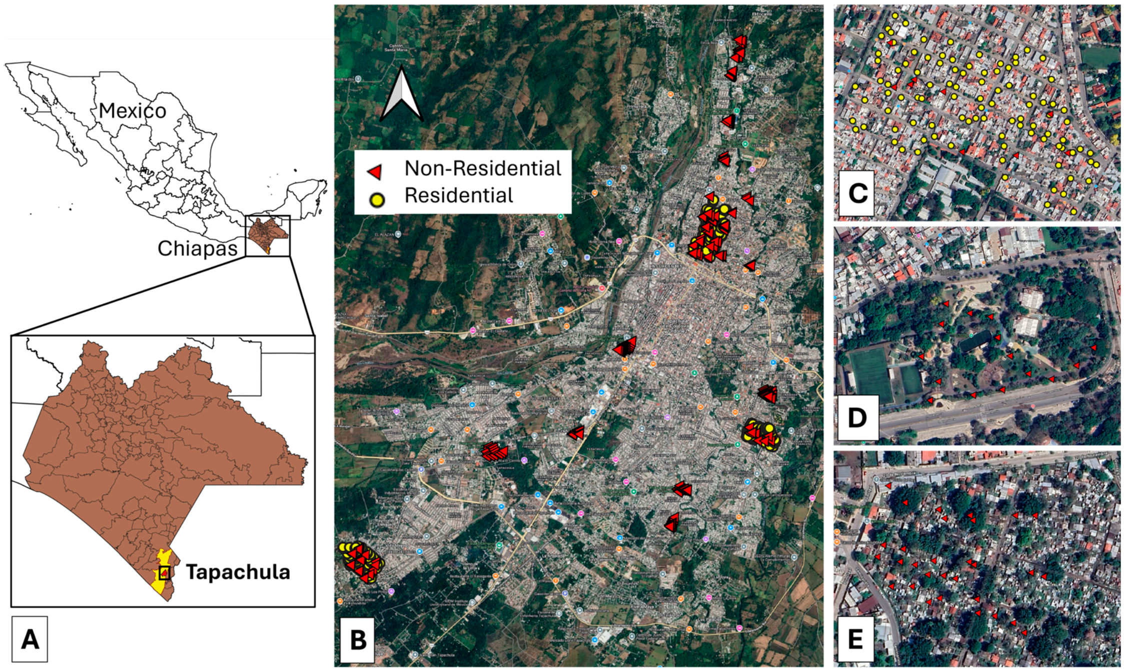

Figure 1. Geographic location and spatial distribution of ovitraps in Tapachula, Chiapas, Mexico. (A) Geographic location of Tapachula city within Chiapas state. (B) Distribution of ovitraps across residential and non-residential areas in Tapachula. (C) Close-up of ovitrap locations in the Laureles neighborhood. (D) Close-up of ovitrap locations in the public park "Los Cerritos". (E) Close-up of ovitrap locations in the cemetery "Jardín".

2.2. Egg Collection

Mosquito eggs were collected in both residential and non-residential areas during August 2025. The sampling period encompassed three weeks and was conducted in the rainy season. The sites chosen for ovitrap placement were divided into two categories: residential, such as Neighborhood Laureles, Neighborhood 5 de Febrero, and Neighborhood Raymundo Enríquez, which are primarily inhabited areas; and non-residential, including sites as: Cementeries, public parks, schools, vacant lots, and other sites (car junk lot, mechanical workshop, car wash, and tire repair shop) [11,15]. Four pairs of field technicians were assigned to each study site to place ovitraps. A map divided each site into four sections, with each team responsible for one section. When ovitrap placement was permitted, each trap was georeferenced using the Google Earth® app on the field technicians' cell phones. In the laboratory, all georeferences for each ovitrap were collected and their coordinates verified on a single Google Earth map. Finally, the coordinates were converted into KMZ format on the MyGeodata platform [16] (https://mygeodata.cloud/converter/kmz-to-kml). A total of 300 ovitraps were distributed across the residential areas. Based on accessibility, 23, 25, and 31 city blocks were selected from the three neighborhoods: 5 de Febrero, Raymundo Enríquez, and Laureles, respectively. Within each block, four ovitraps were placed, one on each block side. The ovitraps were distributed within households in the living room, dining room, front yard, and backyard. Similarly, 300 ovitraps were deployed in non-residential areas. They were positioned in safe locations to prevent disturbance or damage by people or animals. The ovitraps used were the standard design; i.e., black plastic containers, 7 cm in diameter and 16 cm in height, with a capacity of 500 ml [17]. A strip of white filter paper (7 cm wide x 15 cm long) was used as an oviposition substrate to collect eggs of dengue vectors. This strip was lined on the inner container walls. Ovitraps were filled with 400 ml of water, enough to keep the filter paper moist for at least 10 days and prevent evaporation caused by the high temperatures in the study area. The filter paper from each ovitrap was removed weekly from the date of placement and transferred to the CRISP/INSP insectary in plastic bags to determine egg positivity, egg count, and egg hatching for larval development and to identify the species present in the adult stage.

