



Unidad de Control de
Vectores de Puerto Rico

Wide Area Larvicide Spraying using VectoBac WDG (*Bti*) in Puerto Rico

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Current vector situation

Dengue outbreak in Puerto Rico likely within next few months

- 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



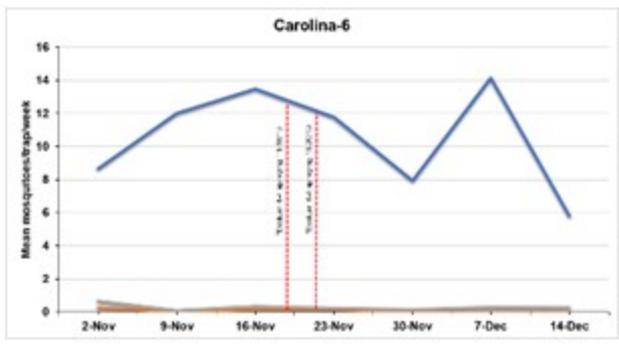
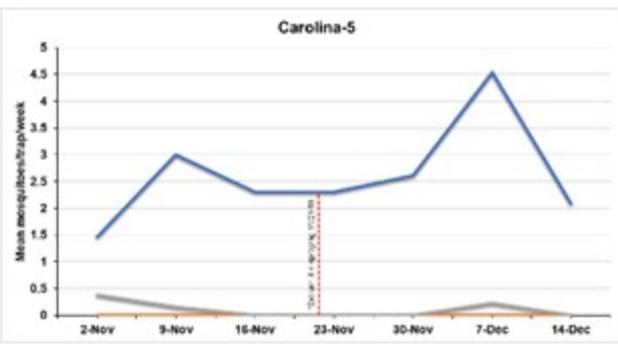
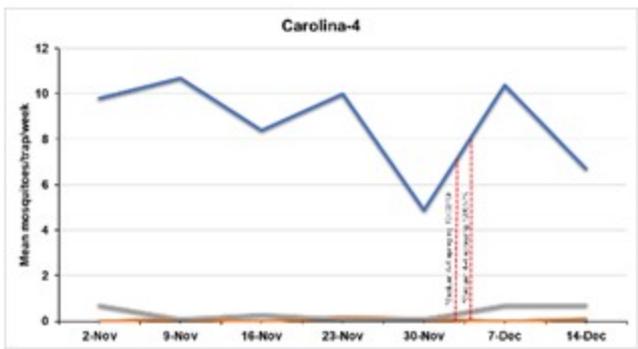
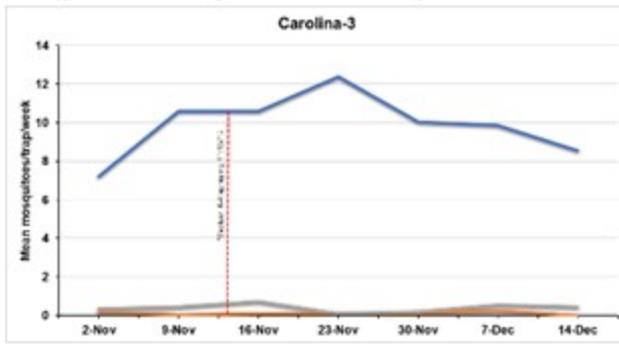
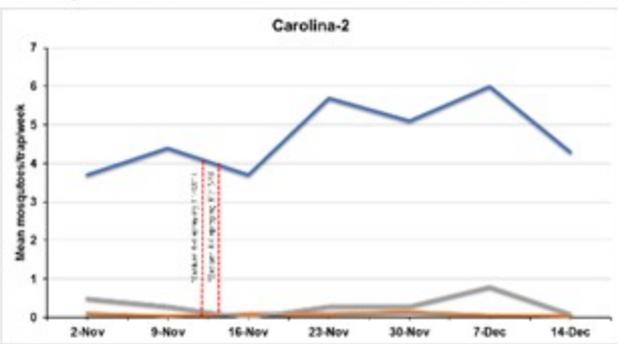
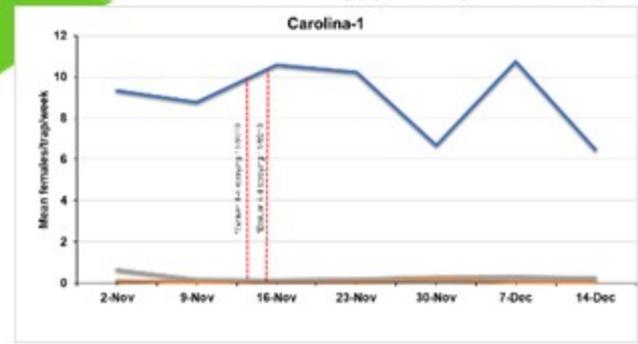
Insecticide resistance is widespread in PR

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.



