Kissing Bugs and Chagas Disease in Georgia and Beyond

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Chagas disease is the most significant vector borne disease in the Americas

6-7 million cases, 30-40k new cases annually, 300k cases in the US

~12,000 deaths annually

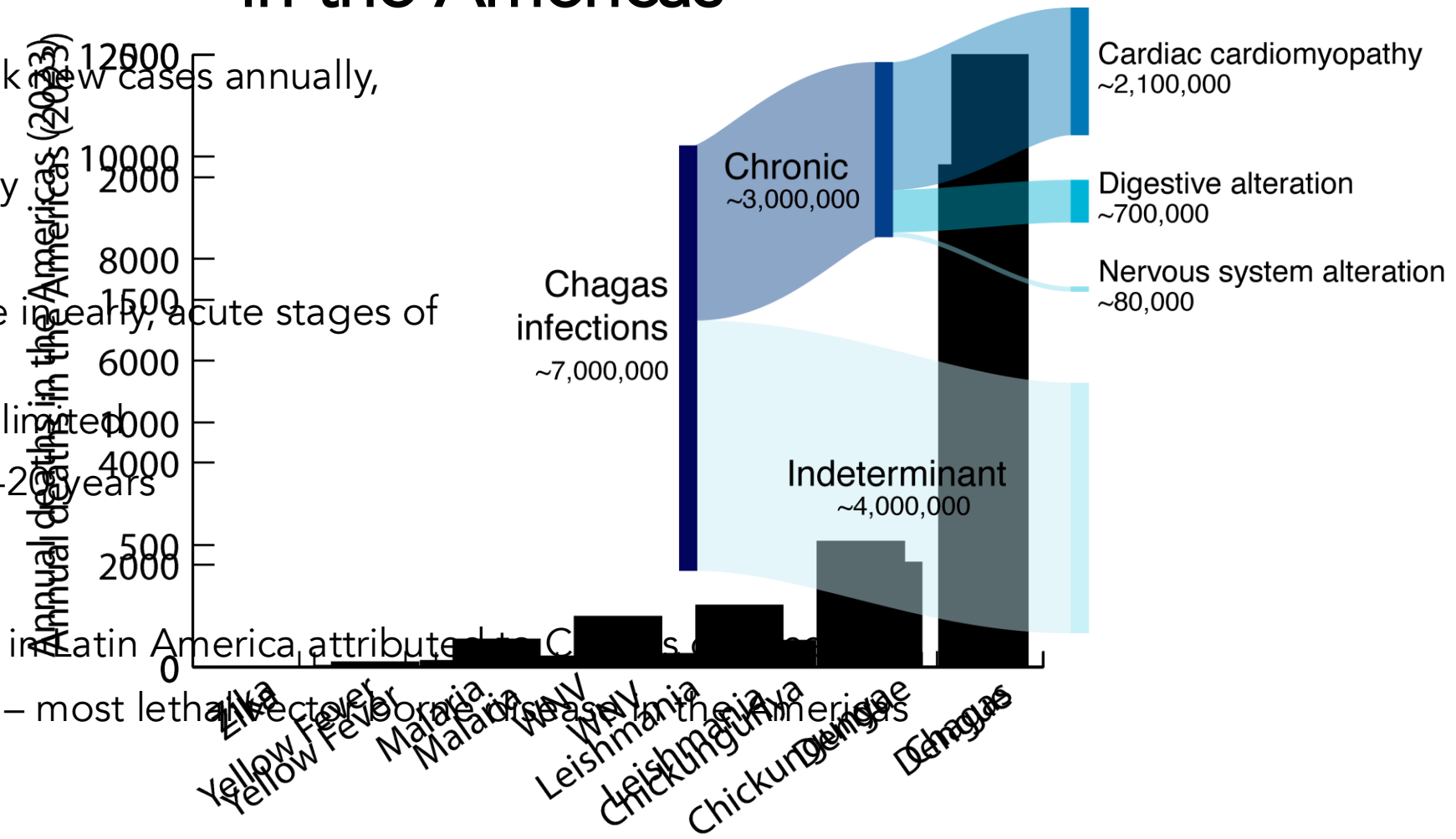
Treatment only effective in early, acute stages of disease

Access to treatments is limited

May be dormant for 15-20 years

36% of all heart failures in Latin America attributed to Chagas disease

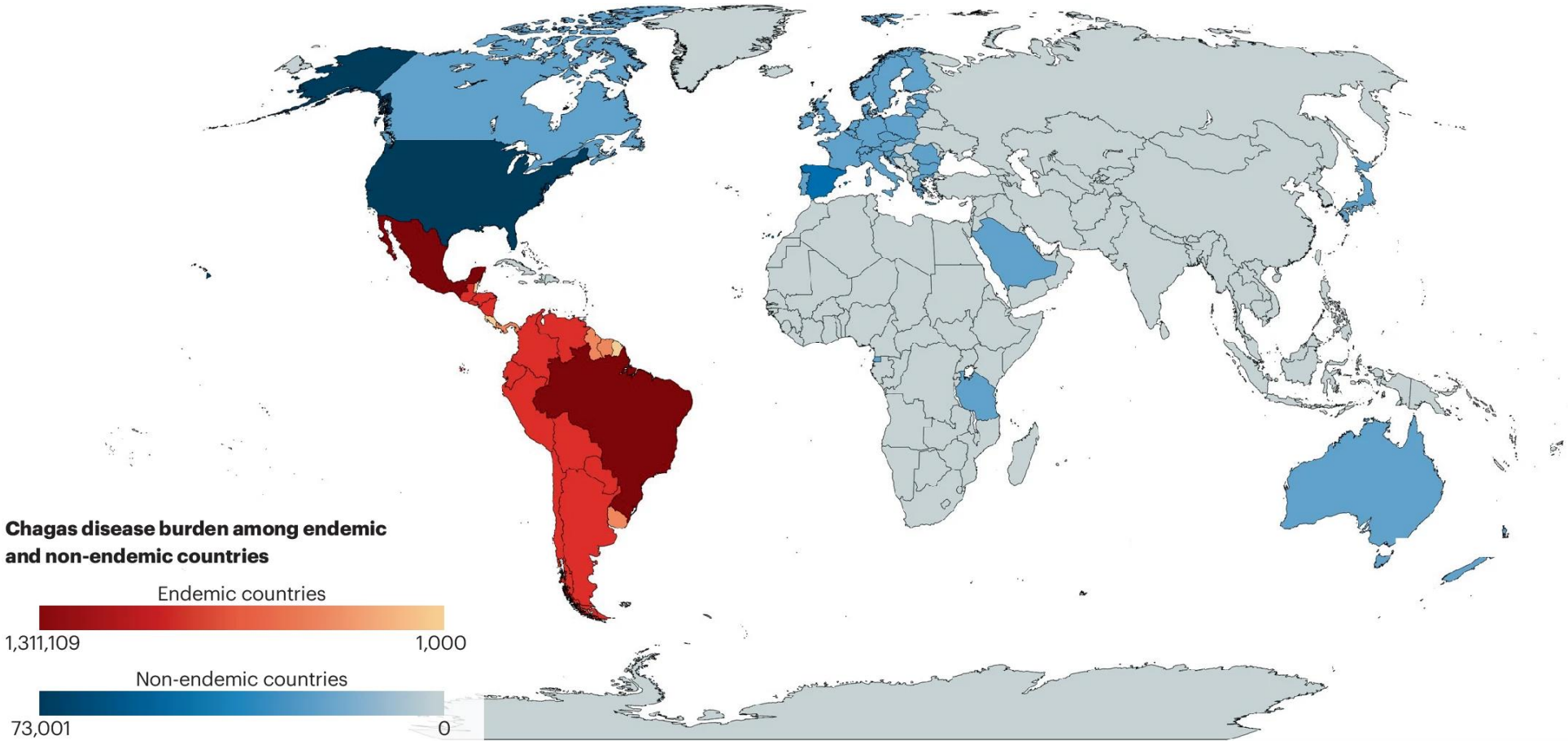
12,000 deaths annually – most lethal vector borne disease in the Americas