2.3. Egg Counts and Aedes Identification

Individual strips of filter paper from ovitraps were placed under a dissecting microscope for egg counting. Subsequently, strips were transferred to 1-L containers of dechlorinated water to stimulate egg hatching. After 12 -24 h, the first-instar larvae were fed by pouring fine-ground mouse food (Lab Diet®). The photoperiod in the insectary was 12:12 Light: Dark, with an average temperature of 25 ± 1 °C and a relative humidity of 40 ± 10% [18]. Emergent adults were identified based on morphological characteristics described by [19].

2.4. Data Analysis

We addressed three main objectives. First, to compare egg productivity of *Aedes sp*. between residential and non-residential areas, we calculated the proportion of ovitraps with eggs (ovitrap positivity) and the mean number of eggs per ovitrap for each area. Differences in ovitrap positivity between residential and non-residential areas were evaluated using the chi-square test of independence. Because egg counts per ovitrap were highly skewed and did not meet normality assumptions, we compared egg productivity between residential and non-residential areas using the Mann–Whitney U test. Within residential areas, differences in egg counts among neighborhoods (5 de Febrero, Raymundo Enríquez, and Laureles) were assessed using the Kruskal–Wallis test followed by Dunn's post hoc test with *p*-value adjustment for multiple comparisons. Within non-residential areas, differences in egg productivity among site categories (schools, vacant lots, public parks and other sites) were evaluated using the Kruskal–Wallis test followed by the Dwass–Steel–Critchlow–Fligner (DSCF) post hoc test. To complement these non-parametric analyses, we additionally provide boxplots showing medians and interquartile ranges in supplementary Figures S1–S3 [20].

Second, to identify and compare the species composition of *Ae. aegypti* and *Ae. albopictus* between residential and non-residential areas, we constructed contingency tables of species by area type (residential vs. non-residential), by residential neighborhood, and by non-residential site category. Associations between species and each spatial factor were evaluated using chi-square tests of independence. Standardized Pearson residuals were examined to identify species that were over- or under-represented in each neighborhood or non-residential site category.

Third, to describe and compare the vector burden of *Aedes* species between residential and non-residential sites, we defined vector burden as the density of eggs and emerged adults per hectare. For each area (residential and non-residential), we calculated total egg counts and total numbers of emerged *Ae. aegypti* and *Ae. albopictus* adults and expressed these values as eggs per hectare and adults per hectare. These density measures were compared descriptively between residential and non-residential areas, because they represent area-level indices rather than independent sampling units suitable for formal hypothesis testing. All statistical analyses were performed using Jamovi version 2.6.44 and R version 4.5.2.

3. Results

Of the 600 ovitraps initially placed, seven could not be located, so 593 were examined. Of these, 297 (50.1%) were installed in households within residential areas, while the remaining 293 (49.9%) were placed in various non-residential locations. These included four cemeteries (119 traps, 20%), three public parks (45 traps, 7.6%), nine schools (39 traps, 6.6%), and 26 vacant lots (26 traps, 4.4%). The other places considered as "other sites" include: two car junk lots (31 traps, 5.2%), 29 mechanical workshops (29 traps, 4.9%), 26 vacant lots (26 traps, 4.4%), two car washes (5 traps, 0.8%), and one tire repair shop (2 traps, 0.3%) (Table 1).

In residential areas, 92.6% (275/297) of ovitraps tested positive, compared to 87.0% (255/293) in non-residential areas. The higher positivity rate in residential zones was statistically significant, with a difference of 5.6 percentage points ($\chi^2 = 4.99$, df = 1, $p = 0.025$).