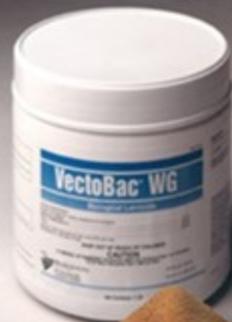
Aedes aegypti trap catches (blue line) before and after ULV treatment with Evolure (permethrin) in Carolina PR, Nov. 2019



— *Aedes aegypti* Fem — *Ae aegypti* male — Other species

Wide Area Larvicide Sprays may be an alternative

- 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.
- Cost is the main limitation:
 - VectoBac = \$15/A per treatment, with short treatment intervals
 - Evoluer 4-4 = \$0.50/A
- Competing products will become available in 2020.



Community Engagement very important in PR

- Developed educational materials and web microsite.
- Training for Bayamón municipal employees.
- Door to door visits to homes in intervention areas.
 - Use of loudspeakers
 - Seek permission to place jars
- Engagement continued throughout the project period.



Bioassay cups tested coverage



Partial Cover

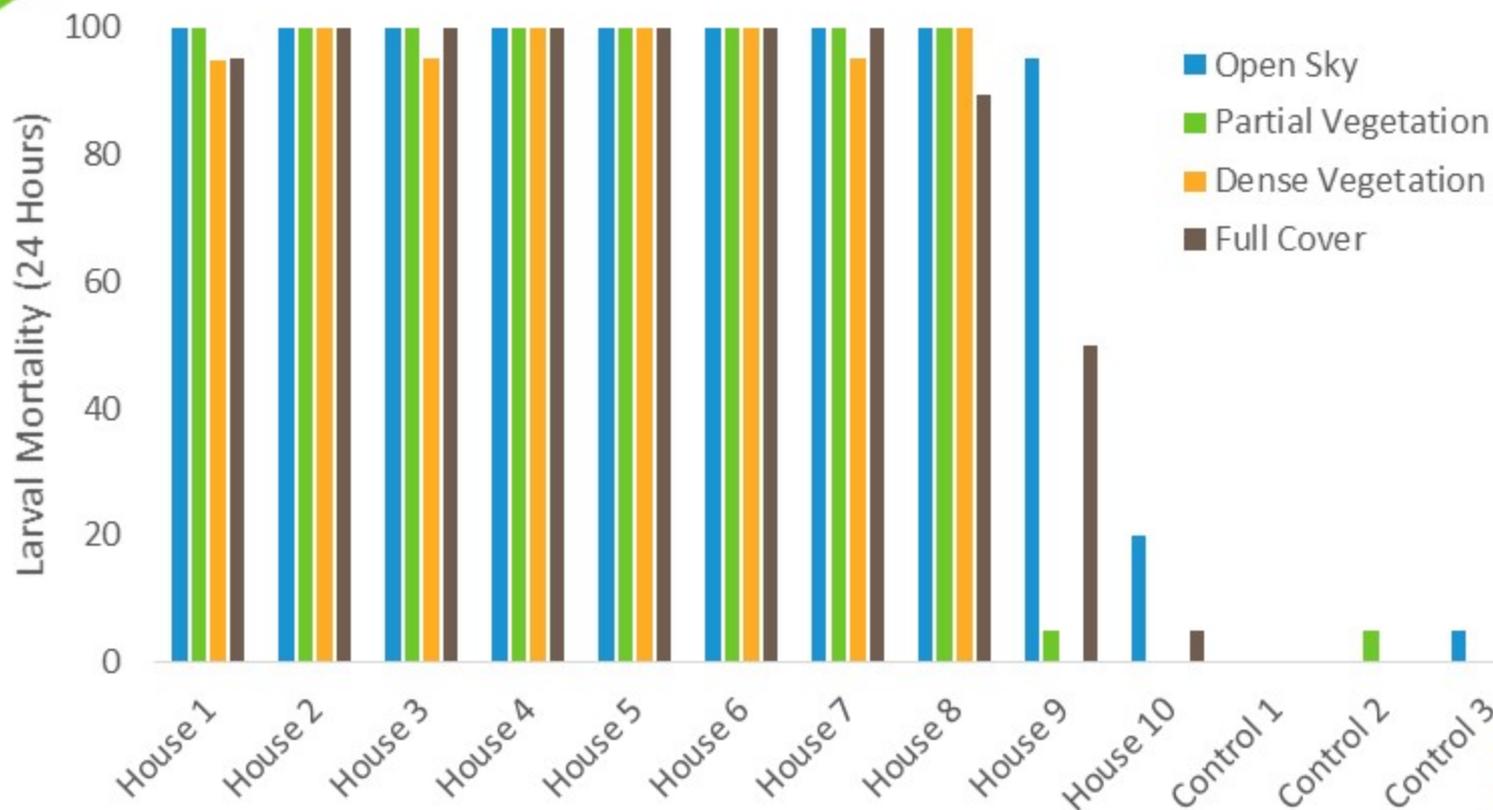


Open to sky

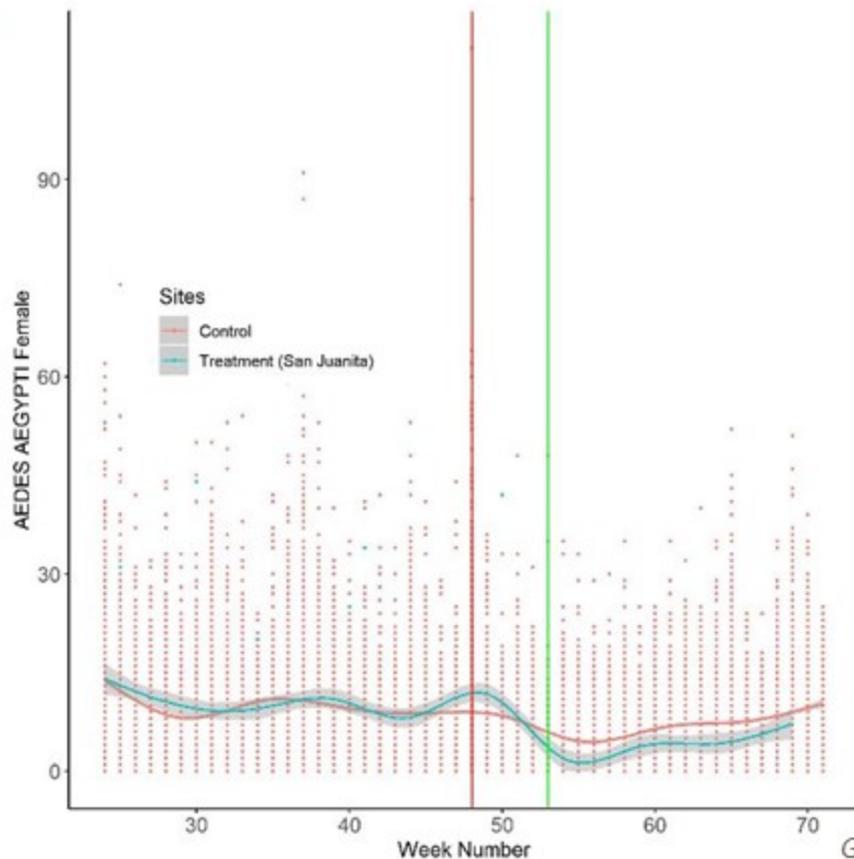


Dense Vegetation

Larval Bioassays – Valencia 5th December, 2018



2018 Results – Significant but we wanted better



- Using all non-treated areas of Bayamón as the untreated control
- Negative binomial regression
- Before Treatment
 - Mean = 9.5 ♀/trap/week
 - Variance = 68.2
 - Control vs Treatment : $P < 0.36$
(not significant)
- After Treatment
 - Mean = 6.8 ♀/trap/week
 - Variance = 37.4
 - Control vs Treatment: $P < 0.000$
(significant)