Widdup et al 2025, PAHO 2025, Bern et al 2011

Chagas disease epidemiology

Most cases in the US originate in Mexico, Central/South America

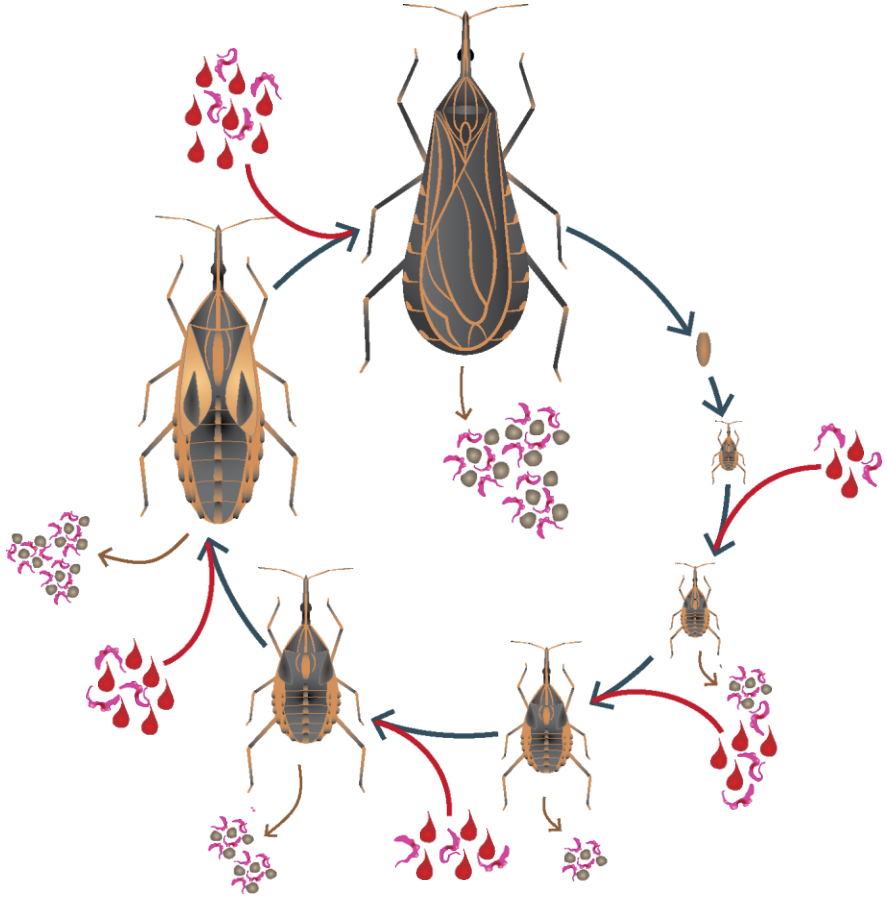


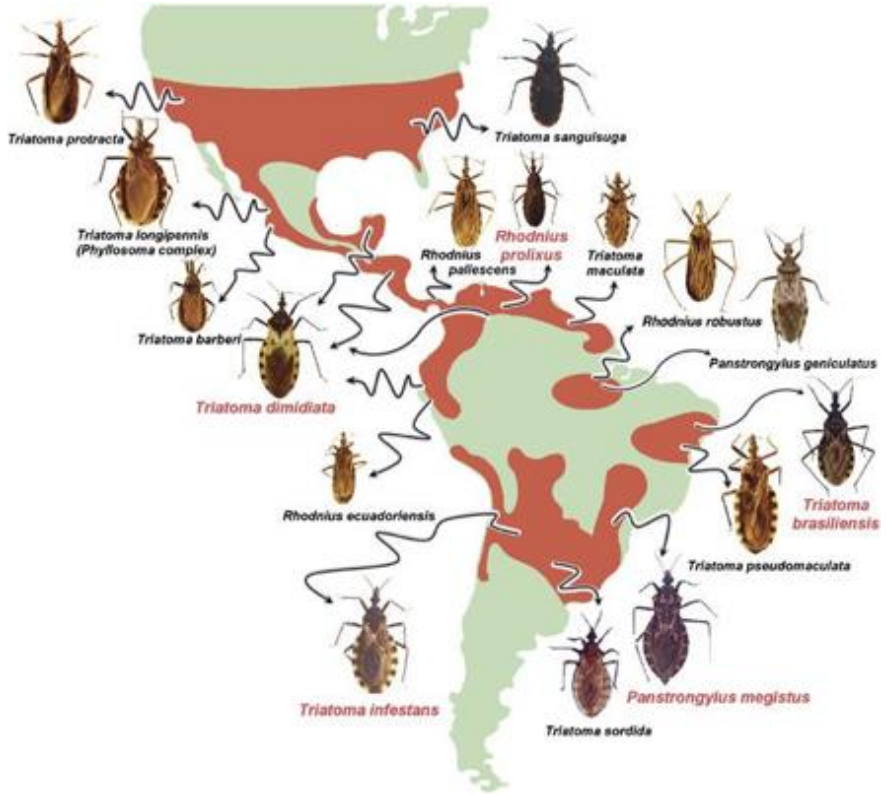
Widdup et al 2025, PAHO 2025, Bern et al 2011