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Table 1. Ovitrap distribution by residential vs non-residential sites categories across sampled neighborhoods in Tapachula, Southern Mexico.

Study area	Category	Sampled neighborhoods and categories of non-residential	ovitraps/ site (n)	Total ovitraps (%)
Residential (R)	Neigborhood	5 de Febrero	100	297 (50)
		Raymundo Enríquez	98	
		Laureles	99	
Non-residential (NR)	Cemetery	Jardín	30	119 (20)
		Municipal	30	
		Indeco	29	
		Prados	30	
	Public Park	Los Cerritos	15	45 (7.6)
		Indeco	15	
		Del Café	15	
	School	Preparatoria 4	4	39 (6.6)
		Teodomiro	8	
		Fray Matías	4	
		República de Cuba	4	
		5 de febrero	2	
		Teófilo de Acebo	6	
		Técnica 3	4	
		Raymundo Enríquez	4	
		Colinas del Rey	3	
	Vacant lots (1 ovitrap per vacant lots)		26	26 (4.4)
	Car junk lots	5 de Febrero	15	31 (5.2)
		Banorte	16	
	Mechanical workshop	MS1	2	29 (4.9)
		MS2	2	
		MS3	2	
		MS4	2	
		MS5	1	
		MS6	1	
		MS7	1	
		MS8	1	
		MS9	1	
		MS10	1	
		MS11	3	
		MS12	1	
		MS14	1	
		MS15	2	
		MS16	2	
		MS17	2	
		MS18	2	
		MS19	1	
		MS20	1	
	Car wash	CW1	3	5 (0.8)
		CW2	2	
	Tire-repair shop	TRS1	2	2 (0.3)
Total R				**297 (50)**
Total NR				**293 (50)**
Total R + NR				**593 (100)**

A total of 42,758 eggs were collected across all study areas, 61.5% (n = 26,316) from residential zones and 38.5% (n = 16,442) from non-residential zones. Ovitraps in residential areas yielded a mean of 88.6 (SE ±5.1) eggs, significantly larger than non-residential areas with 56.1 (SE ±3.3) eggs (U = 33417; $p < 0.001$) (Figures 2 and S1).

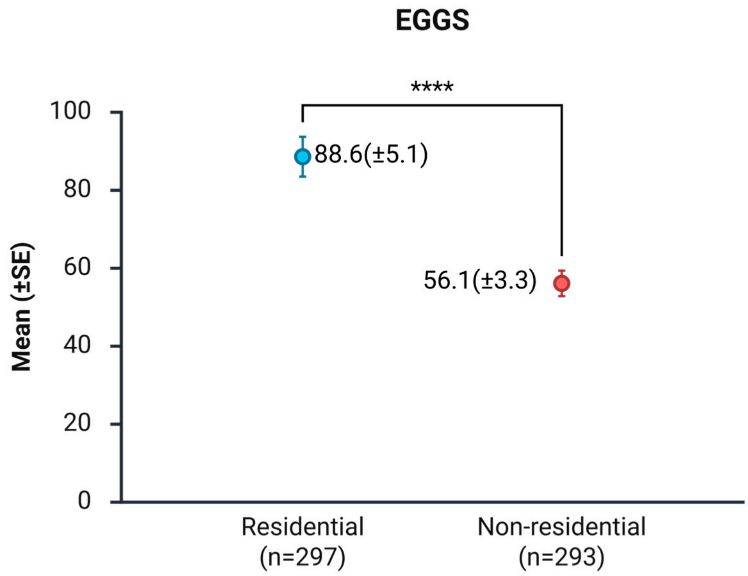

Figure 2. Mean (±SE) number of eggs per ovitrap in residential and non-residential areas of Tapachula, Chiapas, Mexico.

Regarding the residential area, the mean number of eggs per ovitrap was 73.9 (SE ± 9.17) in 5 de Febrero; 114.3 (SE ± 9.7) in Raymundo Enríquez, and 78.0 (SE ± 6.87) in Laureles. The nonparametric Kruskal-Wallis test indicated significant differences in the average number of eggs across the three neighborhoods (H = 16.084; $p < 0.001$). Dunn's post hoc test demonstrated that Raymundo Enríquez had a significantly higher mean number of eggs than 5 de Febrero ($p = 0.0003$) and Laureles ($p = 0.018$). In contrast, no significant differences were observed between 5 de Febrero and Laureles ($p = 0.729$) (Figures 3 and S2).

