



Unidad de Control de
Vectores de Puerto Rico

WALS shows great promise in fighting arbovirus disease in Puerto Rico

Grayson Brown
May 21, 2020

Dengue, chikungunya, Zika are our primary concerns



Antecedentes

Del vector a las enfermedades transmitidas por vectores en las Américas

PAHO/WHO

Geographical distribution of vector-borne diseases* (VBD) in the Americas, 2013- 2018



Distribution of vector-borne diseases (VBD) in the Americas

Country	Dengue	Chikungunya	Zika	Yellow fever	Malaria	Chagas disease	Cutaneous Leish.	Visceral Leish.	Onchocerciasis	Plague	Lymphatic filariasis	Schistosomiasis
Brazil	●	●	●	●	●	●	●	●	●	●	●	●
Ecuador	●	●	●	●	●	●	●	●	●	●	●	●
Venezuela	●	●	●	●	●	●	●	●	●	●	●	●
Bolivia	●	●	●	●	●	●	●	●	●	●	●	●
Guyana	●	●	●	●	●	●	●	●	●	●	●	●
Peru	●	●	●	●	●	●	●	●	●	●	●	●
Suriname	●	●	●	●	●	●	●	●	●	●	●	●
Argentina	●	●	●	●	●	●	●	●	●	●	●	●
Colombia	●	●	●	●	●	●	●	●	●	●	●	●
French Guiana	●	●	●	●	●	●	●	●	●	●	●	●
Guatemala	●	●	●	●	●	●	●	●	●	●	●	●
Mexico	●	●	●	●	●	●	●	●	●	●	●	●
Panama	●	●	●	●	●	●	●	●	●	●	●	●
Paraguay	●	●	●	●	●	●	●	●	●	●	●	●
Costa Rica	●	●	●	●	●	●	●	●	●	●	●	●
Dominican Republic	●	●	●	●	●	●	●	●	●	●	●	●
El Salvador	●	●	●	●	●	●	●	●	●	●	●	●
Honduras	●	●	●	●	●	●	●	●	●	●	●	●
Nicaragua	●	●	●	●	●	●	●	●	●	●	●	●
Belize	●	●	●	●	●	●	●	●	●	●	●	●
Haiti	●	●	●	●	●	●	●	●	●	●	●	●
Saint Lucia	●	●	●	●	●	●	●	●	●	●	●	●
Trinidad and Tobago	●	●	●	●	●	●	●	●	●	●	●	●
United States	●	●	●	●	●	●	●	●	●	●	●	●
Anguilla	●	●	●	●	●	●	●	●	●	●	●	●
Antigua and Barbuda	●	●	●	●	●	●	●	●	●	●	●	●
Aruba	●	●	●	●	●	●	●	●	●	●	●	●
Bahamas	●	●	●	●	●	●	●	●	●	●	●	●
Barbados	●	●	●	●	●	●	●	●	●	●	●	●
Bonaire, St. Eustachius	●	●	●	●	●	●	●	●	●	●	●	●
Cayman Islands	●	●	●	●	●	●	●	●	●	●	●	●
Curaçao	●	●	●	●	●	●	●	●	●	●	●	●
Dominica	●	●	●	●	●	●	●	●	●	●	●	●
Grenada	●	●	●	●	●	●	●	●	●	●	●	●
Guadeloupe	●	●	●	●	●	●	●	●	●	●	●	●
Jamaica	●	●	●	●	●	●	●	●	●	●	●	●
Martinique	●	●	●	●	●	●	●	●	●	●	●	●
Puerto Rico	●	●	●	●	●	●	●	●	●	●	●	●
Saint Barthélemy	●	●	●	●	●	●	●	●	●	●	●	●
Saint Martin	●	●	●	●	●	●	●	●	●	●	●	●
Saint Vincent	●	●	●	●	●	●	●	●	●	●	●	●
Saint Martin (Hol.)	●	●	●	●	●	●	●	●	●	●	●	●
Turks and Caicos Islands	●	●	●	●	●	●	●	●	●	●	●	●
Virgin Islands of USA	●	●	●	●	●	●	●	●	●	●	●	●
Bermuda	●	●	●	●	●	●	●	●	●	●	●	●
British Virgin Islands	●	●	●	●	●	●	●	●	●	●	●	●
Cuba	●	●	●	●	●	●	●	●	●	●	●	●
Montserrat	●	●	●	●	●	●	●	●	●	●	●	●
Saint Kitts and Nevis	●	●	●	●	●	●	●	●	●	●	●	●
Uruguay	●	●	●	●	●	●	●	●	●	●	●	●
Chile	●	●	●	●	●	●	●	●	●	●	●	●

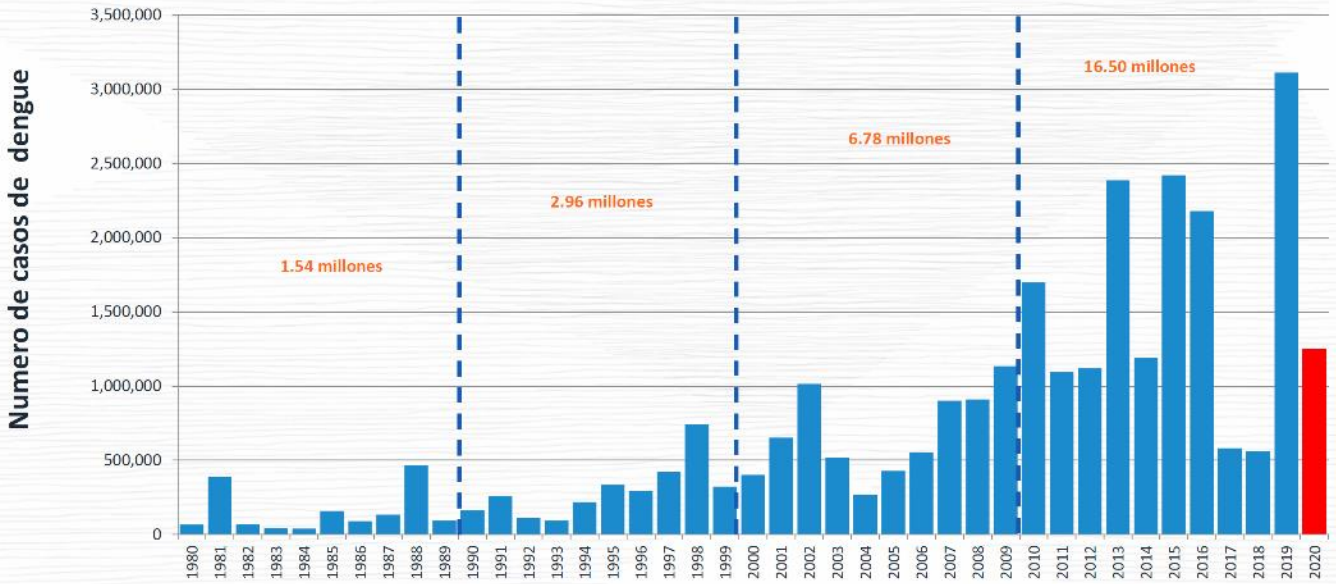
* Not all VBDs transmitted in the Americas are included
Source: PAHO/WHO



