Ecological Modeling for Public Health: Predicting Hotspots of Human and Vector Contact in Rural Madagascar

Duke UNIVERSITY | BASS CONNECTIONS

Ryan Fitzgerald[1,2]

[1]Duke University Biology Department, [2]Duke Global Health Institute

Bass Connections in Global Health

Background

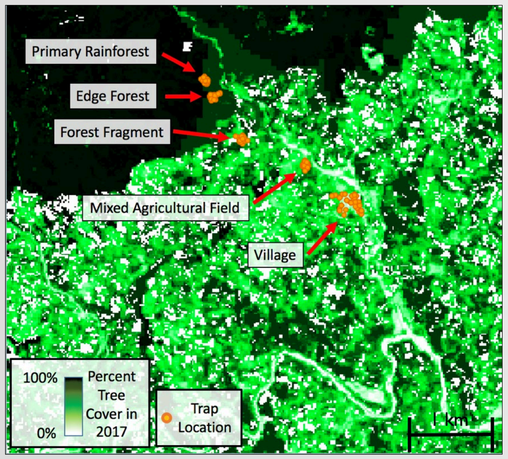
- Vector-borne diseases cause 700,000 deaths annually
- This burden is concentrated in low and middle income countries which also have high deforestation rates
- Deforestation may increase vector-borne disease risk
- Disease outbreak infrastructure is generally reactive, and preventative measures are under-utilized

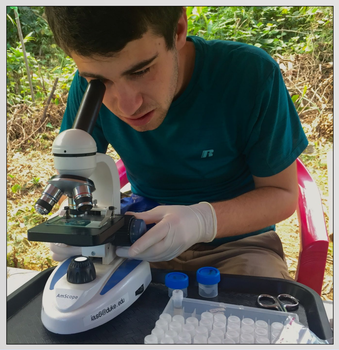
Objectives

- Create a landscape level tick exposure map based on ecological variables and human land use data
- Create a village level flea abundance map
- Establish high-risk areas which could be specifically targeted for preventative vector control

Study Sites & Field Methods

- 5 trap sites, 302 animal captures, 1700 ticks, 118 fleas

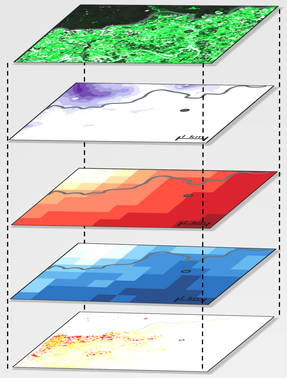




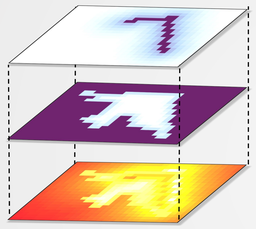
Tick

Flea

Analytical Methods

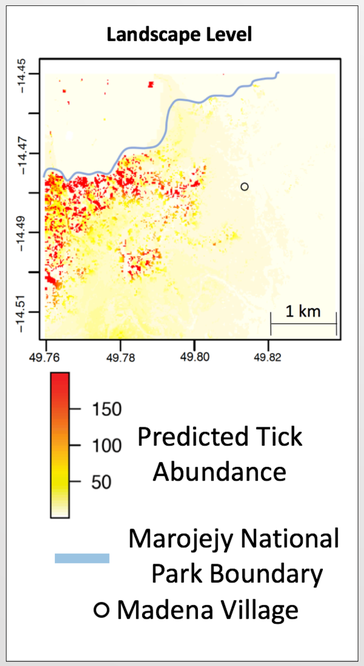


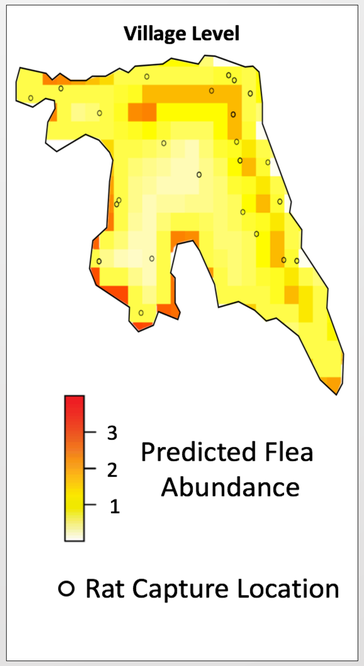
Forest Cover
*
Elevation
+
Temperature
+
Precipitation
=
Landscape Level
Tick Abundance