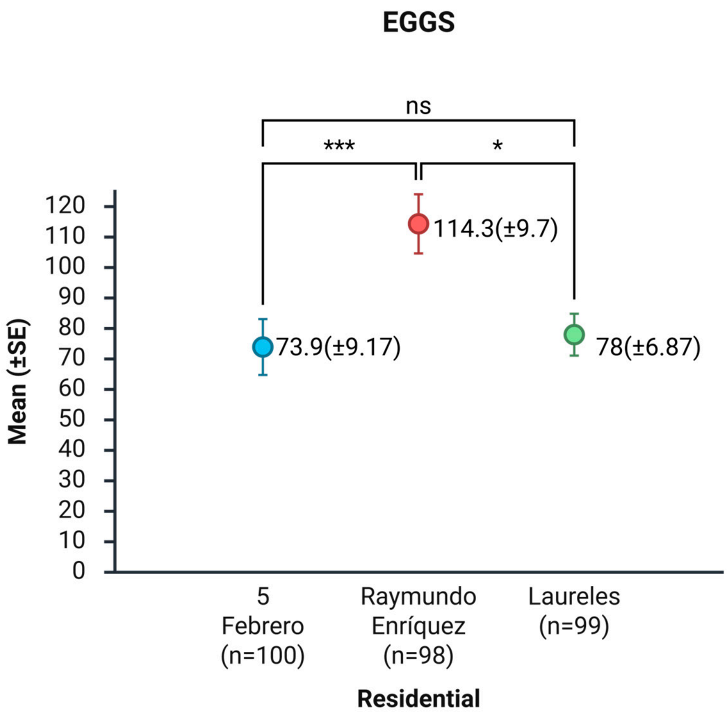

Figure 3. Mean egg counts across various residential sites in Tapachula, Chiapas, Mexico.

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In non-residential areas, the mean number of eggs collected varied across site types. Schools had the highest means, with 74.4 (SE ± 9.2) eggs, indicating more favorable conditions for mosquito oviposition in this environment. Cemeteries had a mean of 56.6 (SE ± 5.4) eggs per ovitrap, while public parks slightly outperformed, averaging 58.5 (SE ± 7.4) eggs per ovitrap. Car junk lots, Mechanical workshops, car washes, tire repair shops, grouped under the "other" category, showed the lowest egg mean of 38.1 (SE ± 4.9). The non-parametric Kruskal-Wallis test demonstrated significant differences in the quantity of eggs among site categories ($\chi^2 = 14.1$; df = 4; $p = 0.007$). Post-hoc analysis using the Dwass-Steel-Critchlow-Fligner multiple comparisons test revealed a significant difference between schools and the “other” category (W = –5.019; $p = 0.004$), with no significant differences in the other pairwise comparisons ($p > 0.05$). In summary, these findings indicate that mosquito egg productivity is higher in schools compared to sites classified as “other” (Figures 4 and S3).