Triatomine kissing bugs

~150 species worldwide, almost all in the Americas

Obligately and exclusively hematophagous





Transmit *T. cruzi* through feces deposited near bite

All species can harbor *T. cruzi*, only ~36 sp. are domestic/peridomestic

Gourbière et al 2011





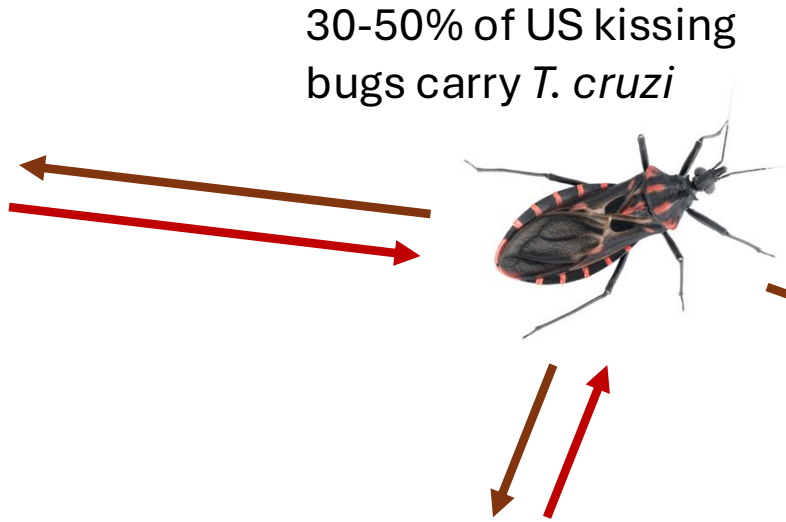

T. cruzi transmission routes

Blood meal

Fecal

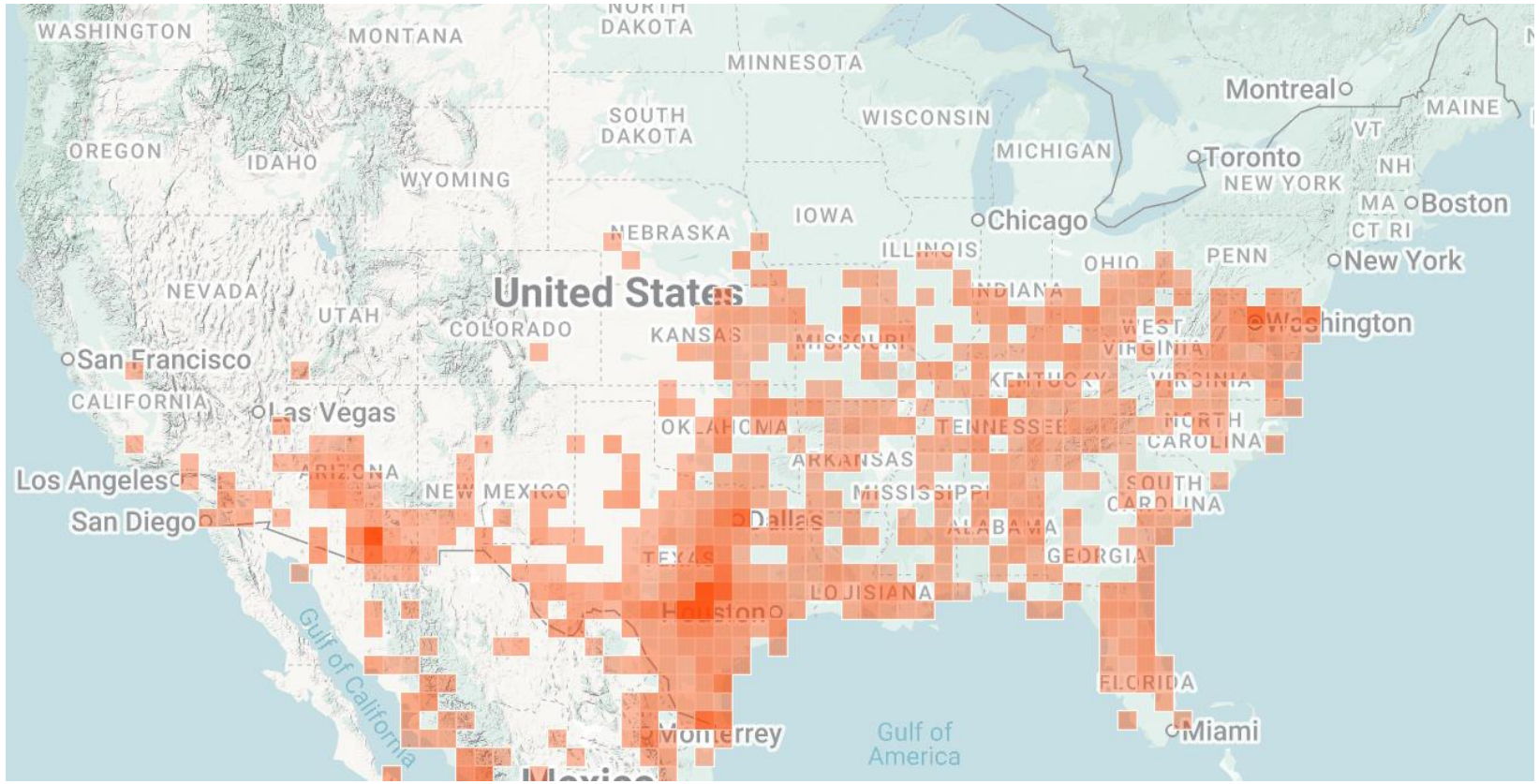
Vertical

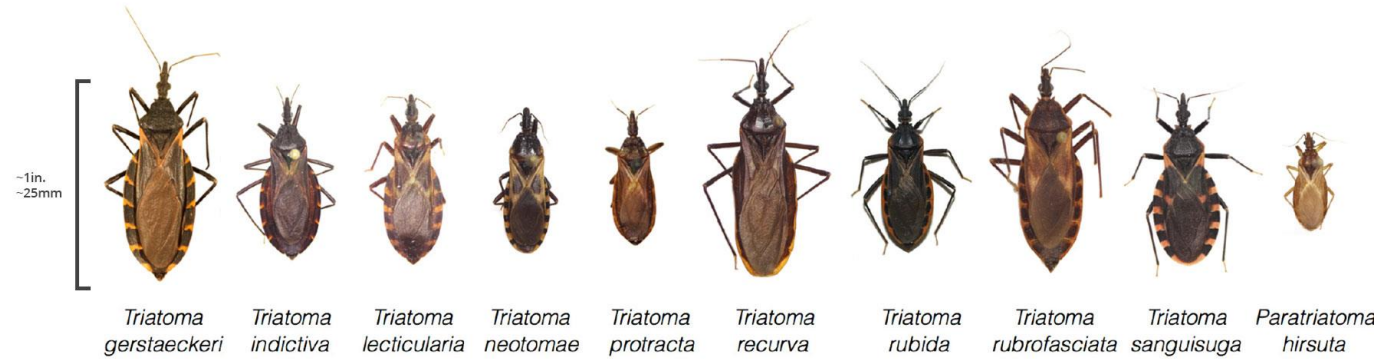
30-50% of US kissing bugs carry *T. cruzi*



