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Use of dispersion index to identify key containers responsible for *Aedes aegypti* breeding in select communities of Guatemala

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INTRODUCTION

We quantified household containers that could become *Aedes aegypti* breeding sites, in order to determine "key" container types most responsible for Zika transmission in each community, and to focus vector control actions on a limited number of key container types. We used a dispersion index (DI) to ensure the data we collected on key containers and presence of pupae were statistically significant.

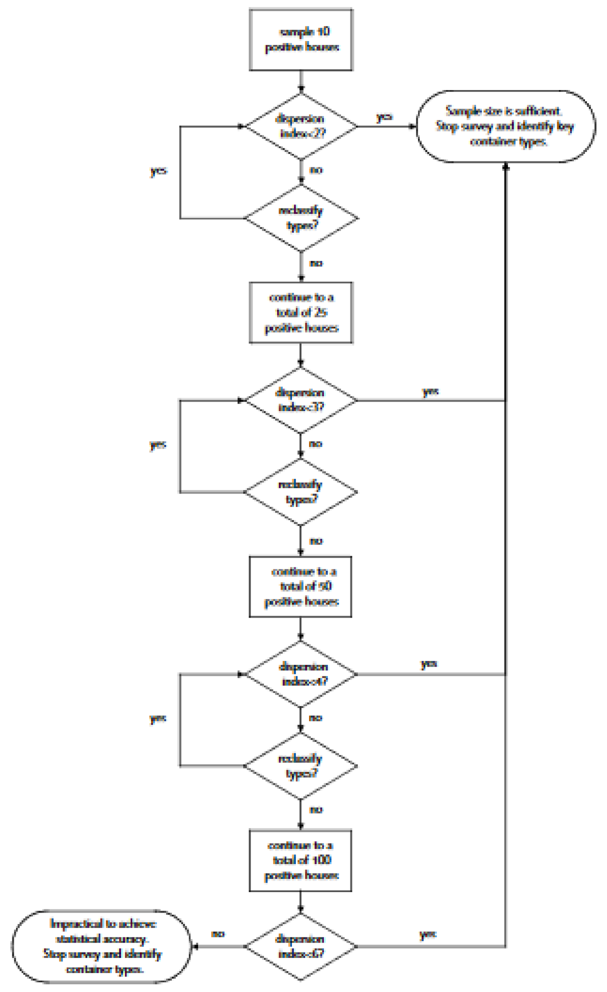
METHODS

- In 2018, a round of pupal surveys was conducted in 42 Guatemalan communities.
- Water containers were inspected for *Aedes* pupae, which were counted when present.
- A total of 679 households (HHs) were visited, 47% of which contained pupae (HH index).
- The dispersion index (DI) was used to quantify the degree of dispersion of pupae between key containers. It is calculated as:

Dispersion Index (N_1) = $10^{H'}$

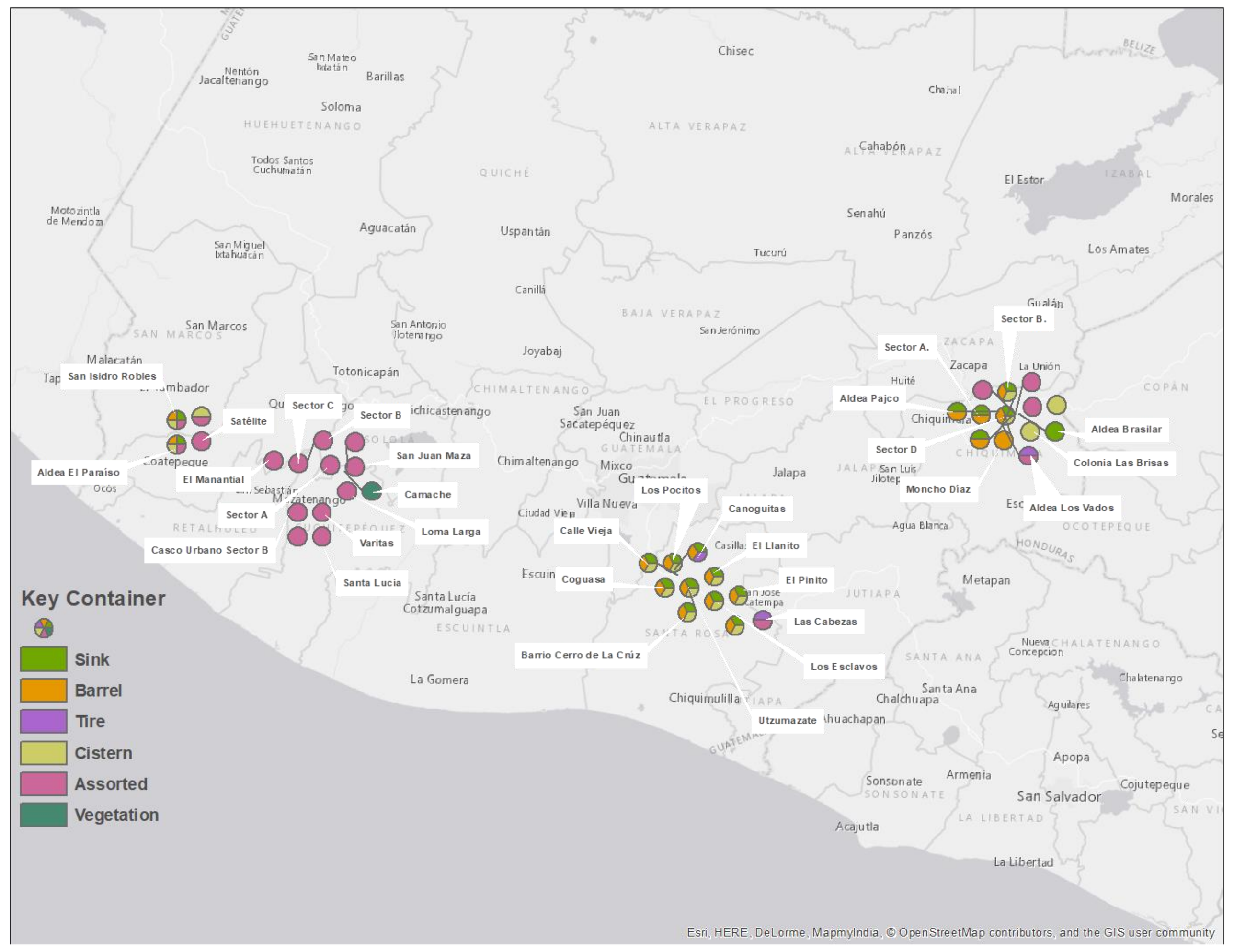
Where Shanon-Wiener index (H') = $-\sum_i p_i \log_{10}(p_i)$

Where Pi is the proportion of pupae in the key container class "i", and Σ is the sum over the key container classes/types which contain at least one pupa[1]. DI is larger when pupae are more evenly distributed across key container types[1]. The dispersion index was evaluated on an initial sample of 10 pupae-positive households. Based on the DI, it was then determined if the sample size had to be increased or kept as is. The flow chart below demonstrates how the sample size was determined:



(1) Fooks &Alexander 2006

RESULTS



Different types of key containers are color-coded in the map to the left. The use of DI allowed for basins and barrels to be identified as key breeding sites for *Aedes* in 40 out of the 42 communities visited. Small and medium containers kept in the front yards or backyards were identified as key breeding sites in 17 communities. Used tires kept outdoors were identified as key breeding sites in 2 communities.