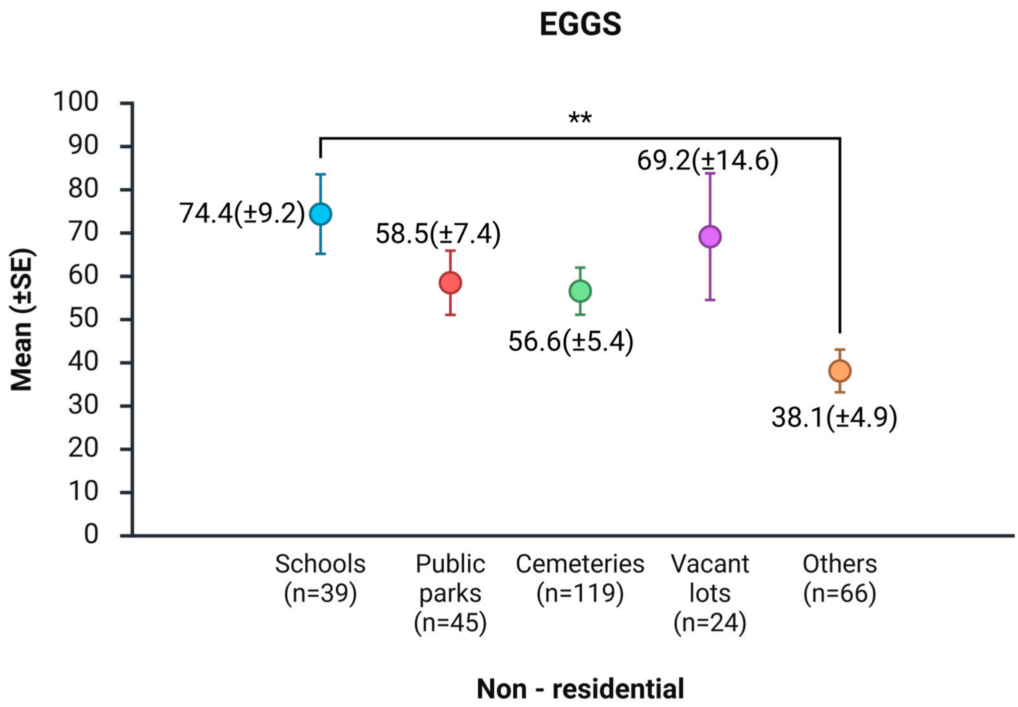

Figure 4. Average egg counts across various non-residential site categories in Tapachula, Chiapas, Mexico.

Out of a total of 42,758 eggs collected, a subset of 16,965 eggs was selected for species identification purposes. Of these, 7,543 (44.5 %) adults emerged and were subsequently identified. Among them *Ae. aegypti* constituted 65.4% ($n = 4{,}932$), whereas *Ae. albopictus* accounted for 34.6% ($n = 2{,}611$). Regarding their origin, 5,409 adults (71.7%) were from residential areas, while 2,134 (28.3%) were from non-residential areas. In residential zones, *Ae. aegypti* exhibited a predominant presence at 83.3% (n=4,506), in contrast to *Ae. albopictus*, which represented 16.7% ($n = 903$). Conversely, in non-residential zones, the species composition was inverted: *Ae. aegypti* comprised only 20.0% ($n = 426$), whereas *Ae. albopictus* constituted 80.0% (n=1,708). The chi-square statistical test ($\chi^2 = 2{,}734$; df = 1; $p < 0.001$) demonstrated a highly significant association (Figure 5).

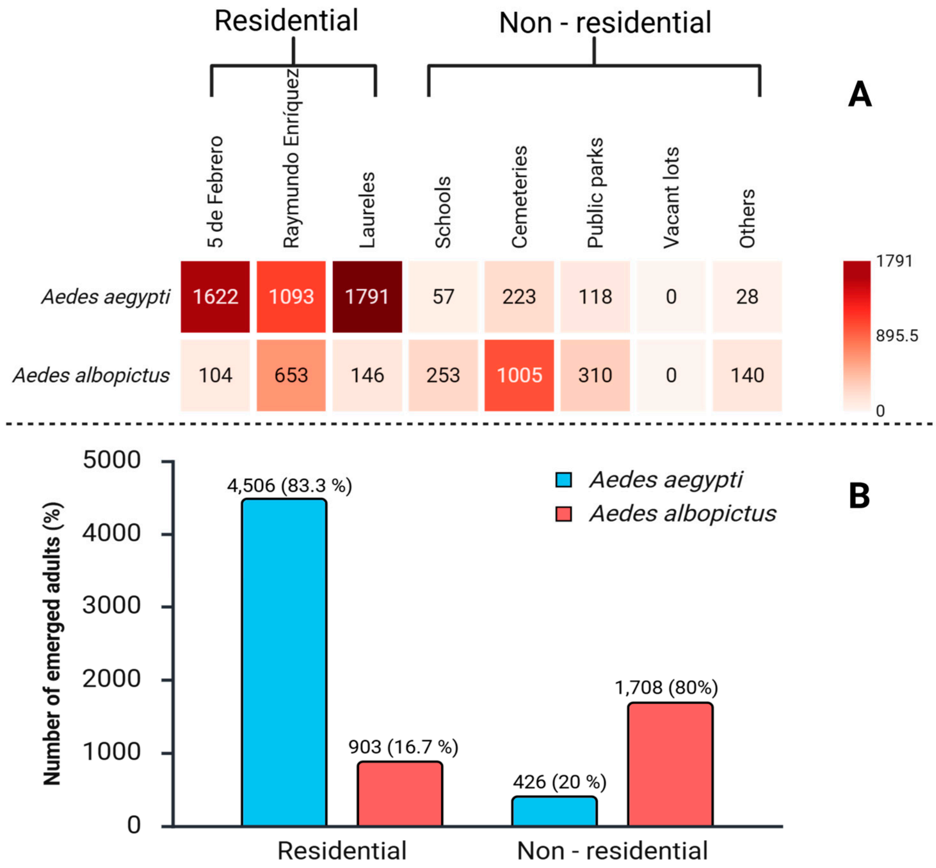

Figure 5. Absolute (A) and relative (B) abundance of emerged *Ae. aegypti* and *Ae. albopictus* adults in residential and non-residential environments.

