

Is Adaptation Maladaptation? An assessment of mosquitoes and water harvesting

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Key Partner: Irene Ogata (Tucson Water)

End Users: Tucson Water, Pima County Vector Control

Project Dates: 2018 – 2020

Summary of Impact

Assessing effectiveness of adaptation strategies: This project provided Tucson Water and Pima County Vector Control with information about the effectiveness of green stormwater infrastructure in Tucson, AZ. Findings suggest that most tested sites did not create mosquito breeding habitat, and thus were not maladaptive.

Use of results: Findings were shared with societal partners who used this evidence to support their green infrastructure adaptation activities.

Deepening relationships: This project helped strengthen existing partnerships with city and county government agencies.

Problem Statement

As society adapts to climate change, it is important to ensure that adaptations do not create new problems. Green infrastructure that diverts stormwater to rainwater harvesting basins can inadvertently create new habitats for mosquitoes, especially if the infrastructure falls into disrepair or is improperly designed. Increased mosquito populations can lead to increased incidence of vector-borne disease in humans, like West Nile virus.

Research Focus

This project focused on evaluating the effectiveness of green stormwater infrastructure sites in Tucson, AZ. In 2018, researchers sampled 28 selected sites after rain events, including basins, curb cuts, and bioswales to test if they created breeding habitat for mosquitoes.

Project Activities

Planning Meetings: Initial planning meetings were held with representatives from Tucson Water and Pima County Vector Control, who informed the research design and data collection sites, and provided background information on green infrastructure in Tucson.

Data Collection: Undergraduate students collected water and mosquito data at 28 selected rainwater harvesting sites after rain events.

Data Sharing: Research findings were shared with Tucson Water and Pima County Vector Control via co-authorship of the manuscript as well as multiple discussions along the way as the project progressed.

Project Outputs

Peer-reviewed Publications:

Brown, H.E., L. Keith, V. Madera-Garcia, A. Taylor, N. Ramirez, and I. Ogata. 2022. Greening up for mosquitoes: A comparison of green stormwater infrastructure in a semi-arid region. *Journal of the American Mosquito Control Association* 38(2):109-112.
<https://doi.org/10.2987/21-7055>

Presentations:

Madera-Garcia, V. 2019. Is adaptation maladaptation: an assessment of mosquitoes and water harvesting. PacVec Annual Meeting, UC Davis.

Brown, H. 2024 Water Harvesting as Maladaptation with Respect to Vector-borne Diseases. Pima County Vector Control Monthly meeting.

Selected Scientific Findings:

During the sampling period in 2018, data were collected from 28 green infrastructure sites after rain events, totaling 212 visits to basins (63%), curb cuts (34%), and a bioswale (2%). The largest basin consistently retained water and tested positive for the mosquito *Culex quinquefasciatus*, a West Nile virus vector. While green infrastructure basins could turn into mosquito breeding habitat, study results showed that they were not collecting and retaining water long enough to do so.

On supporting city climate action:

I was very happy that Heidi and Ladd offered to do a study about green stormwater infrastructure and mosquitos. We tend not to be very good about collecting metrics on how our basins are performing, so bringing that data to table is great.

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Irene Ogata, Tucson Water

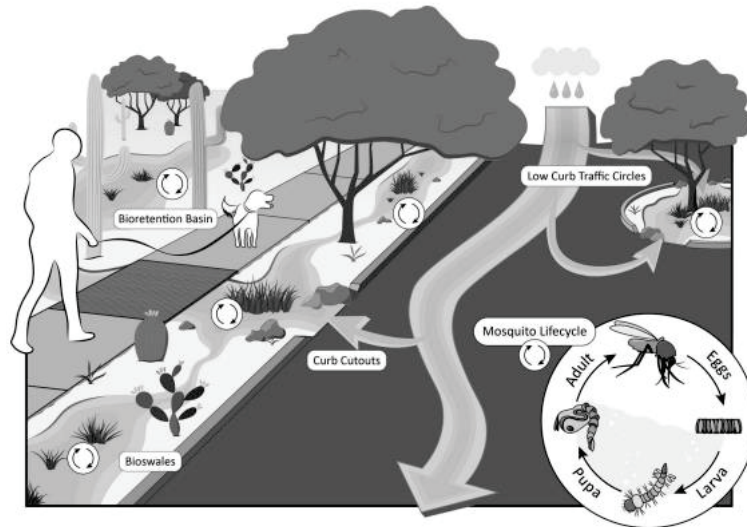


Fig. 1. Schematic of green stormwater infrastructure with generic mosquito life cycle embedded. Green stormwater infrastructures (GSIs) where stormwater pools for longer periods may become a source for mosquito emergence. Image credit: Erika Lynn Schmidt.

Leveraged Funding

Supporting this project:

- Centers for Disease Control and Prevention (CDC), Pacific Southwest Regional Center of Excellence in Vector-borne Diseases Training Grant Program (\$24,999)

Project Challenges

The timing of the monsoon – at the end of the summer – presented an unexpected challenge to finding student workers as summer trained students stopped working just as the monsoon and fall semester started. Researchers planned to repeat the study over multiple years, but 2020 was a ‘non-soon’ and there was no water accumulation.

Societal Impacts by Category

Connectivity:

- CLIMAS researchers strengthened existing relationships with Tucson Water and Pima County Vector Control. Tucson Water has referred Brown and Keith for other City of Tucson research needs related to green infrastructure, heat, and health.

Conceptual:

- Findings from this study confirmed that Pima County’s well-maintained green infrastructure practices were not generating new mosquito populations. One basin that had standing water did yield larvae. These findings were shared with societal partners. Tucson Water used these findings to understand green stormwater infrastructure performance and effectiveness.

Capacity Building:

- Five undergraduate students and 1 graduate student from different academic backgrounds worked on this interdisciplinary project and gained experience conducting community-based scientific research.