Latin America is experiencing a severe dengue outbreak

OPS/OMS

Número de casos de dengue en las Américas, 1980 – 2020*



Fuente: Datos enviados a PLISA por los Ministerios e Institutos de Salud de los países y territorios de las Américas
*Datos del 2020 a a la Semana Epidemiológica #17



COVID should not stop vector control operations

Dengue: Reporte de casos, confirmados por laboratorio, casos severos, muertes. 2020

Region	Total	Confirmed	SevereDengue	Deaths
The Americas	1,251,101	447,209	2,938	390

COVID-19: Reporte de casos y muertes (nuevos/24h)

Situación Global

3,588, 773 casos
(71,463)

247, 503 muertes
(4,102)

Americas

1,507, 148 casos
(29,701)

81 070 muertes
(1,480)

Fuente:Dengue: Datos enviados a PLISA por los Ministerios e Institutos de Salud de los países y territorios de las Américas *Datos del 2020 a la Semana Epidemiológica #17
COVID-19 Datos enviados para OMS, 6 Mayo 2020

Current vector situation

Dengue outbreak in Puerto Rico has begun.

- Record year for dengue in Latin America & Caribbean
 - > 2M Brasileiros
 - Terrible epidemic in Central America, 30% severe
- Caribbean cases up 340% region wide in 2019 vs 2018
 - Outbreaks in Cuba, Jamaica, Haiti, Cayman Islands, Guadalupe, St. Martins, Martinique
 - Case counts in PR are rising



Aedes aegypti: main disease vector in PR

Traditional insecticides are ineffective against the mosquito that transmits dengue in Puerto Rico



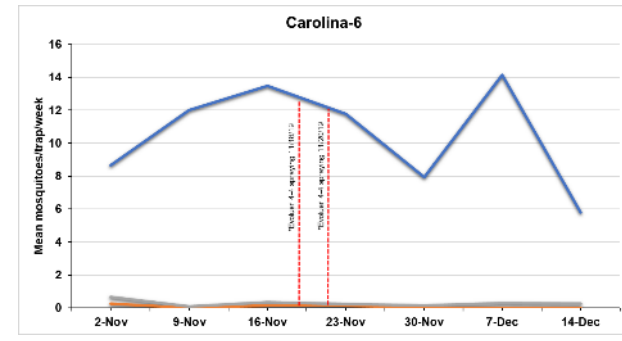
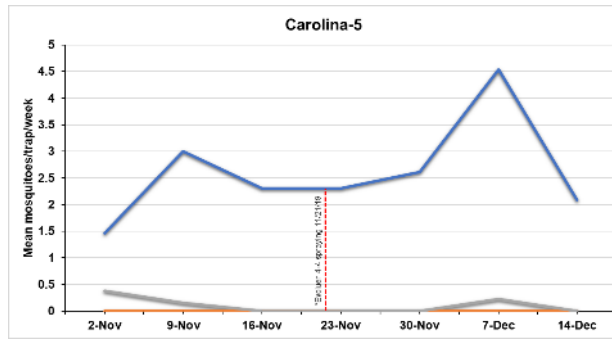
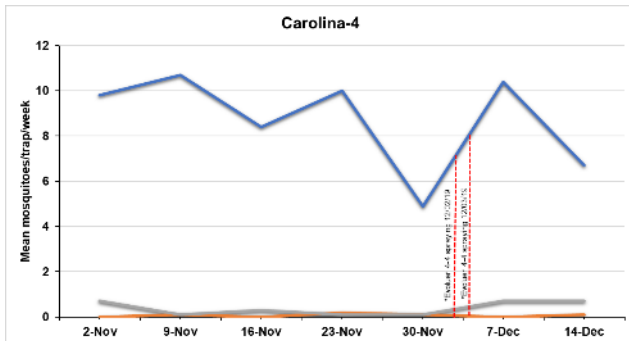
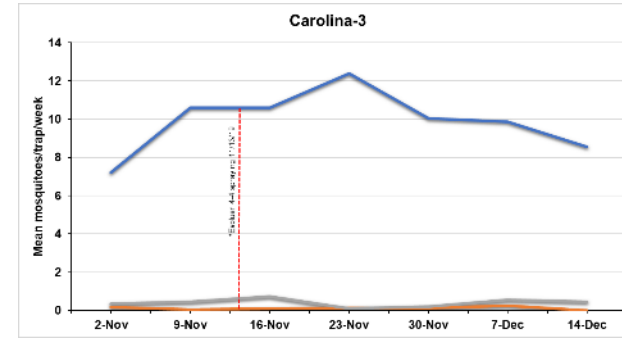
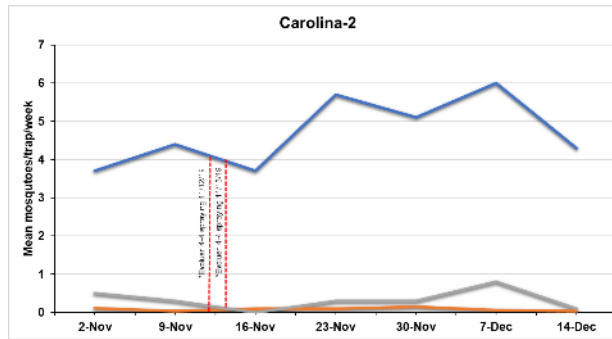
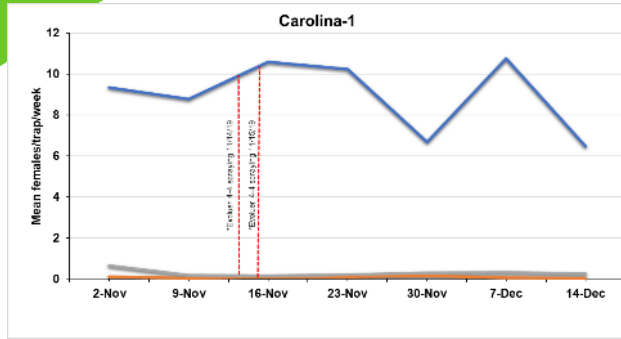
Insecticide resistance is widespread in PR