Grey = Standard Error



2019 Tests involved program changes – 3 legs

1. Changed equipment and modified it from factory recommendations
 - Buffalo Turbine vs. 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





A1, 100 m



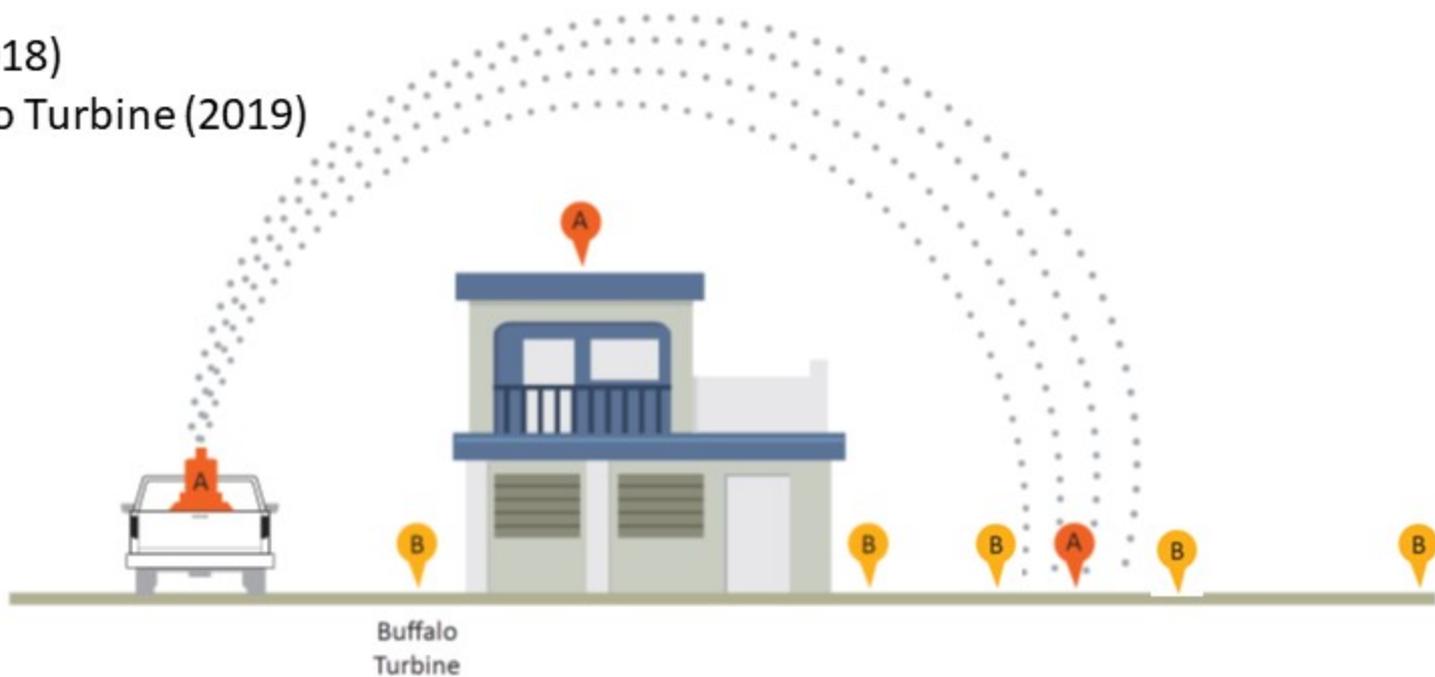
Buffalo Turbine, 100 m



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



Heavy equipment is needed for debris cleanup



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Home inspections – the third leg



