Kissing Bug (*R. pallescens*) Population Structure in Panamanian Rural Landscapes

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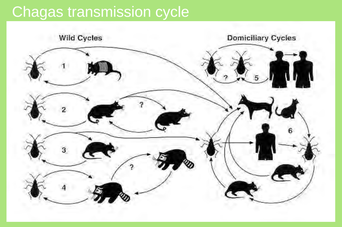
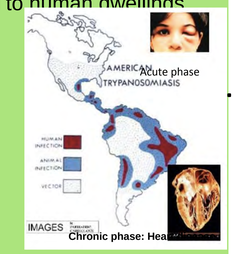
INTRODUCTION:

- Chagas disease is a vector-borne zoonotic disease that is significant for causing morbidity and mortality, and heart failure frequently in Latin America and other countries due to human migration
- The disease is caused by an apicomplexan parasite called *Trypanosoma cruzi (T.cruzi)* that is transferred between mammal species, including humans, by hematophagus triatomine ('kissing bugs') vectors, which pass the infective stage of the parasite in their feces.
- There are over 130 hematophagous triatomine species that can live in sylvatic and/or domestic and peridomestic environments varying in different degrees of adaptation to human dwellings

Chagas transmission cycle





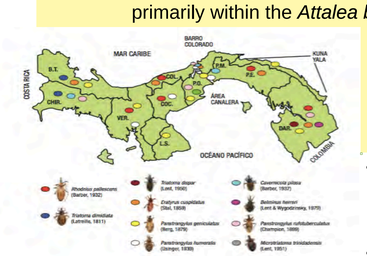
- In many tropical forest areas of Central and South America, there are palm-associated triatomine vector species that have contact with people by contaminating food or drink, or flying into homes from peridomestic palms.[3]
- Defecation on or around the bite wound from a kissing bug can then help transfer the T.cruzi parasite into the human body
- Although house-adapted triatomine vectors of Chagas disease may be controlled by housing improvements and fumigation, it is very difficult to to prevent or control palm-associated triatomine contact with domestic animals and humans.
- Improved control and monitoring of triatomine populations thus requires **further understanding of their population structure** to predict their population dynamics.[3]
- Anthropogenic land use (e.g. deforestation, cattle pastures) may also impact the population structure of triatomine vectors[2]

Study Objective:

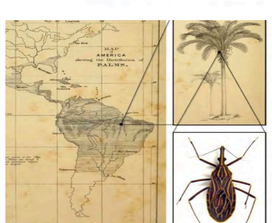
The objective of this study is to compare the population structure of the Chagas disease vector, *Rhodnius pallescens,* across different types of anthropogenic land use. This information can be applied to 1) models of vector population dynamics and 2) experiments for vector population control, and 3) improvements in vector sampling techniques.

Study System:

In Panama, the primary vector for the Chagas disease is the triatomine *Rhodnius pallescens* bug that lives and reproduces primarily within the *Attalea butyracea* palm tree.[2]



- Triatomine bugs have **5 nymph stages** before molting to the final adult stage- all can be found in various palm tree habitats
- The *R. pallescens* female adult will mate between 1-3 days after their final molt stage and typically through the months of June-September (wet season)[1]
- 10-30 days later oviposition starts and each female adult will lay one or two eggs per day totaling up to 10-30 eggs between their blood meals and 200 eggs in their lifetime[1]
- The eggs will then hatch within one to three weeks



MATERIALS AND METHODS

Kissing bugs caught on a Noireau trap (left)

Materials:

- Data on Rhodnius pallescens' adult and nymph stages collected in Panama by Dr. Nicole Gottdenker in year 2008-09 and Christina Varian in year 2013-2015 during the wet season

Data Collected:

The following information was used from the data collection:

- The habitat type (forest, peridomestic, pasture, contiguous)
- The different palm tree sites within the habitat type (contiguous, early-secondary, mid-secondary, pasture, and peridomestic)
- Nymph age structure and adult sex of the R. pallescens bug collected

Analysis:

- All analysis and graphs were performed in R studio version 0.99.491

RESULTS:

Habitat type and population stage structure

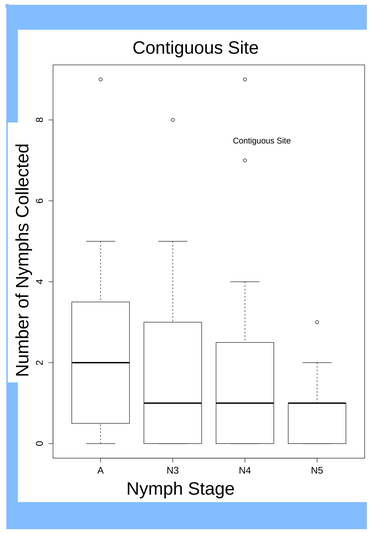


Figure 1. The contiguous forest palm tree site of adults and nymph stages 3-5. There is no presence of any nymphs 1 and 2 found in this site.

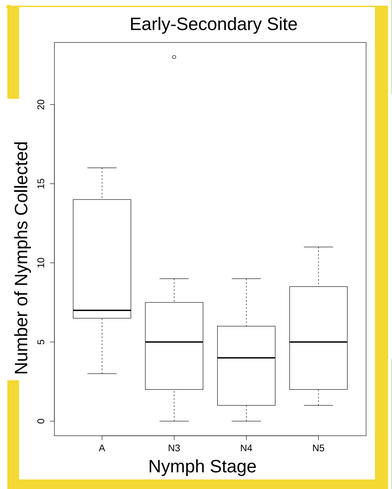


Figure 2. The early-secondary palm tree site of adults and nymph stages 3-5. There was no presence of any nymph 1 or 2 found in this site

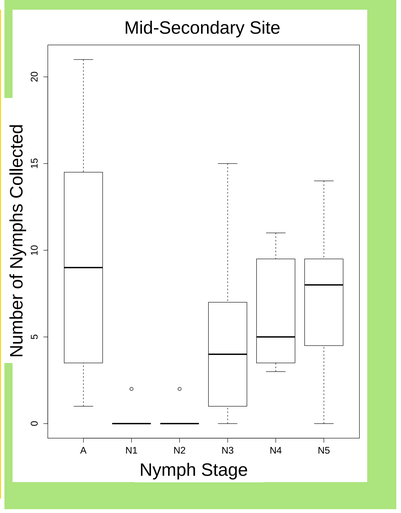


Figure 3. The mid-secondary palm tree site shows the adult and nymph stages 1-5. The nymph stages 1 and 2 are significantly low

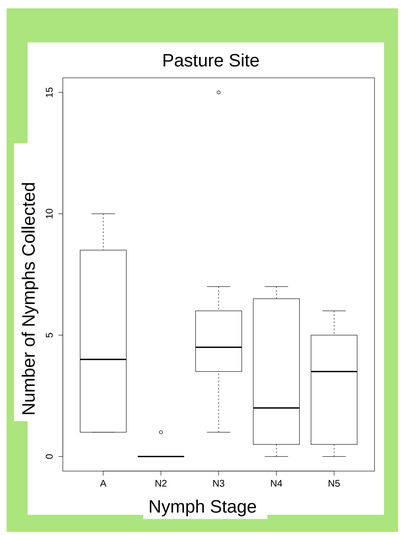


Figure 4. Pasture palm tree site shows the adult and nymph stages 2-5. The nymph stage 1 is not represented and nymph stage 2 is underrepresented

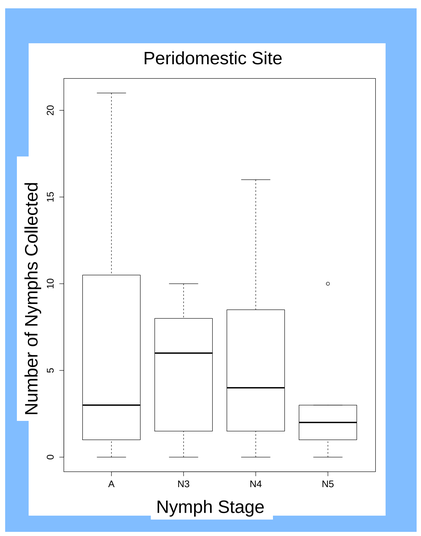
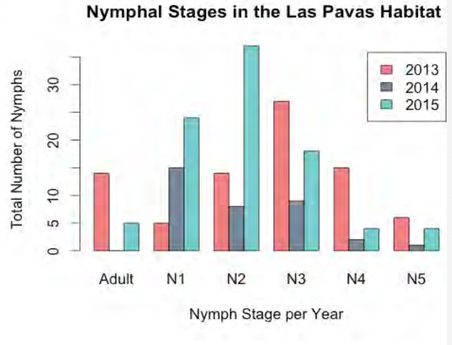
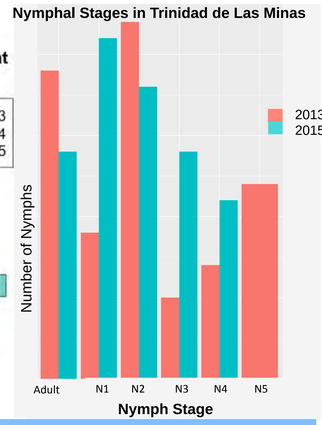