50% of raccoons and possums carry *T. cruzi*

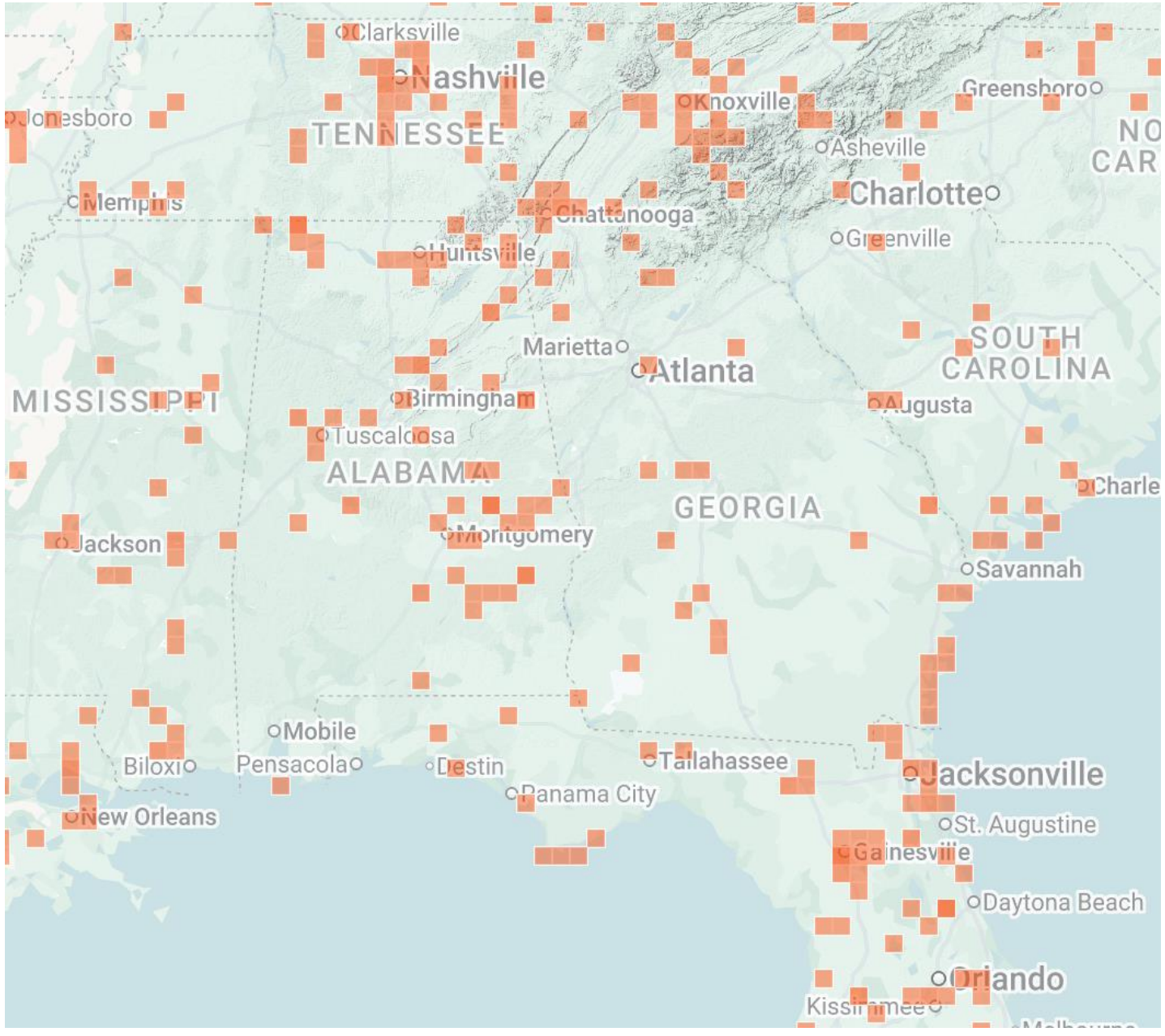
Kissing bugs in the US





Sarah Hamer, Texas A&M

Triatoma sanguisuga – Eastern bloodsucking conenose bug



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EMERGING INFECTIOUS DISEASES®