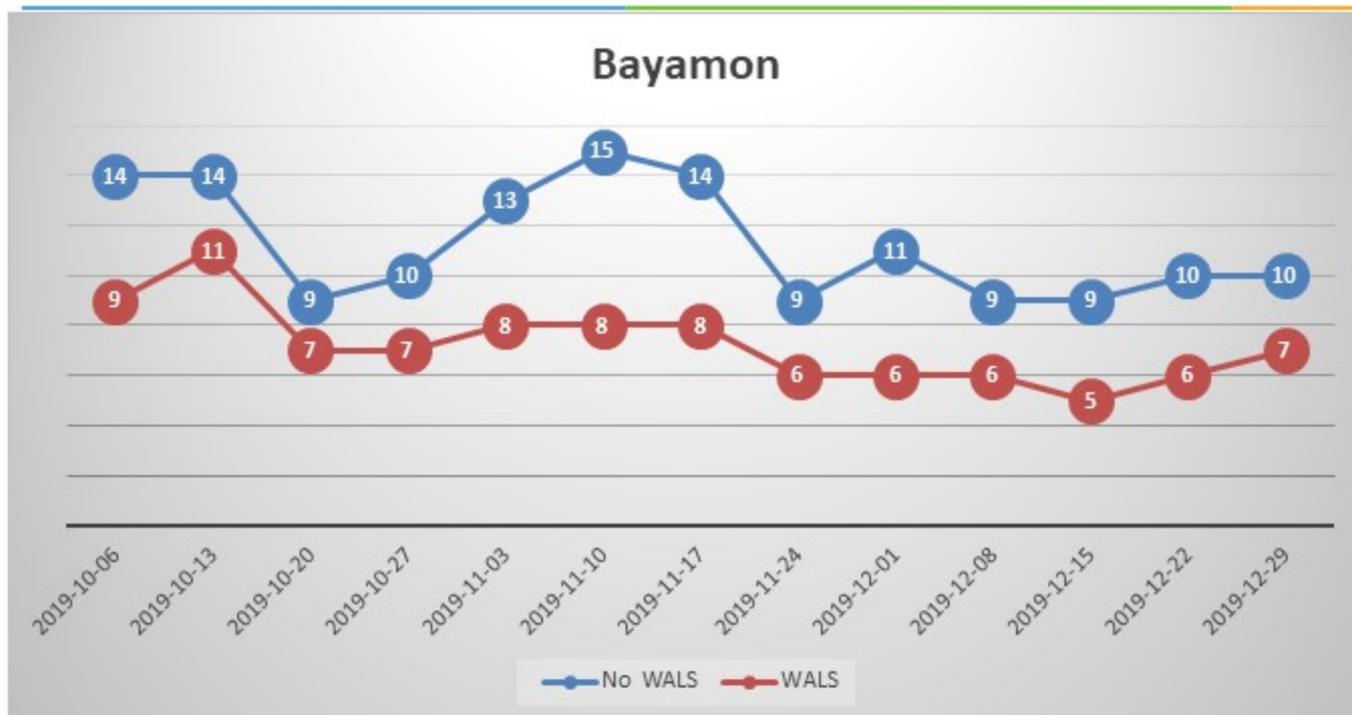


Tested in 2 communities in 2019 -- 2020

- Bayamón – More clusters than treated in 2018
- Dorado – City-sponsored program. Comparison area is the nearby San Juan.