Insecticide	Diagnostic Dose ($\mu\text{g}/\text{bottle}$)	Exposure time (min)	Mortality (%) by Location		
			Carolina	Bayamón I	San Juan I
Permethrin	15	30	4	3	0
Deltamethrin	10	30	29	40	43
Etofenprox	15	30	8	0	0
Phenothrin	20	30	0	0	0
Lambda-cyhalothrin	10	30	28	19	24
Chloropyrifos	20	45	64	95	88
Malathion	50	30	97	67	83

Mortality of >98% = susceptible population as established by the World Health Organization.

Clearly, we have to find a different way to combat dengue here.

Aedes aegypti trap catches (blue line) before and after ULV treatment with Evolure (permethrin) in Carolina PR, Nov. 2019



— Aedes aegypti Fem — Ae aegypti male — Other species



Dengue appears to be confined to hotspots

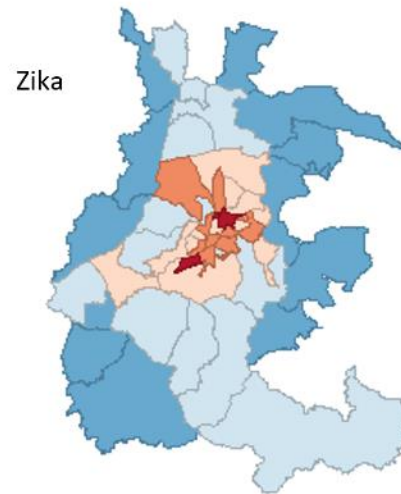
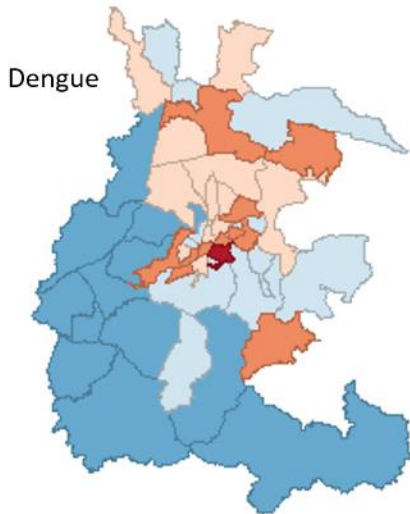
- Most of our 2,000 traps have never produced a mosquito positive for dengue
- Those few areas that have produced positive mosquitoes do so repeatedly.
- Presumably the COVID-19 lockdown has affected the spatial epidemiology of dengue possibly by maintaining those hotspots.
- We expect that as the lockdown is eased, the epidemiology will revert back to its normal pattern.

Current emphasis is on finding these hotspots and working with the municipality to reduce *Ae. aegypti* inside the hotspots.



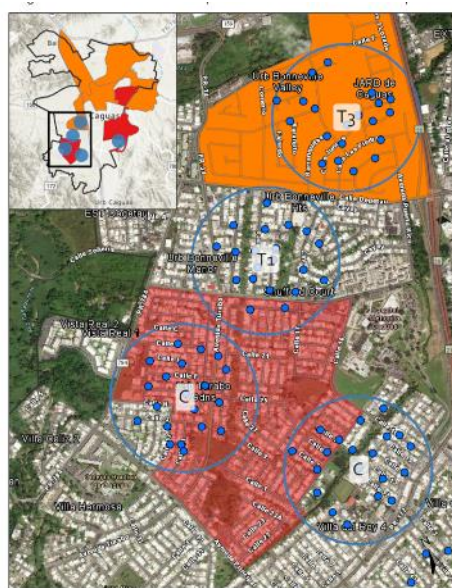
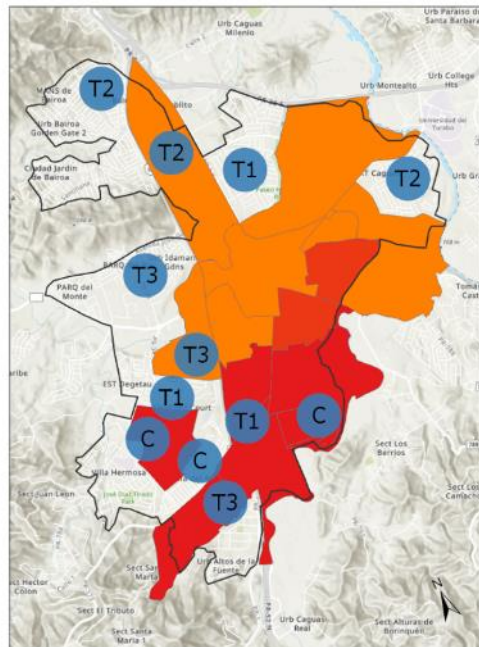
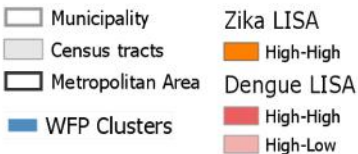
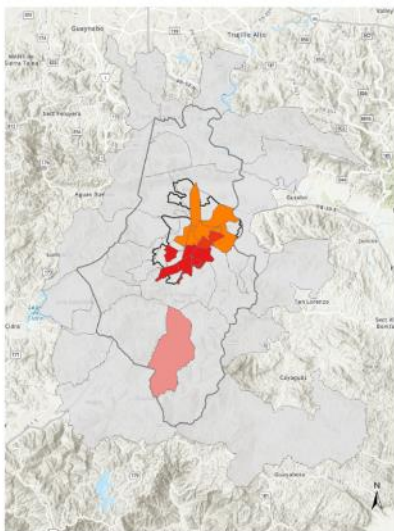
VCU efforts in this outbreak – Hot spot analyses