3.1. Frequency of Emerged Species in Residential Sites

In total, 5,409 adults emerged from the eggs collected in residential areas, of which 83.3% belonged to *Ae. aegypti* ($n = 4{,}506$) and 16.7% to *Ae. albopictus* ($n = 903$). The productivity of both species varied significantly across neighborhoods (Figure 5). The chi-square test of independence revealed a highly significant association between species and neighborhood ($\chi^2 = 796$; df = 2; $p < 0.001$).

Across the residential areas, *Ae. aegypti* was the predominant species compared to *Ae. albopictus*. Pearson's standardized residuals showed that *Ae. aegypti* was overrepresented in the 5 de Febrero (residual = 4.86) and Laureles (residual = 4.42) neighborhoods, whereas *Ae. albopictus* was strongly underrepresented in both areas (residuals = -10.85 and -9.86, respectively). Although in absolute numbers *Ae. aegypti* was more abundant in the three neighborhoods (Figure 6), and the standardized residues show proportional differences. In Raymundo Enríquez, *Ae. albopictus* represented a much larger proportion than expected, which explains its overrepresentation (residual = 21.17), while *Ae. aegypti* was notably underrepresented (residual = -9.48) even though the absolute number of *Ae. aegypti* is still higher.

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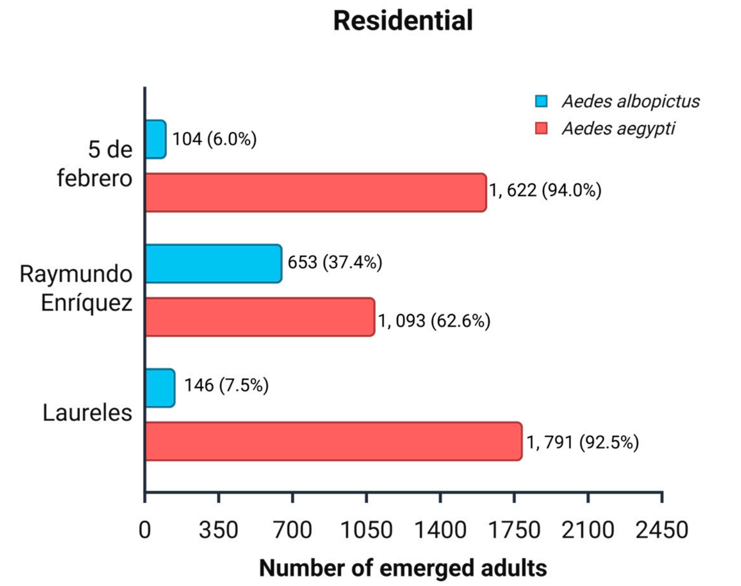

Figure 6. Number of emerged adults from eggs among residential samples in Tapachula, Chiapas, Mexico.

3.2. Frequency of Emerged Species in Non-Residential Areas

From the eggs collected at non-residential sites, a total of 2,134 adult mosquitoes emerged. Of these, 80.0% were identified as *Ae. albopictus* ($n = 1{,}708$), and 20.0% as *Ae. aegypti* ($n = 426$). The number of emerging adults was not evenly distributed among the various types of urban sites (Figure 7). In all sites, *Ae. albopictus* was the predominant species. The most abundant sites for *Ae. albopictus* were cemeteries and public parks, with 81.8% and 72.4%, respectively. Similarly, *Ae. aegypti* showed high adult abundance in cemeteries and public parks with 18.2% and 27.6%, respectively. A chi-square test revealed significant differences in species composition based on site type ($\chi^2 = 19.6$; df = 3; $p < 0.001$). Post-hoc analysis based on standardized residues showed that, among non-residential sites, public parks are particularly favorable environments for producing *Ae. aegypti*, while *Ae. albopictus* is generally dominant in most other non-residential sites evaluated.