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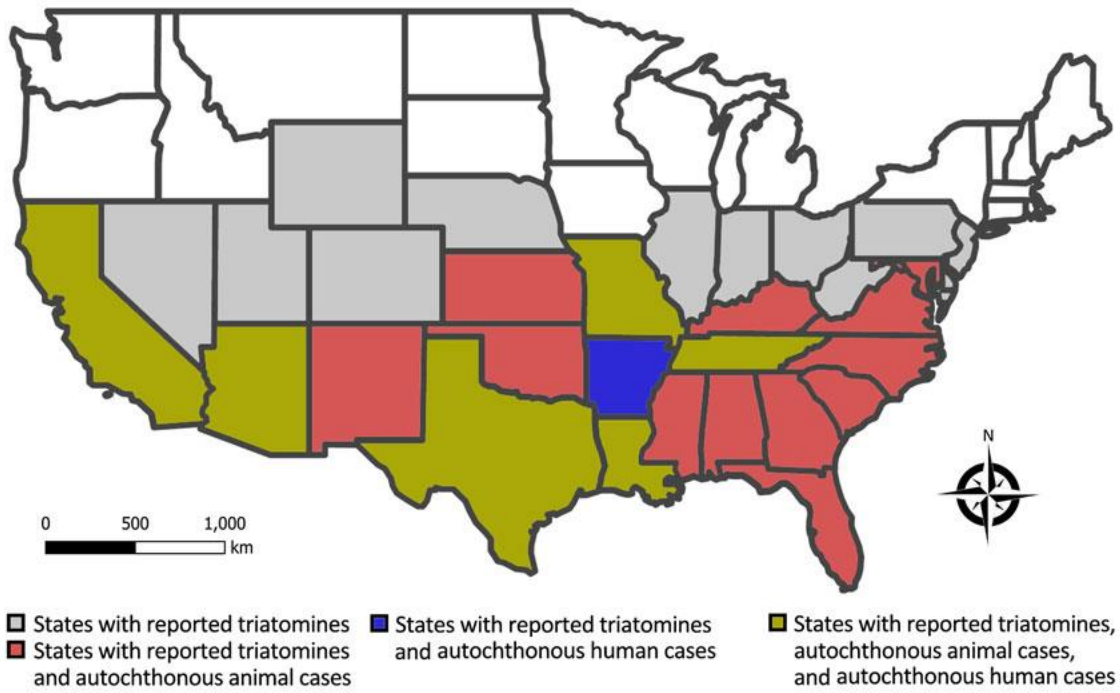
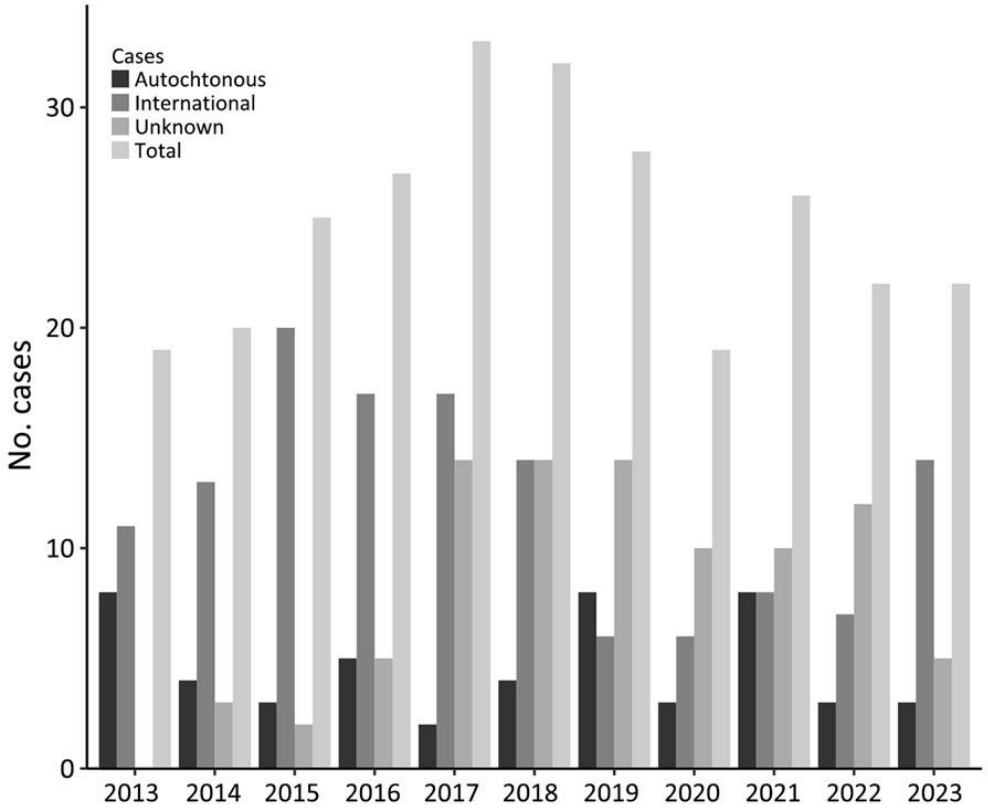
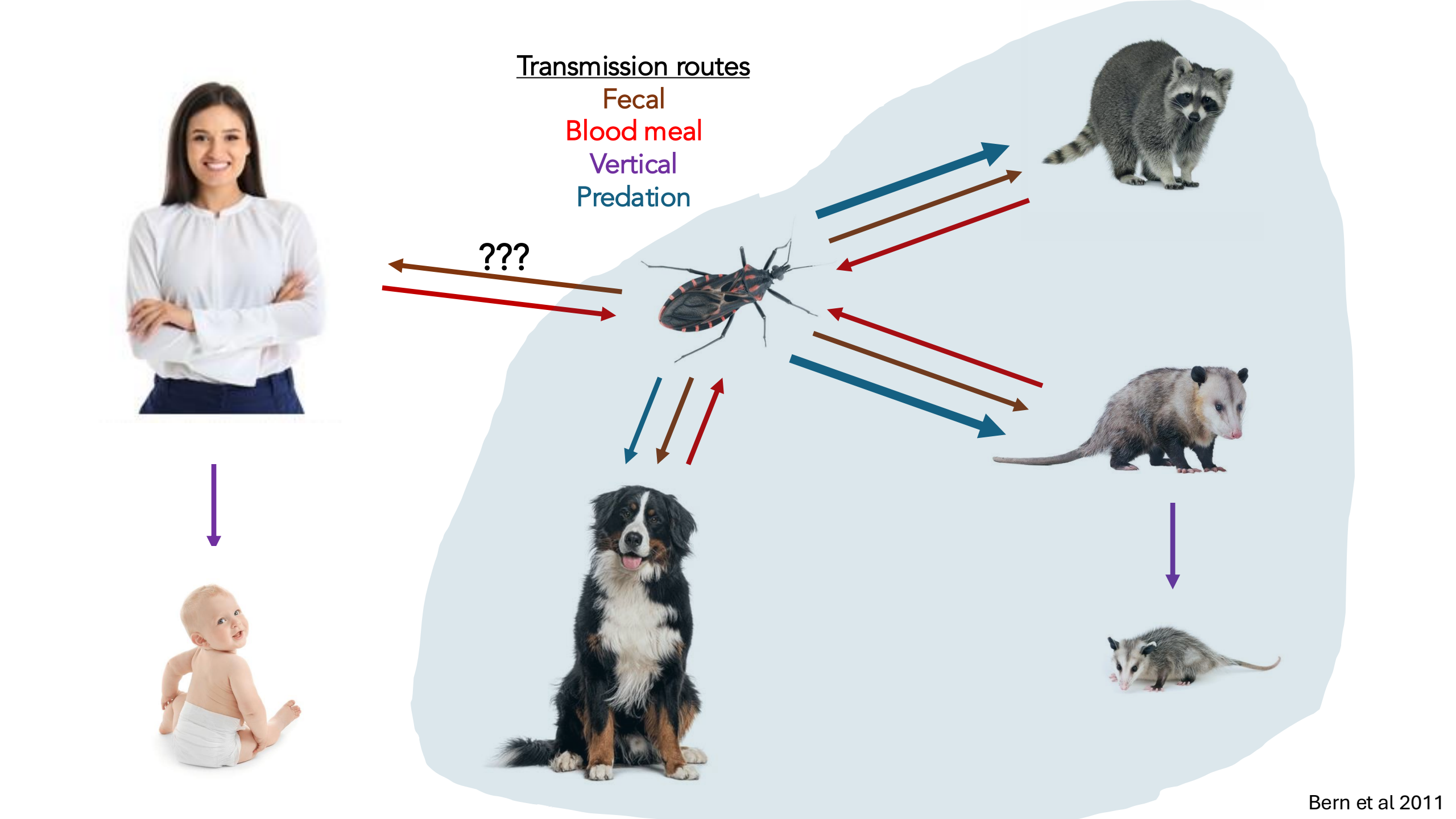
Perspective

Chagas Disease, an Endemic Disease in the United States

Norman L. Beatty, Gabriel L. Hamer, Bernardo Moreno-Peniche, Bonny Mayes, and Sarah A. Hamer[1]







Bern et al 2011

Kissing bugs and Chagas disease in the US

- Many sylvatic reservoirs with high infection rates (>50%)
- Some peridomestic species, evidence of feeding on humans
- 30-50% of bugs infected with *T. cruzi*
- Sylvatic transmission by vertebrate predation

- Most species are primarily sylvatic
- Transmission routes different
- **Autochthonous transmission to humans is rare in the US**

- Significant threat to working dogs, outdoor kennels
  - Infection rates from 10-50%
- Rarely screened for
- Diagnostic sensitivity to US *T. cruzi* strains unclear

Chagas disease research at UGA

Cell biology/Center for Tropical and Emerging Global Diseases
- Chagas vaccine development - Rick Tarlton
- Genomics of *Trypanosoma* – Jessie Kissinger
- Cellular biology of *T. cruzi* – Drew Etheridge

Odum School of Ecology
- Ecology of kissing bugs and land use - Nicole Gottdenker
- Population genetics of kissing bugs – Travis Glenn