Caguas



VCU efforts in this outbreak – Hot spot analyses

Caguas



C	Control
T1	Intervention with 1 trap
T2	Intervention with 2 traps
T3	Intervention with 3 traps

Hotspot size is in the order of hundreds of meters

VCU efforts – Working with municipalities



Unidad de Control de
Vectores de Puerto Rico

Un programa del  Instituto para Ciencia,
Tecnología e Investigación
de Puerto Rico

Plan de Manejo de Emergencias para Municipios de Puerto Rico sobre el *Aedes aegypti*

**Dr. Grayson Brown, Director Ejecutivo
Unidad de Control de Vectores de Puerto Rico
20 de abril de 2020**

- Explains the current dengue situation and the need for vector control now.
- Identifies specific actions that can be taken to mitigate dengue
- Lists the ways in which the PRVCU can help. Main tools are PCR testing and WALS.



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Wide Area Larvicide Sprays (WALS) are one of the VCU's main tools in this plan.

- VectoBac WDG registered and available for use in Puerto Rico.
 - *Bti* (*Bacillus thuringiensis israelensis* strain AM65-52)
 - Wettable dispersible granule
 - Specific to mosquito larvae with rapid kill action (2-24 hours)
- No known resistance in Puerto Rico *Ae. aegypti* populations.
- PRVCU has the equipment and expertise.
- Product has no known negative effects on humans or other vertebrates – regardless of health status
- Extremely environmentally friendly



Community Engagement very important part of WALs

- Developed educational materials and web microsite.
- Training for municipal employees.
- Involvement of municipality in debris cleanup.
- Door to door visits to homes in intervention areas.
 - Use of loudspeakers
 - KAP surveys, homeowner instruction, home inspections, etc.
- Engagement continues throughout our involvement.