Dispersion Index and type of pupae producing containers and key containers (in bold red) according to Pupal Demography Survey in 42 communities of Guatemala

Communities	Dispersion Index*	Key Containers
Canoguitas	1.56	**sink**, barrel, tires
Los Pocitos	1.23	**sink**, barrel, cistern
Coguasa	1.47	**sink,** barrel, cistern
Calle Vieja	1.25	**sink**, barrel, cistern
Utzumazate	1.37	**sink**, barrel, cistern
Cerrito de la Cruz	1.16	**sink**, barrel, cistern
Las Cabezas	1.89	**tires**, assorted small containers
Casco Urbano Oratorio	1.91	**sink**, barrel, cistern
El Pinito	1.74	**sink**, barrel, cistern
Los Esclavos	1.45	**sink**, barrel, cistern
El Llanito	1.12	**sink**, barrel, cistern
Casco Urbano A	1.00	**sink**, barrel, cistern
Casco Urbano B	1.13	**assorted small containers**
Santa Lucia	1.00	**assorted medium containers**
Varitas	1.99	**assorted small containers**
San Juan Maza	1.26	**assorted small containers**
Canton Maza	1.95	**assorted small containers**
Camache	1.85	**outdoor vegetation**
Loma Larga	1.68	**assorted small containers**
sector A	1.64	**assorted small containers**
sector B	1.00	**assorted small containers**
sector C	1.27	**assorted small containers**
El Manantial	1.00	**assorted small containers**
San Isidro Robles	1.33	**sink**, barrel, cistern, assorted small containers
San Isidro centro	1.19	**sinks**, barrels, cistern, assorted small containers
Satelite	1.92	**assorted small containers**
Paraíso	1.84	**sink**, barrel, cistern, assorted small containers
Aldea los Vados	1.00	**tires**, assorted small containers
Moncho Díaz	1.74	**barrel**
sector A	1.23	**sink**, barrel
sector B	1.00	**sink**, barrel, cistern
sector D	1.34	**sink**, barrel, cistern
Colonia Guillermo Guerra	1.00	**assorted small containers**
Caserío Tierra blanca	1.00	**cistern**
Colonia Las Brisas	1.00	**cistern**
Aldea Pajco	1.21	**sink**, barrel
Camotán área urbana	1.00	**sink**, barrel
Aldea Caparja	1.00	**assorted small containers**
Aldea Brasilar	1.00	**sink**
Caserío Agua caliente	1.00	**assorted small containers**

DISCUSSION

In contrast to other entomological indices, DI was used to effectively determine pupal container productivity and identify key *Aedes* breeding sites that needed to be targeted and removed.

These data were used to guide the implementation of social and behavior change communication and community mobilization activities to reduce or eliminate key containers, such as mass disposal of used tires in targeted communities.

Research shows that targeting the most productive water containers could be as effective in lowering entomological indices as targeting all water containers regardless of their mosquito productivity[3]. Data-driven vector control activities have the potential to increase cost effectiveness and impact in the reduction of Zika transmission.

REFERENCES

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As part of the Zika Community Response (ZICORE) project in Guatemala, we quantified household containers that could become *Aedes aegypti* breeding sites in order to gather entomological data to target Zika prevention and control interventions. As the water supply fluctuates, households store water and often have non-useful containers outside where rain water also accumulates. In 2017, a round of pupal surveys was conducted in 32 Guatemalan communities. Water containers were inspected for *Aedes* larvae or pupae, which were counted when present. A dispersion index (DI) was used to validate the sample size of water containers and to determine if the sample size needed adjustment. A total of 821 households (HHs) were visited, 40% of which contained pupae (HH index). Use of DI allowed for basins and barrels to be identified as key breeding sites for *Aedes* in 18 out of the 32 communities visited. Small and medium containers kept in the front yards or backyards were identified as key breeding sites in 8 communities. Used tires kept outdoors were identified as key breeding sites in 3 communities. These data were used to guide the implementation of social and behavior change communication and community mobilization activities to reduce or eliminate key containers, such as mass disposal of used tires in targeted communities. In contrast to other indices, DI was used to effectively determine container productivity and identify key *Aedes* breeding sites that needed to be targeted and removed. Such data-driven vector control activities have the potential to increase cost effectiveness and impact in the reduction of Zika transmission.