Biochemistry and Molecular Biology
- Drug development – Maria (Belen) Cassera

Warnell School of Forestry
- Sylvatic *T. cruzi* transmission - Michael Yabsley

Entomology Department
- Kissing bug salivary gland biology – Don Champagne
- *T. cruzi*-Kissing bug-microbiome interactions – Kevin Vogel

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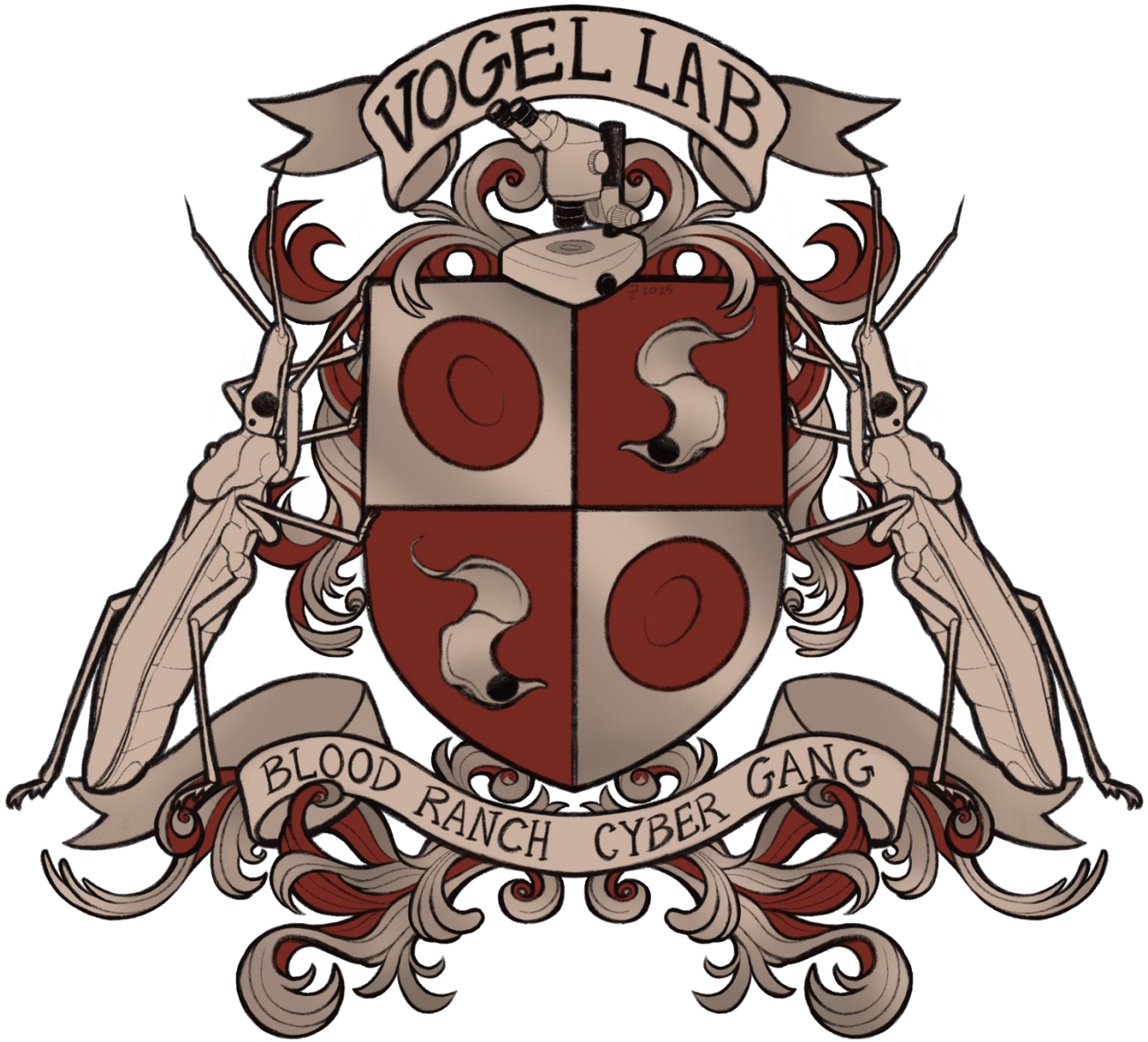
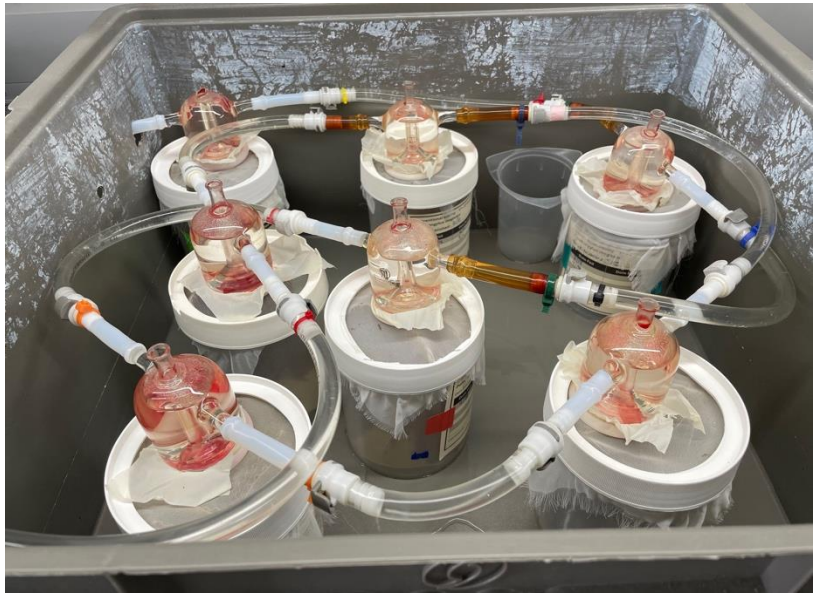
Vogel Lab kissing bug research