Bioassay cups tested coverage



Partial Cover

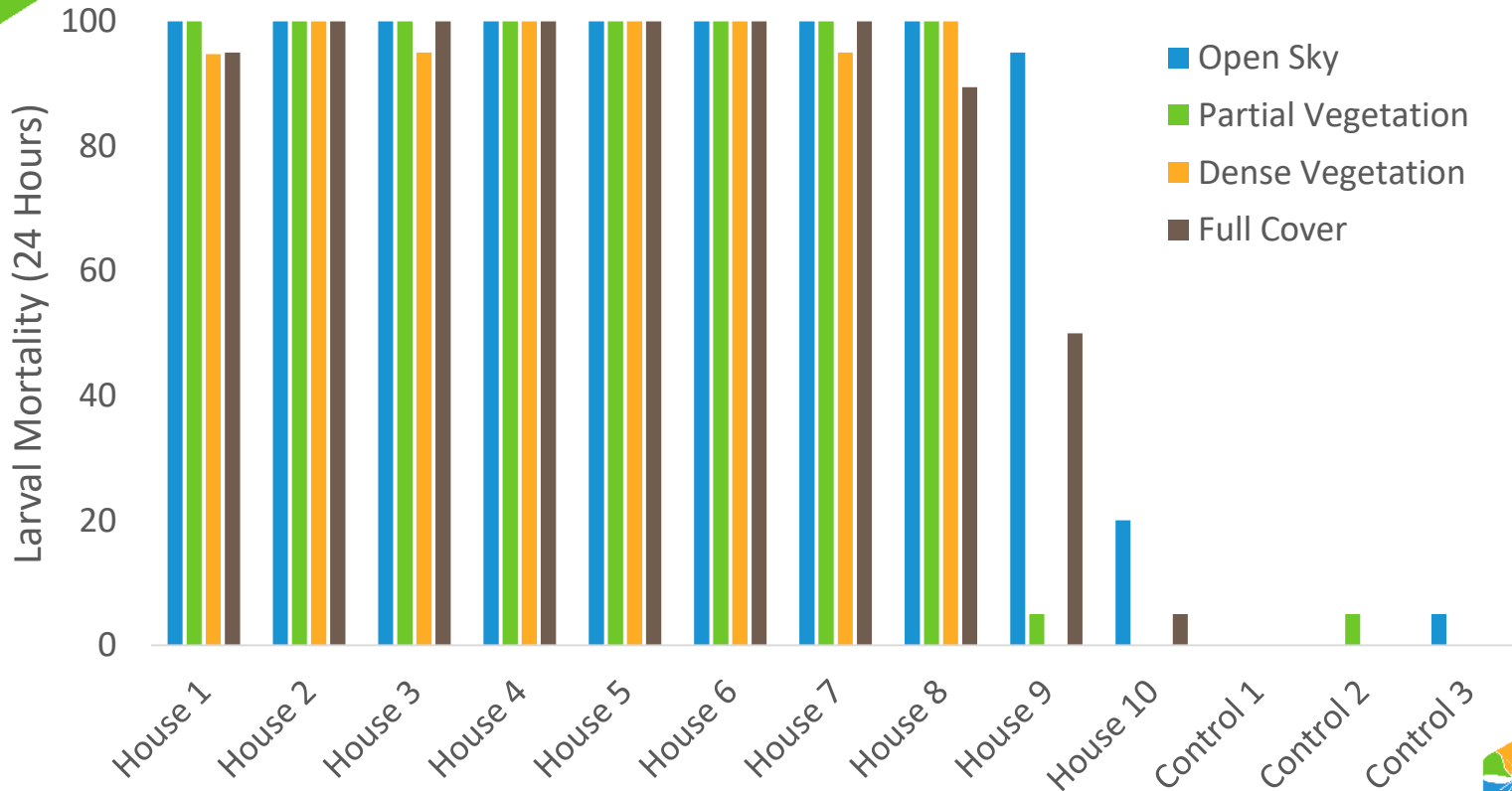


Open to sky



Dense Vegetation

Larval Bioassays – Valencia, Bayamón





WALS is a component in an overall program

1. Changed equipment and modified it from factory recommendations
 - Buffalo Turbine and A1
 - 12% vs 24%
 - Double volume (flow rate)
 - With adulticides and mist blowers: High end of the label volume and low end of the label rate is better
 - Increased air velocity
 - Micronaire blade angle set to 45 deg (bigger droplets to avoid over atomization)
 - Reduced application intervals from 2 weeks to 10 days
2. Required debris cleanup as a condition of participation
3. Continued community engagement adding house to house inspections

We have 5 machines





A1, 100 m



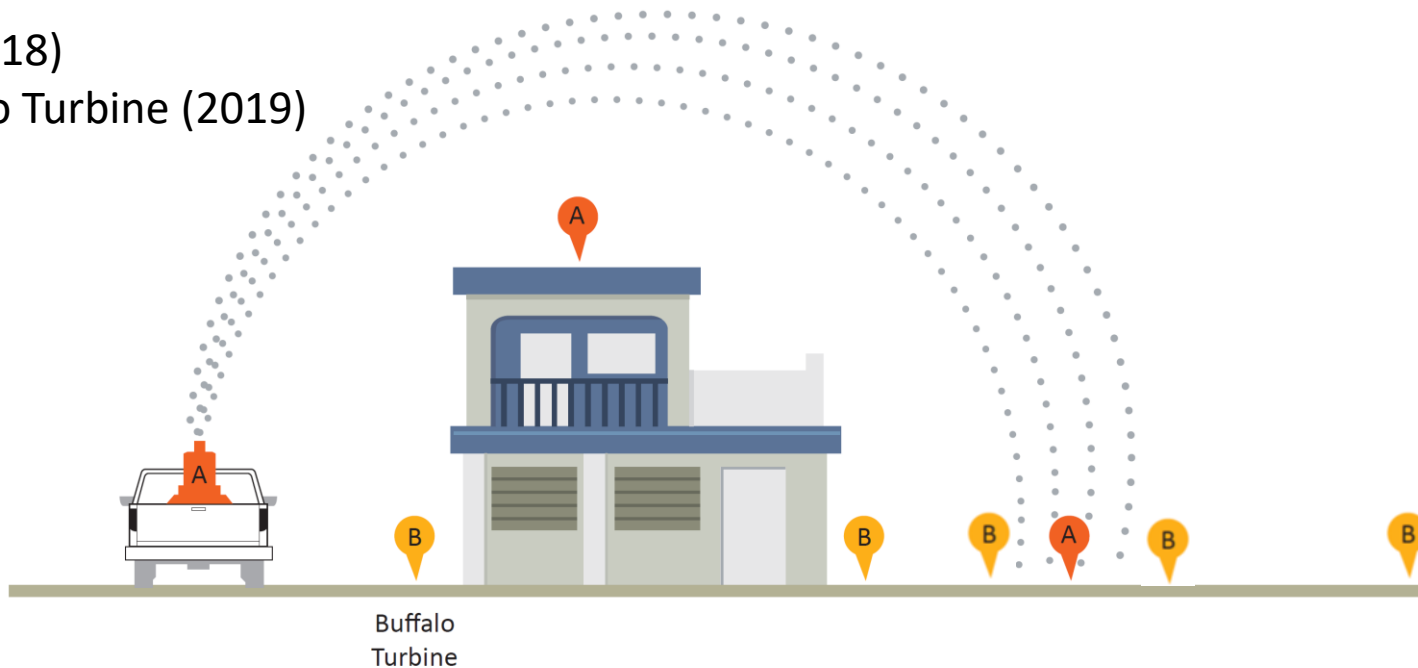
Buffalo Turbine, 100 m



We believe that the new equipment delivers more product to the best target areas

A = A1 (2018)

B = Buffalo Turbine (2019)