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



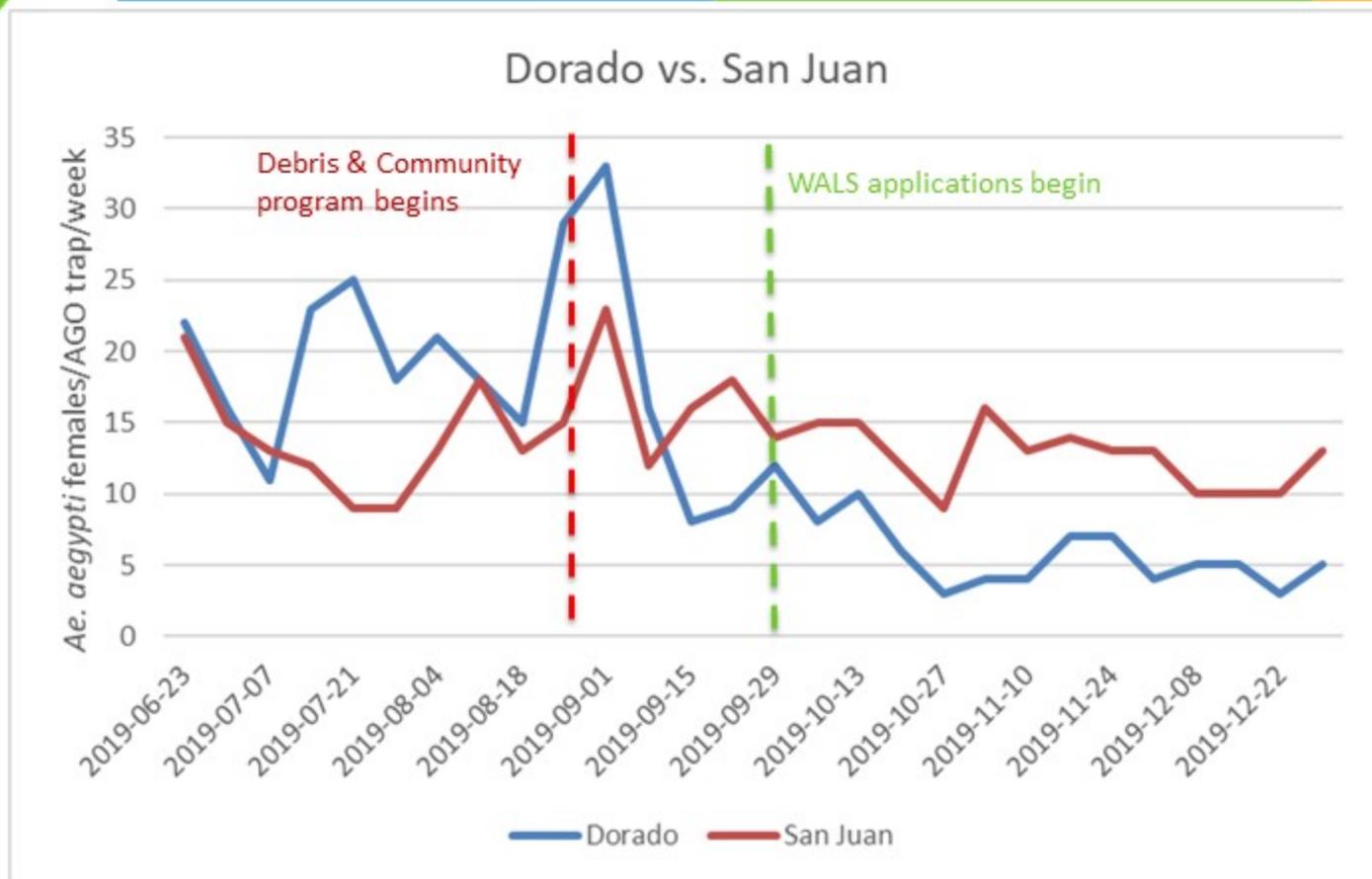
Similar to other studies, i.e.

[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](#)