Vogel Lab kissing bug research



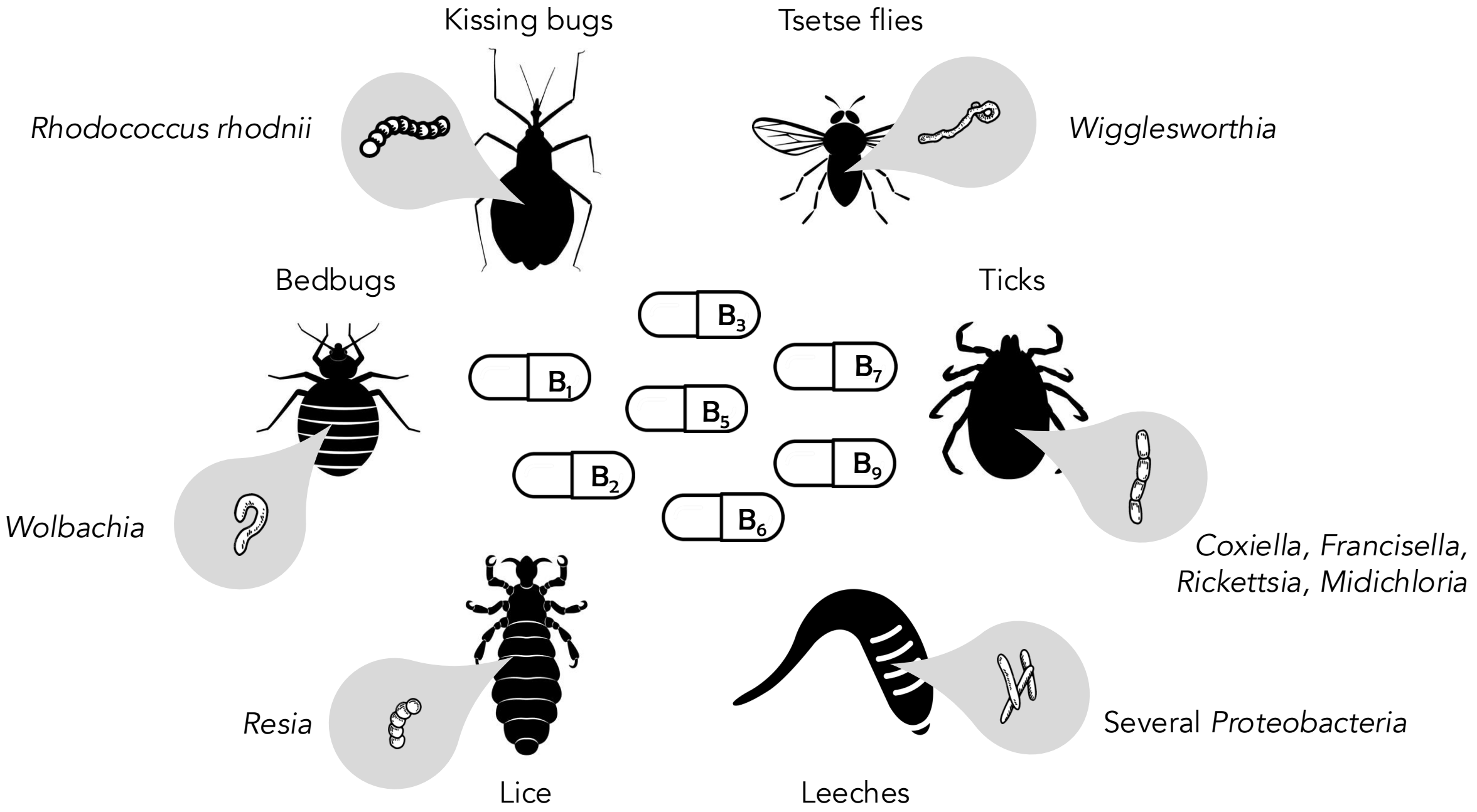
Rhodnius prolixus (Columbia)

Triatoma dimidiata (Belize)

Panstrongylus megistus (Brazil)

Triatoma infestans (?)

Obligately + exclusively hematophagous invertebrates require bacterial symbionts



Strengths of the *R. rhodnii* – *Rhodnius* system

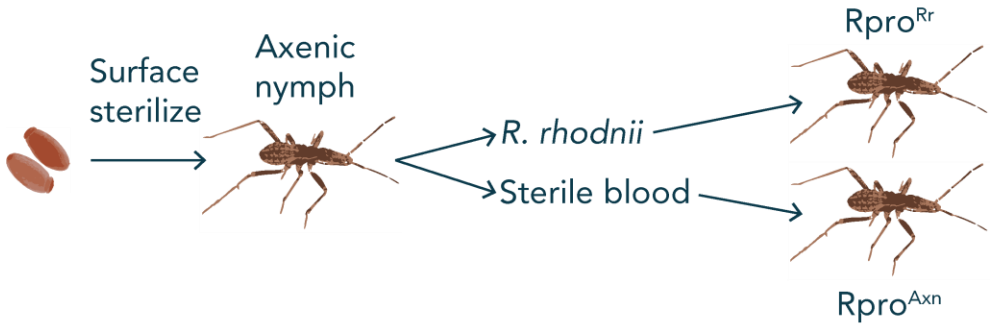
Environmentally acquired - can easily remove bacteria from eggs without antibiotics; gnotobiotic + axenic

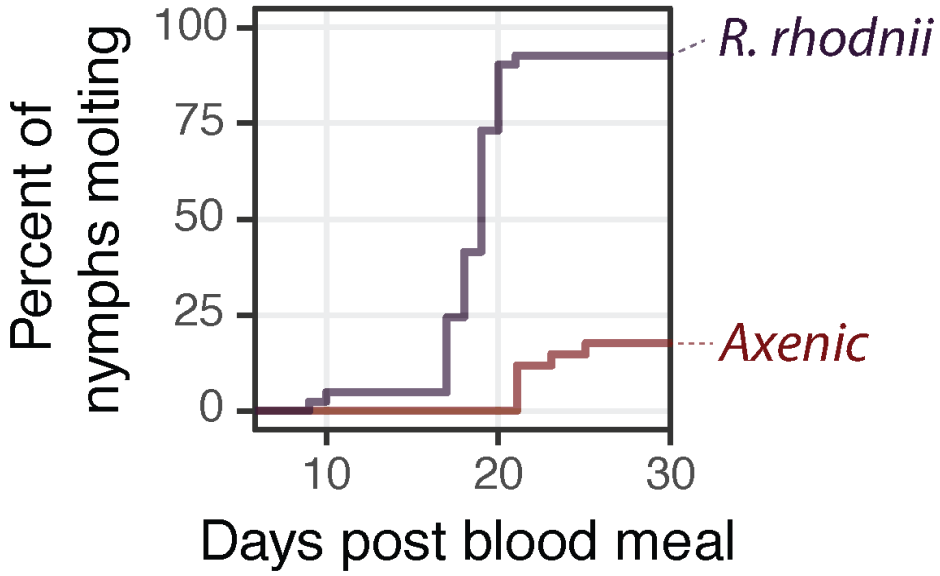
Culturable – can grow in LB, re-introduce to the bug