Debris is a big issue in PR, too big for the PRVCU



This alone reduced *Ae. aegypti* by up to 50%

Home inspections/Homeowner training



KAP – Knowledge, Attitudes, Practices

Dorado

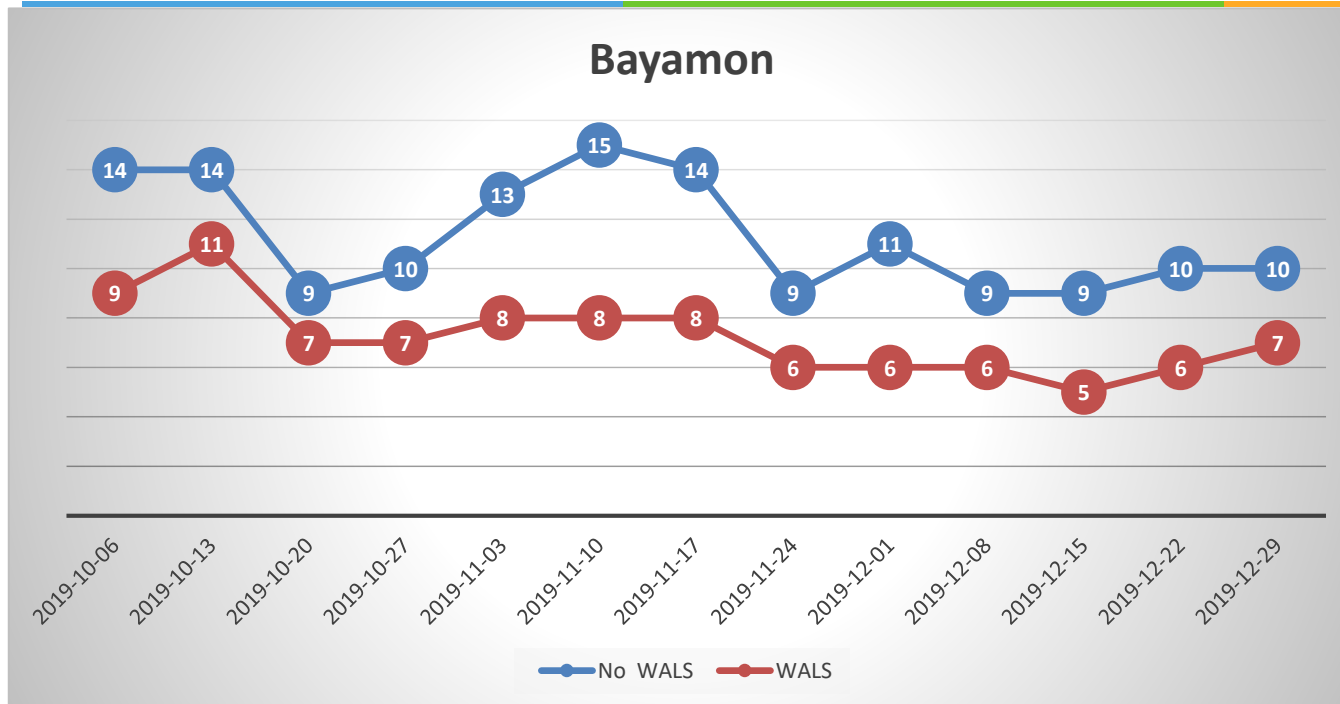
Practices	San Carlos		Post		Villa Santa		Post	
	n	%	n	%	n	%	n	%
What measures have you taken to reduce the risk of contracting diseases transmitted by the <i>Aedes aegypti</i> mosquito?								
Removed/emptied/cleaned water containers	23	43.4	12	42.9	14	42.9	14	63.6
Used insect repellent	13	24.5	7	25.0	5	12	5	22.7
Used insecticide	10	18.9	4	14.3	0	22	0	0.0
Removed stagnant water	12	22.6	8	28.6	8	0	8	36.4
Used metallic cloth	8	15.1	6	21.4	1	19	1	4.5
In the last months (Since August 2019) Do you use insecticide inside your home?								
Yes	45	84.9	17	60.7	35	83.3	11	50.0
No	8	15.1	11	39.2	7	16.7	11	50.0
In the last months (Since August 2019) Do you store water?								
Yes	21	39.6	7	25.0	10	23.8	1	4.5
No	32	60.4	21	75.0	32	76.2	21	95.5

Important result: Container indices fell by 50 – 75%





Overall 30 – 40% reduction in *Ae. aegypti* trap counts

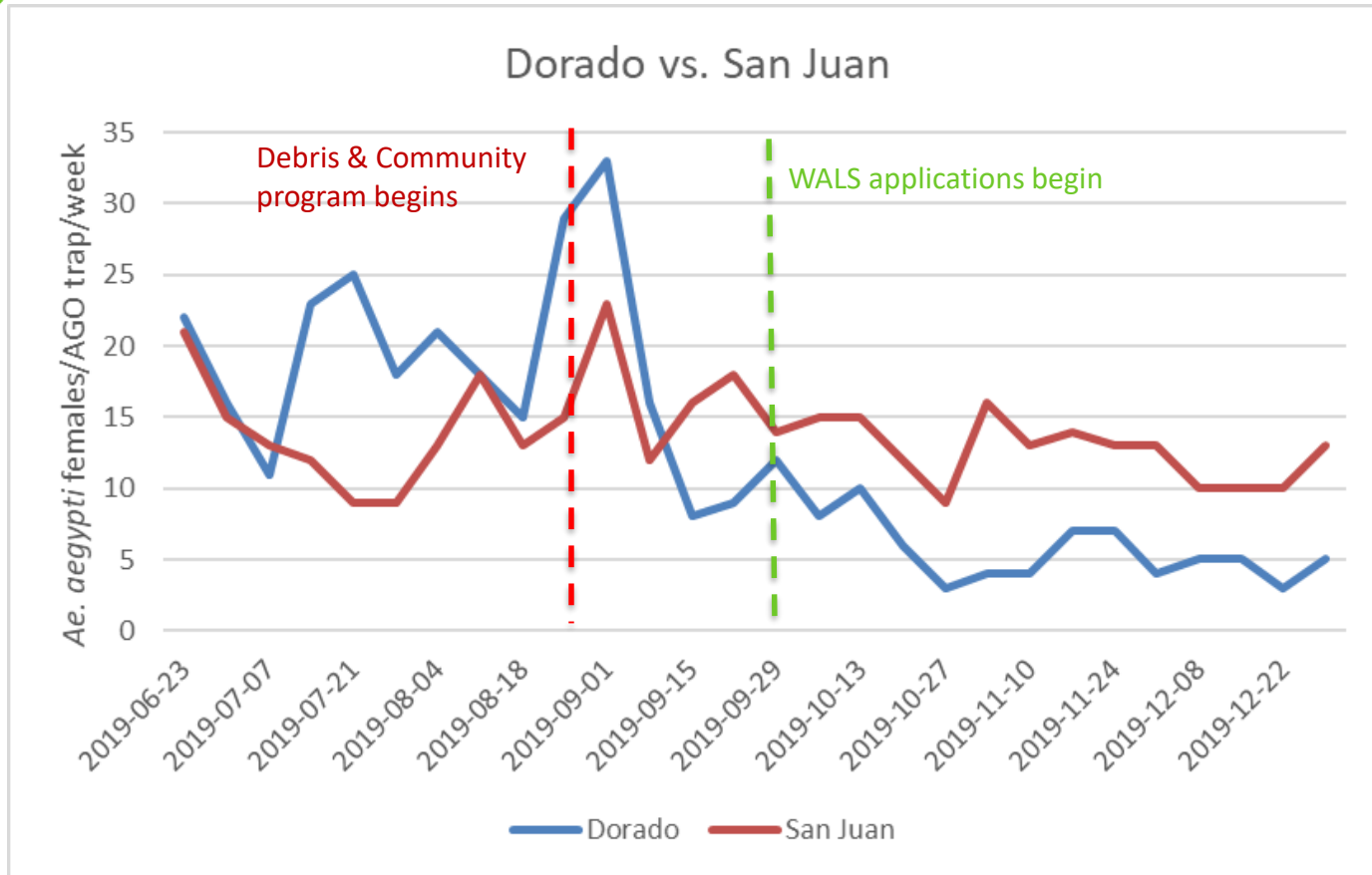


Similar to other studies, i.e.