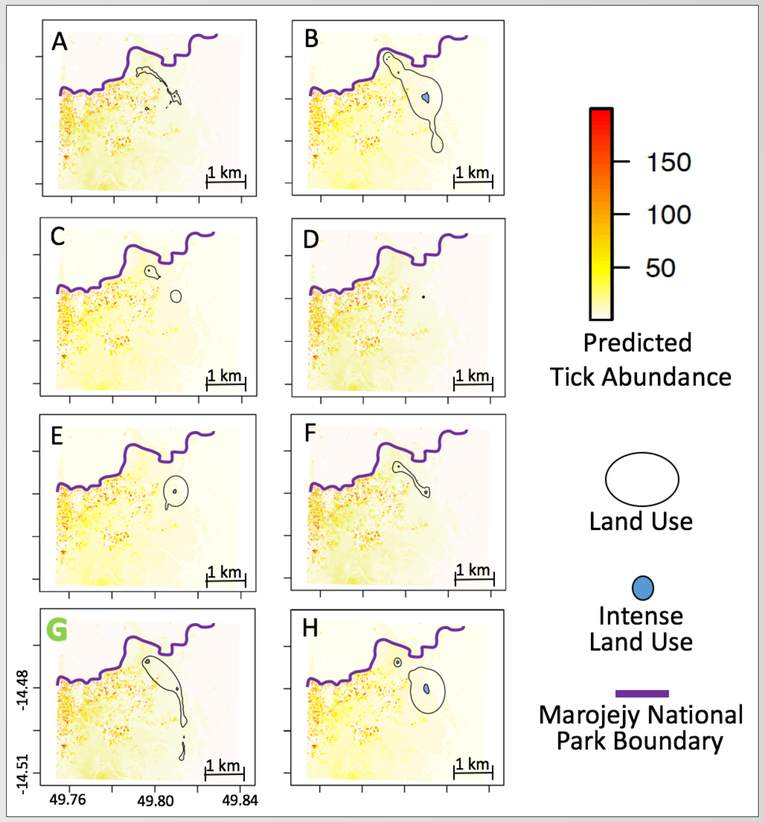
Distance to Main Road
*
Distance to Village Boundary
=
Village Level
Flea Abundance

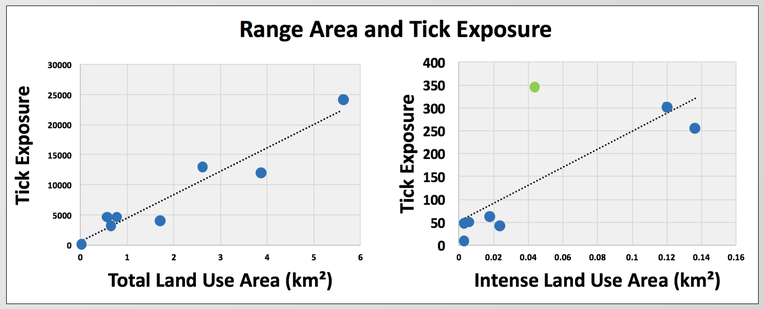
Models





Results





Conclusions & Applications

- A high-resolution ecological approach to predicting vector-borne disease risk hotspots is effective
- Conservation of forests may decrease vector exposure
- Preventative measures can be specifically targeted to high-risk areas, mitigating costs and risks

I am appreciative of the Bass Connections program for funding interdisciplinary undergraduate research and facilitating student/faculty relationships. I would like to thank Dr. Charles Nunn, Dr. James Herrera, Dr. Randall Kramer, and Dr. Chris Woods for serving on my thesis committee. I would also like to thank Dr. Caroline Amoroso, Ajile Owens, Lisa Regula, and Ravelomanantsoa Fifi for their assistance with this project. Special thanks to the Duke Lemur Center and MICET – specifically Charles Welch, Lanto Andrianandrasana, Dr. Benjamin Andriamihaja and Tiana Vololontiana – for their help organizing this project. Finally, none of this would have been possible without the contributions of the local people from Mandena, specifically our team members Edouard, Herlin, Tiomily, Seraphine, Desire, and Francine, who were gracious hosts, invaluable partners, and ultimately – our friends.