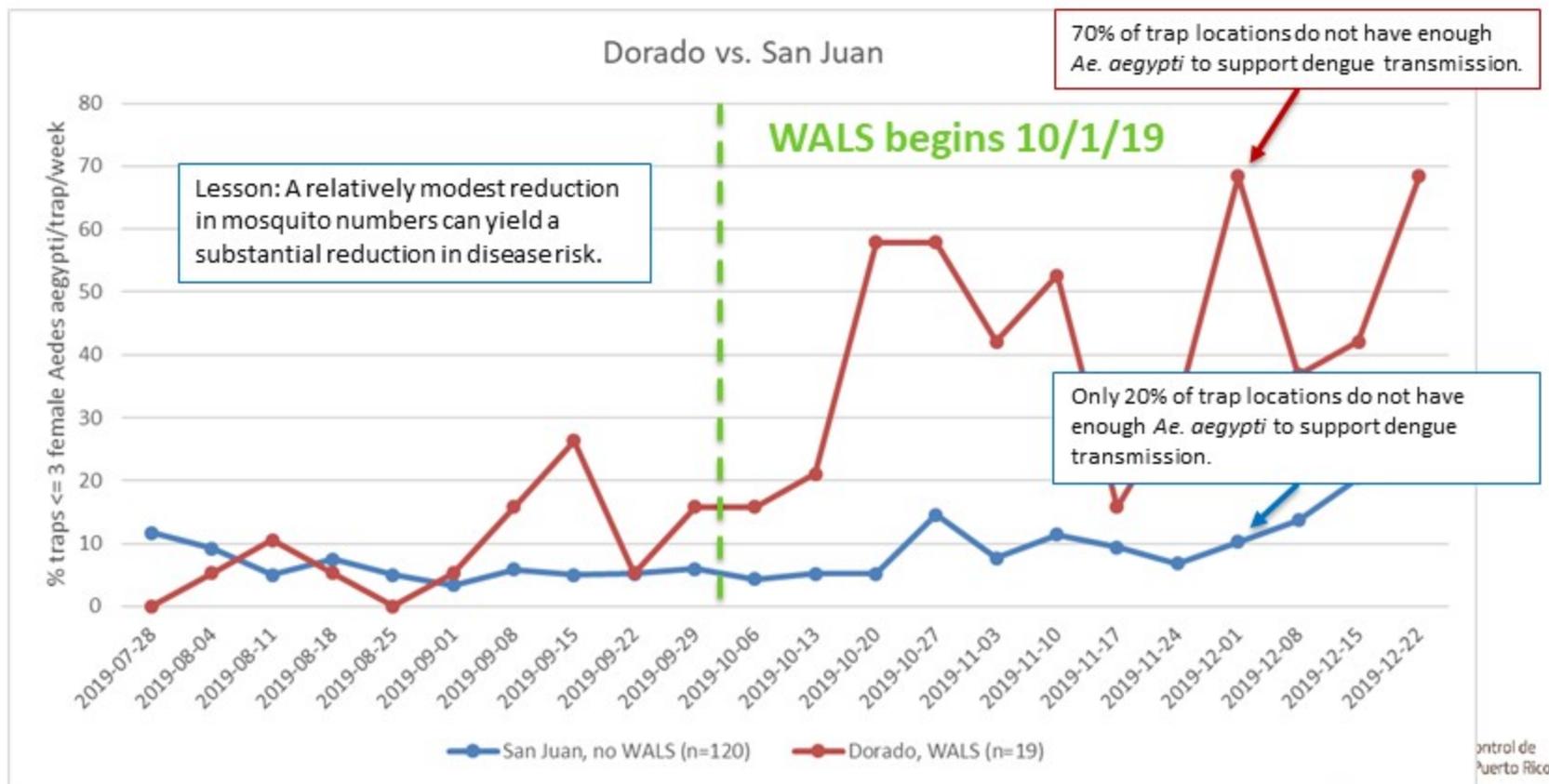


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Trap count reductions in Dorado (WALS) vs San Juan (no WALS)