Figure 5. Peridomestic palm tree site shows the adult and nymph stages 3-5. There is no representation of nymph stages 1 and 2

Results: Nymph stage structure of bugs in palms collected from pasture, forest patches and peridomestic sites from the years 2013-2015 in Las Pavas and Trinidad de Las Minas habitats





Discussion:

- In a predicted stable age distribution of the *R pallescens* bug, there should be relatively larger numbers of amounts of early nymphal stages and lower relative numbers of older nymphs. *N1* and N2 stages appear to be under-represented in our data from 2008 as compared to recently collected samples (Trinidad de las Minas and Las Pavas 2013-2015). Potential reasons for this:
  - Unstable populations in 2008
  - Under-sampling of N1 and N2 in 2008 due to bugs not attaching or attracted to Noireau (mouse-baited traps). Traps were improved with a better sticky tape in 2013, which may have led to higher collection of younger nymphs between 2013-2015.
  - Seasonality-The *R. pallescens* bug has a specific mating season in the months of June through September, as well as a particular time when the eggs are laid and hatched. If the adults and nymphs were collected before or after the peak hatching or during the time that N1 and N2 stages were not dominant, it is possible that they were not present.
  - Lower survival of N1 and N2 stages due to increased predation.
- For the 2008 data, the predicted N5 numbers were particularly low in contiguous forests as compared to deforested sites and also lower in pasture sites. It is possible that the relatively low N5 stage numbers in contiguous habitats could be to natural enemies, such as the highly virulent strains of the entomopathogenic trypanosome *T. rangeli,* where they may be more prevalent in contiguous sites, and also may cause a higher pathogenic effects in older-stage bugs (Gottdenker et al. *In press*).
- In the 2013-2015 data, there were greater number of bugs captured in the Trinidad de las Minas site (forest fragment, pasture and peridomicile) than in the Las Pavas and there are no apparent interannual trends of stages captured.
- In the 2013-2015 data, it is likely Adult survivorship or N5-Adult moulting rates are lower in the Las Pavas Site.

- There was a significant association between the bug stage and habitat type (Chi-squared = 37.3, df = 20, p =0.02)
- In each habitat type, the estimated number of N3, N4 and N5 significantly greater in disturbed habitats (glm, negative binomial errors)[2]
- The estimated number of N5 in contiguous habitats was particularly compared to disturbed habitats.
- Nymph: Adult ratios did not significantly differ between habitat types, but tended to be higher in pasture sites (Kruskal-wallace, p=0.1)

Conclusion and Future Directions

- In conclusion there is a habitat-association of the difference of population structure frequency in the of the *R. pallescens* bug in different stages
- From the results, there is an importance to finding new methods of sampling, and researching if there is a possible disturbance preventing the nymphs to successfully molt into different stages

Acknowledgements

I would like to thank the REU Population Biology of Infectious Diseases program, Dr. Nicole Gottdenker, Christina Varian, The National Science Foundation, and the Gottdenker lab.

REFERENCES

[1]Gary R. Mullen, Lance A. Durden et.al 2002, *Medical and Veterinary Entomology* (2nd Edition) Academic Press, [2]Fernando Abad-Franch et al. 2015, Acta Tropica (Volume 151; 126-141)· [3]Gottdenker et al. *In press. 2012*, [4]Luis Fernando Chaves et al. 2006, *Rhodnius prolixus*