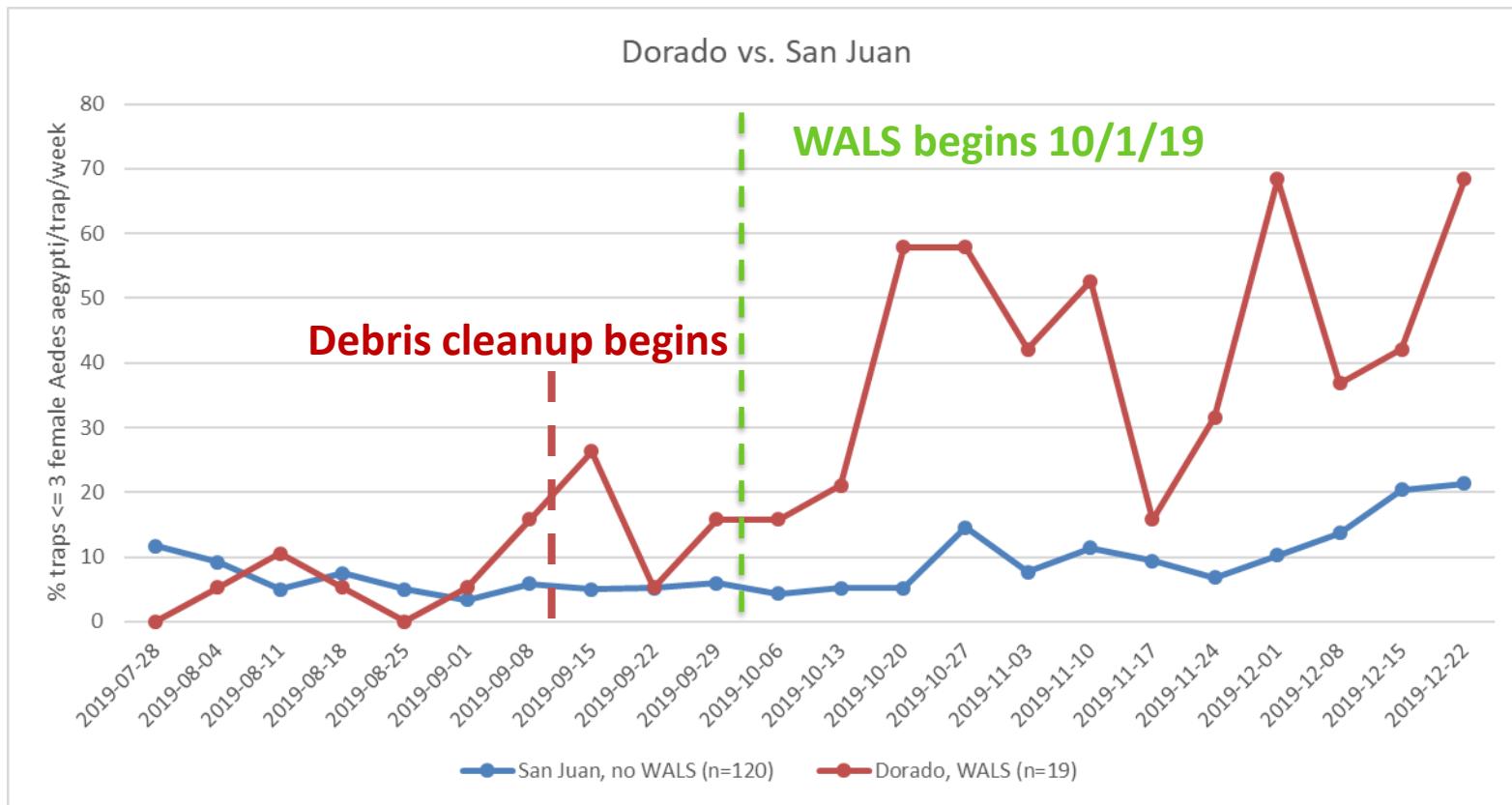
[Garcia-Luna, S. M., L. F. Chaves, J. G. Juarez, B. G. Bolling, A. Rodriguez, Y. E. Presas, J. Mutebi, S. C. Weaver, I. E. Badillo-Vargas, G. L. Hamer, W. A. Qualls. 2019. From surveillance to control: Evaluation of a larvicide intervention against *Aedes aegypti* in Brownsville, Texas. *J. Amer. Mosq. Cont. Assoc.* 35: 233-237](#)

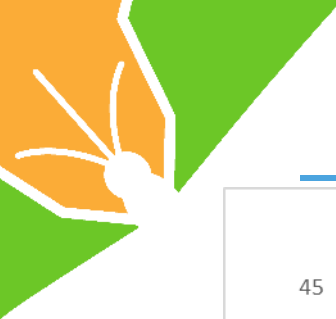


Trap count reductions in Dorado (WALS) vs San Juan (no WALS)