% Traps with ≤ 3 females/trap/week



Mean Separation of San Juan vs Dorado, pre vs post treatments

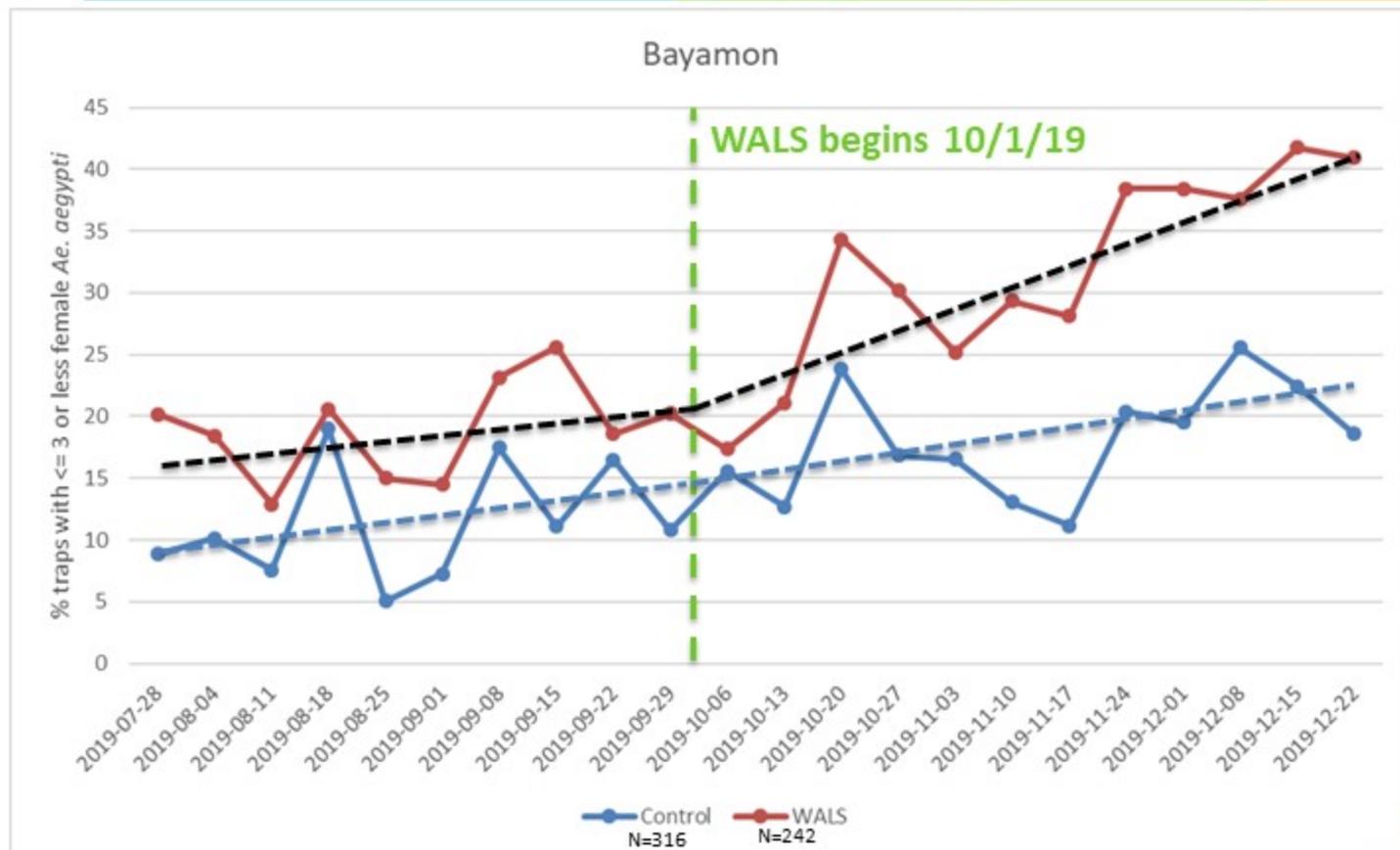
Conclusion: WALS is strongly increasing the % of traps that have 3 or fewer mosquitoes/week.

Bonferroni, $\alpha = 0.05$	San Juan Pre Treatment	San Juan Post Treatment	Dorado Pre Treatment
San Juan Post Treatment	P = 0.12		
Dorado Pre Treatment	P = 0.41	P = 0.25	
Dorado Post Treatment	P = 0.000102	P = 0.00042	P = 0.00030



Presumably, this means a reduction in disease transmission risk.

A greater effect is seen when plotting the % of traps with ≤ 3 female *Ae. aegypti*/trap/week



WALS + Debris Removal + Community Engagement

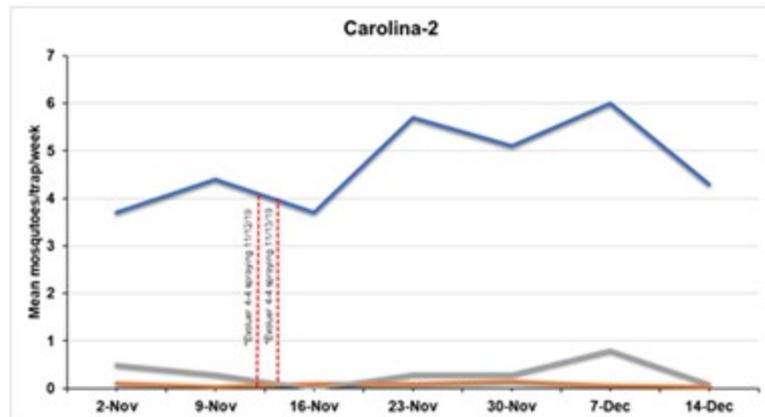
The only effective way to reduce *Ae. aegypti* in Puerto Rico right now.

- Uses a general use product based on a bacterium that affects only mosquito larvae
- Significant reduction in *Ae. aegypti* in Dorado
- Greater reduction in dengue outbreak risk
- Program being extended to Guaynabo, Bayamón, and Carolina.

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 ↓





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¡Muchas gracias!

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