Abundance of mosquito populations over space and time across CIEE Monteverde Campus, Costa Rica

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Introduction

CIEE Monteverde campus employs a biodigester to anaerobically break down animal waste, but open-air effluent ponds may attract disease vector mosquitoes.

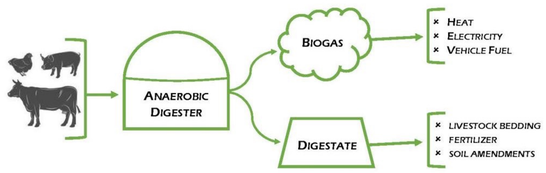

Figure 1. Cow and pig waste feeds into the biodigester and is anaerobically broken-down producing methane, a biogas that is used for cooking in the CIEE Monteverde campus kitchen

Questions

- What is the abundance of mosquitos and species composition in animal digester effluent ponds?
- How does mosquito abundance and composition in effluent ponds compare to other standing bodies of water across CIEE Monteverde campus?
- Do nets help prevent oviposition and reduce mosquito abundance in animal digestor effluent ponds?

Methods

- Sampled four bodies of water across the CIEE campus at six time points (Figure 2)
- 50mL tubes were used for collection of mosquito larvae at transects in the digester effluent ponds and 3 additional sites
- Quantified mosquito abundance from each site
- Reared a subset of larvae to identify species
- Conducted a preliminary experiment using netting as a control measure to decrease mosquito oviposition and abundance in digester effluent

Results

Year	Dominant Species
2017	*Aedes spp*.
2018	*Aedes aegypti*
2019	*Culex spp*.

Animal digester effluent ponds are the most **significant breeding ground** for **mosquitos** on CIEE Monteverde Campus, Costa Rica. ***Culex* spp.** is **dominating** animal digester retention ponds.

Mosquito Abundance

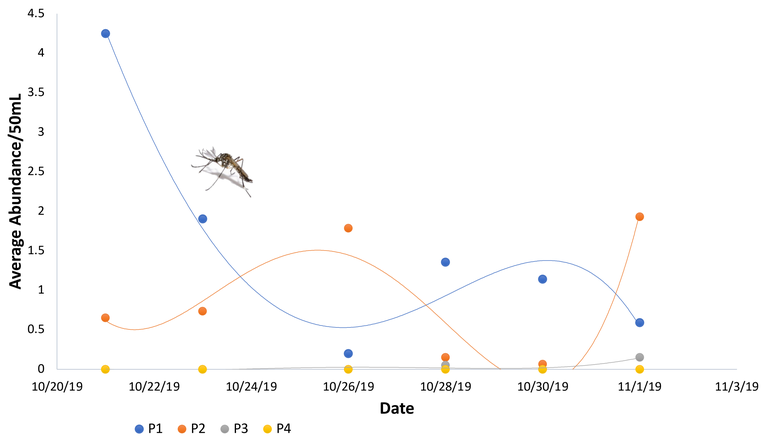

Figure 2. Average mosquito larvae abundance in animal digester effluent ponds 1-4; cyclical pattern between Pond 1 and Pond 2 larvae abundance, and low abundance in pond 3 and 4.

Mosquito Control Experiment

Photo H. Trial netting experiment

Photo I. Implementation of nets across all four retention ponds

Results from preliminary netting experiment were inconclusive - mosquitoes did not oviposit in netted or open-air containers. Currently, a trial with netting placed over each of the effluent ponds is being conducted to further elucidate if netting is an effective approach to reducing mosquito populations in effluent ponds.

Photo descriptions: Photo A; additional sampling sites across CIEE Monteverde Campus, Photo B; sampling method, Photo C: example of larvae sample from animal digester, Photo D: mosquito larvae in rearing container, Photo E; example of rearing containers, Photo F; species identification in lab, Photo G; image of adult *Culex* spp.

Sample Sites

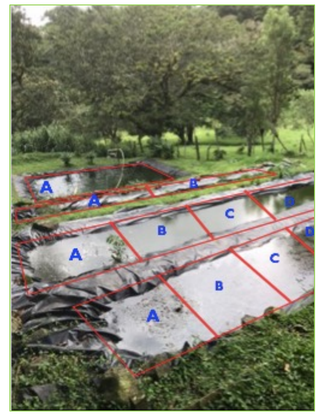

Figure 3: Animal digester effluent ponds 1-4 with sampling transects outlined

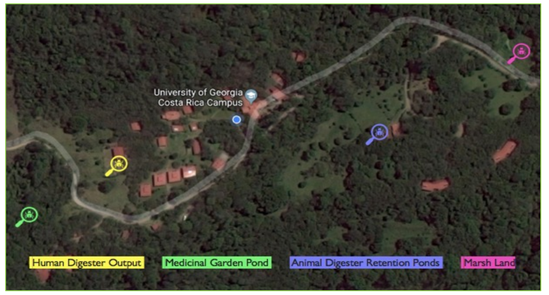

Figure 4: Sampling sites across CIEE Monteverde Campus, San Luis, Costa Rica: Human Digester Output, Medicinal Garden Pond, Animal Digester Retention Ponds, and Marsh Land

Future Directions

- Incorporate quantitative sampling of mosquito population dynamics to standardize long term monitoring
- Explore what is causing the annual changes in species composition
- Continue monitoring of ponds with netting
- Measure more abiotic and biotic variables (e.g. dissolved oxygen and continuous temperature measurements; other macroinvertebrates)

What does it mean?

- *Culex* spp. is a vector for West Nile virus and Japanese encephalitis (Calderón-Arguedas et al. 2009).
- As temperature increases, so does the spread of mosquito populations into warmer climates. Vector carrying mosquitos could be a serious problem in the future (Githeko et al. 2000).

References
Briggs, A.A. & Osenberg, C.W. Oecologia (2019) 190: 835. https://doi.org/10.1007/s00442-019-04448-3
Calderón-Arguedas, O., Troyo, A., Solano, M. E., Avendaño, A., & Beier, J. C. (2009). Urban mosquito species (Diptera: Culicidae) of dengue endemic communities in the Greater Puntarenas area, Costa Rica. *Revista de biologia tropical*, *57*(4), 1223–1234. doi:10.15517/rbt.v57i4.5459
Githeko, Andrew & Lindsay, Steve & Confalonieri, Ulisses & Patz, Jonathan. (2000). Climate Change and Vector- Borne Diseases: A Regional Analysis. Bulletin of the World Health Organization. 78. 1136-47. 10.1590/S0042-96862000000900009.

Acknowledgments

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