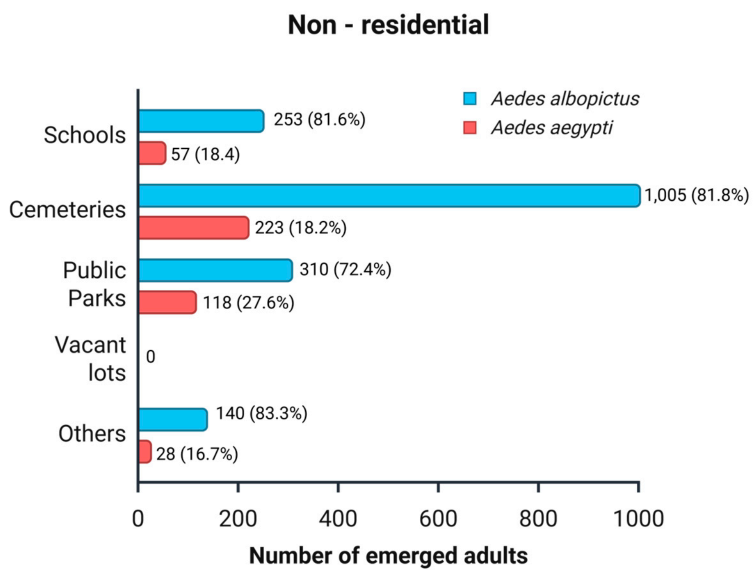

Figure 7. Number of emerged adults from eggs among non-residential samples in Tapachula, Chiapas, Mexico.

3.3. Vector Burden by Residential and Non-Residential Areas

Our research encompassed 88.3 hectares in residential zones and 93.8 hectares in non-residential zones. The residential zones yielded a total of 26,316 eggs, averaging 298.0 eggs per hectare. Conversely, the non-residential zones produced 16,442 eggs, averaging 175.3 per hectare. Species productivity varied between site types and species. For *Ae. aegypti*, the adult density per unit area was much higher in the residential zone (51.0 adults/ha) than in non-residential sites (4.5 adults/ha). Conversely, for *Ae. albopictus*, non-residential sites had a productivity of 18.2 adults/ha, while residential areas reached 10.2 adults/ha.

4. Discussion

Despite unsubstantiated suspicions attributing inadequate control rates in both indoor and outdoor house environments against *Ae. aegypti*, the factors explaining these findings remain poorly documented. The recurring epidemics in Latin America annually necessitate consideration of the possibility of additional vector populations existing outside human dwellings, thereby eluding vector control measures. This study, conducted in southern Mexico, generated data that support these suspicions.

One of the most efficient methods for monitoring the presence, abundance, and composition of *Aedes sp*. in specific times and spaces is the use of ovitraps. The ovitraps can be placed inside or around homes in residential areas—and in non-residential areas such as cemeteries, vacant lots, or recreational parks [21]. Information obtained from ovitraps helps determine the risk of transmission of dengue, Zika, or Chikungunya viruses. In the present study, the high ovitrap positivity for *Aedes sp*. eggs indicates the presence of gravid females feeding on a blood source near or inside homes. Our results showed that *Ae. aegypti* was significantly predominant compared to *Ae. albopictus* in the three selected residential areas. Furthermore, the pattern of species presence changed in non-residential areas, where *Ae. albopictus* showed a significantly greater presence than *Ae. aegypti*. This pattern was different in a study of entomological surveillance conducted in Brazil, where the densities of *Ae. aegypti* were higher than those of *Ae. albopictus* in residential and non-residential areas [22].

In our study, egg productivity was significantly higher in residential than in non-residential sites (88.6 ± 5.1 vs. 56.1 ± 3.3 eggs/ovitrap, $p < 0.0001$; Figure 2). This finding indicates that, on average, dwellings harbor the highest density of *Aedes spp*. eggs, and consequently, the vector burden was more significant in residential sites, while non-residential sites contribute a smaller, but still important, portion of total egg production. Similarly, [22] reported in Rio de Janeiro that, using ovitraps in three neighborhoods with different socio-environmental characteristics, an average of 69 eggs per dwelling per week, compared to 44 eggs per non-residential property per week. An increasing number of reports documenting higher activity of dengue vectors in non-residential urban environments highlight these areas as supplementary targets for control. In Yucatán, Mexico, [12] assessed the role of vacant lots as sources of immature *Ae. aegypti*: 74% of immatures were found in non-residential premises, and vacant lots represented 50% of the non-residential area, whereas 26% of immature stages were located in residential premises. In a subsequent study, [8] found freshly blood-fed *Ae. aegypti* females in Catholic church buildings, with 97.4% of blood meals identified as human.