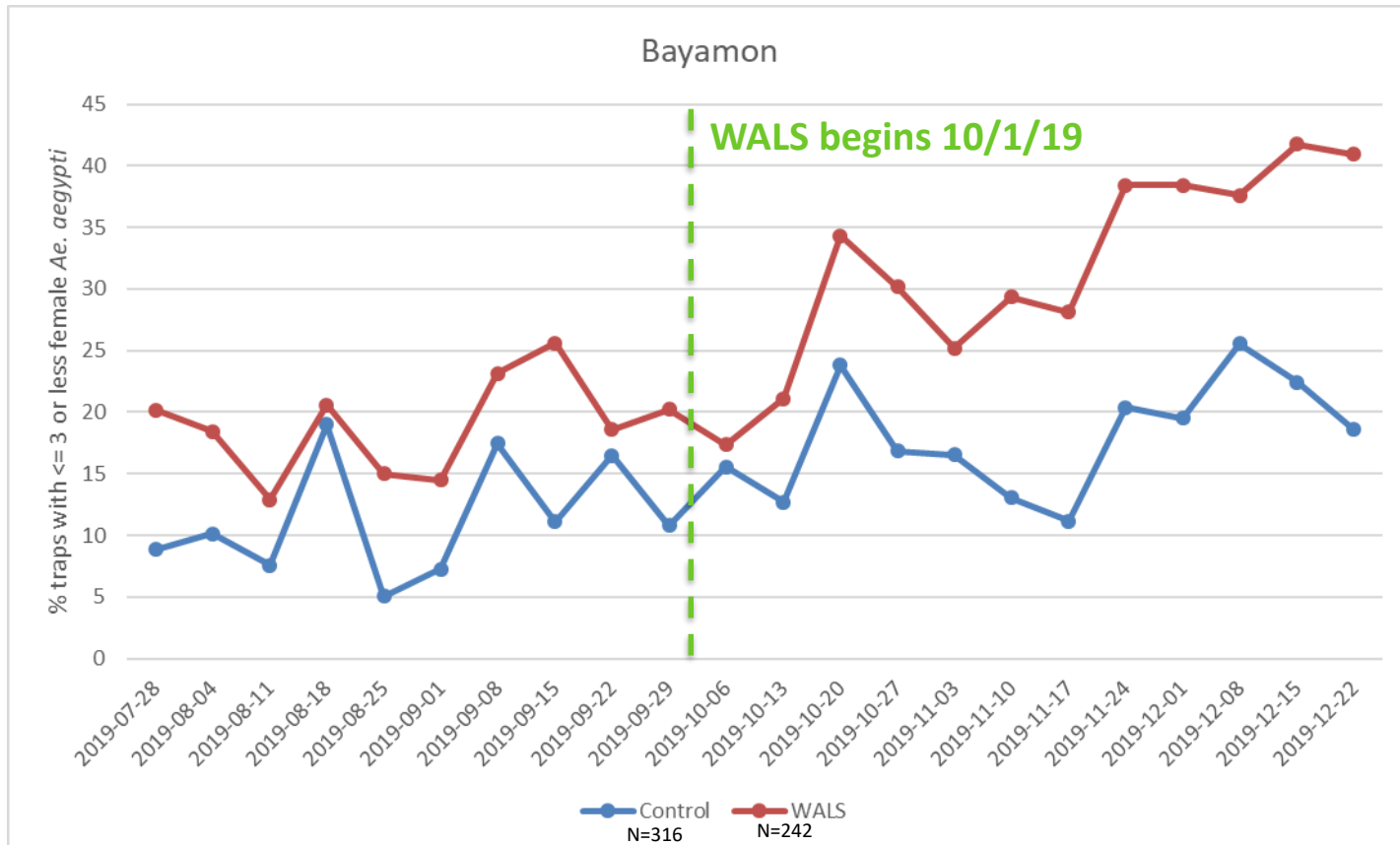


% of Municipality protected against dengue outbreak





Even WALs alone provides significant protection



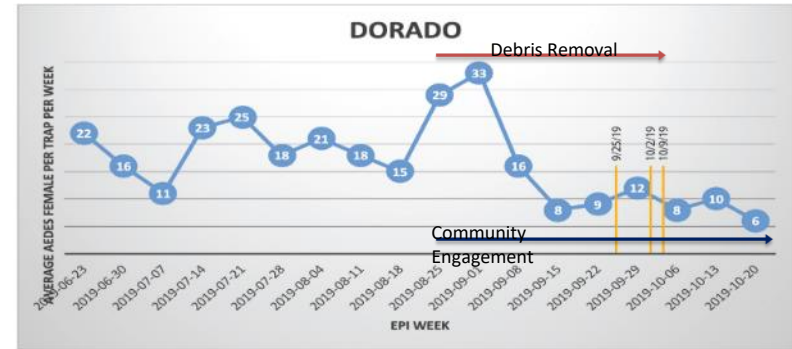


WALS + Debris Removal + Community Engagement

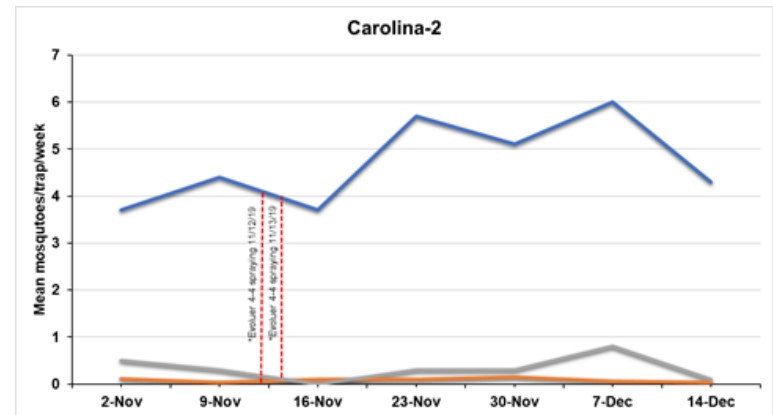
The only effective way to reduce *Ae. aegypti* in Puerto Rico right now.

- Uses a general use product based on a bacterium that affects only mosquito larvae
- Significant reduction in *Ae. aegypti*
- Greater reduction in dengue outbreak risk
- Program being extended to Guayanabo, Castaña, Bayamón, Toa Baja, Caguas.

WALS is not perfect but currently, this is the ONLY system that has proven effective in reducing *Ae. aegypti* in Puerto Rico.



↑ WALS vs Permethrin ↓





Targeting hotspots is our best chance to stop mitigate the outbreak

- WALs, along with municipal and community mobilization, is showing greater reduction in *Ae. aegypti* than any other available control.
- By targeting epicenters, the program is logistically and financially practical.
- Enthusiastic acceptance by mayors (this is an election year in PR).
- Wide public acceptance.



Unidad de Control de
Vectores de Puerto Rico

¡Muchas gracias!

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