Regarding the impact of both *Aedes* species on vector burden across residential and non-residential premises in Tapachula, Chiapas, Mexico, our data revealed clear patterns. Populations of *Ae. aegypti* were consistently dominant across all residential sites, whereas *Ae. albopictus* predominated in all non-residential sites (Figure 5). In contrast, [22] reported that *Ae. aegypti* remained the predominant species in both residential and non-residential premises, with *Ae. albopictus* represents only a minor fraction of adults, even in non-residential settings. Thus, while in Rio de Janeiro, non-residential premises mainly reinforced an *Ae. aegypti* driven vector burden, in Tapachula non-residential environments, appears to contribute to the production of *Ae. albopictus* increasing the heterogeneity of the local vector community.

This situation occurring in Southern Mexico represents an expansion trend of *Ae. aegypti* from household indoor spaces to nearby and surrounding inhabited spaces, and *Ae. albopictus* has a distribution frequency toward outdoor, densely wooded surroundings. This is explained by the sequential phases of adaptation of invasive species during colonization of a new geographical territory. Nevertheless, the epidemiological importance of both vector species is well known elsewhere, along with their role in driving larger and more frequent dengue and other arboviral outbreaks in Mexico and other endemic countries. Indeed, vector control programs should consider integrating non-residential premises to achieve more substantial reductions in vector populations. Even more, there is an urgent need to develop specific research targeting field operations and strategies. For instance, traditional cleaning campaigns are popular and recommended to eliminate breeding sites in backyards. Even though removal of small to medium-sized containers is successful, this operation is not applied to cemeteries, public parks, schools, vacant lots, car junk lots, markets, churches, body shops, etc. In non-residential areas, the civilian population does not conduct any control measures; therefore, free mosquito certification needs to be strongly regulated by the City Health Departments. In addition, the importance of non-residential areas is increased by the report of dormant eggs [23] attached to objects within them, such as the inner walls of discarded tires and other commonly used containers like plastic buckets. Similarly, dry eggs are an important support for the vertical transmission of dengue viruses during the interepidemic season. [24] reported that around 5% of adults emerged from field-collected *Ae. aegypti* eggs were positive for dengue viruses from Chiapas, Oaxaca, Guerrero, and Veracruz.

This study showed the vector burden of *Ae. aegypti* and *Ae. albopictus* in residential and non-residential areas. This will be useful for making substantial adjustments to modern integrated vector control strategies, as sustainable, area-wide field operations are urgently demanded.

5. Conclusions

This study shows that urban residential areas in Tapachula, Chiapas, sustain a higher overall egg productivity (mean of 88.6 eggs) of *Aedes spp*. than non-residential premises (mean of 56.1 eggs), as reflected by the greater ovitrap positivity and mean number of eggs per trap in households (Figure 2). In contrast, non-residential sites such as schools, vacant lots, public parks, and cemeteries accounted for a substantial fraction (38.5%) of total egg production and were particularly important for *Ae. albopictus* (Figure 5). Species composition differed between environments: *Ae. aegypti* predominated in all residential areas (Figure 6), whereas *Ae. albopictus* was consistently more abundant in non-residential sites, resulting in distinct area-level patterns of vector burden per hectare for each species. These findings indicate that dengue vector control programs cannot rely solely on household-based interventions. Non-residential premises in the urban landscape act as sources of vectors that can re-infest nearby homes and public spaces. Future studies of the role of *Aedes sp.* populations outside households are recommended to incorporate an area-wide strategy into current integrated dengue vector management programs.

Supplementary Materials: The following supporting information can be downloaded at: Preprints.org, Figure S1: Comparison of total egg counts between residential and non-residential areas, Figure S2: Distribution of total egg counts across Residential sites, Figure S3: Distribution of total egg counts across Non-residential sites.

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Abbreviations

The following abbreviations are used in this manuscript:

CRISP	Centro Regional de Investigación en Salud Pública
INSP	Instituto Nacional de Investigación en Salud Pública

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