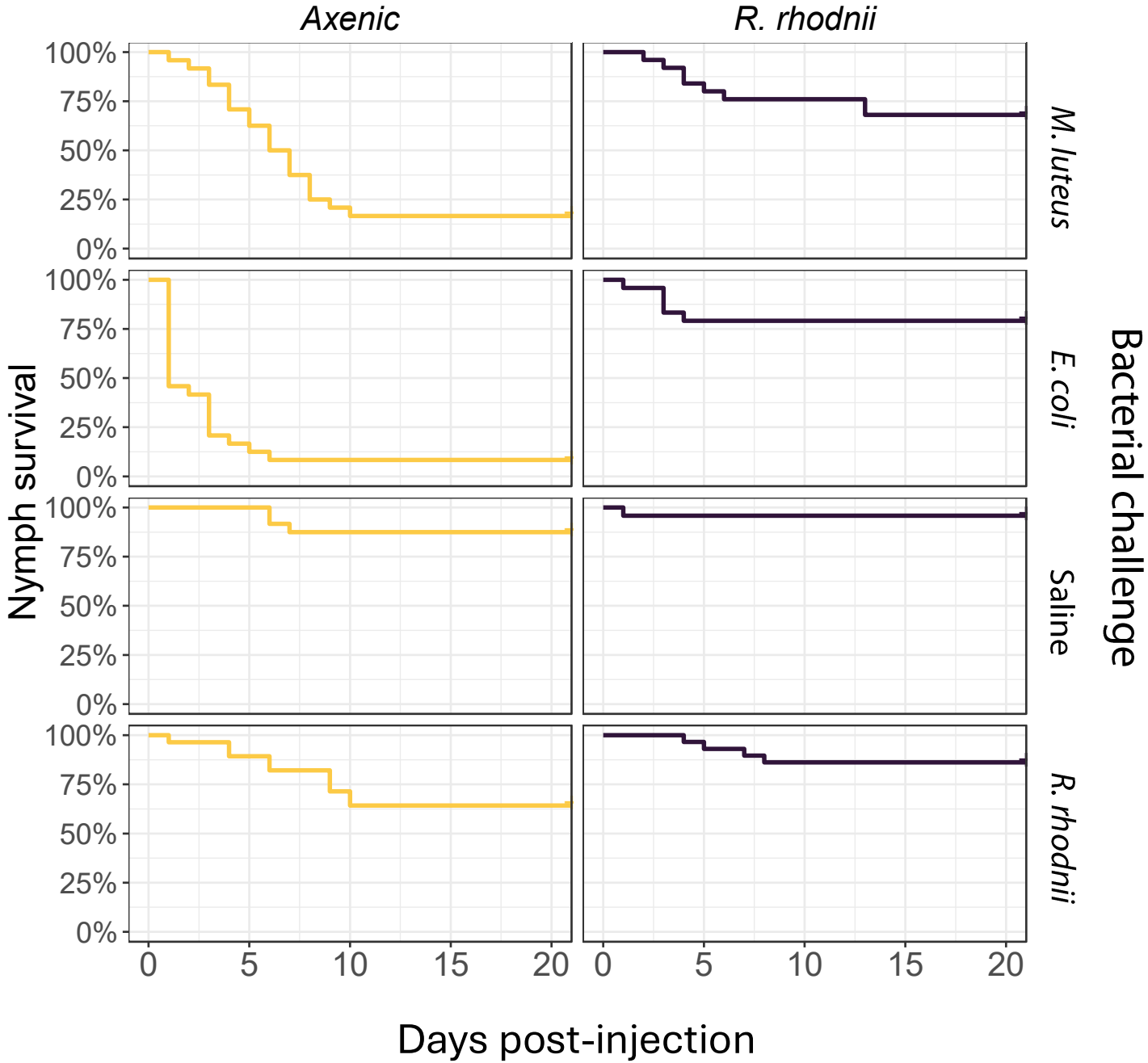
Transformable – genetically tractable/manipulatable

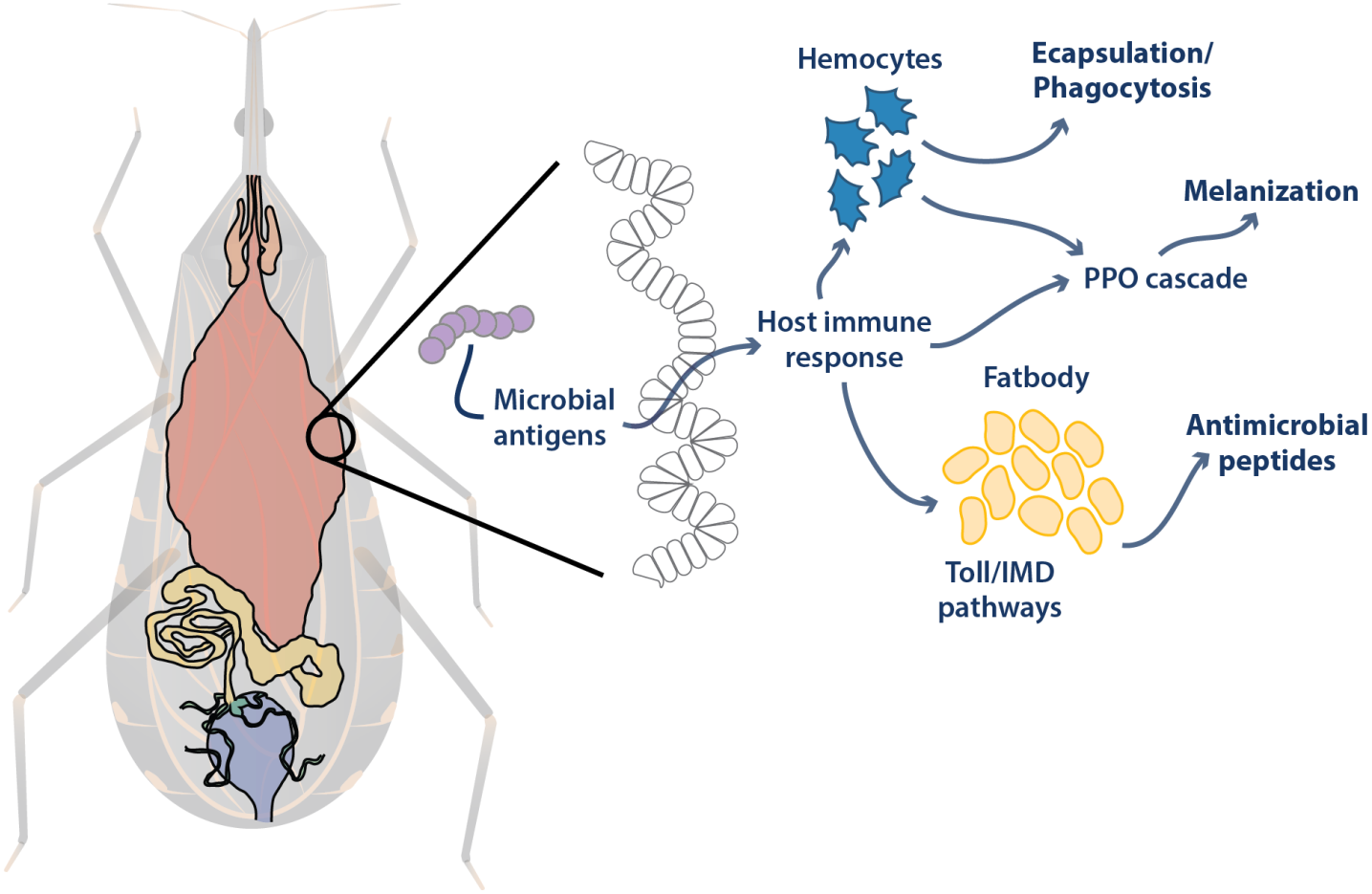
Bugs highly amenable to RNAi – simple manipulation of host gene expression

R. rhodnii function in *R. prolixus*

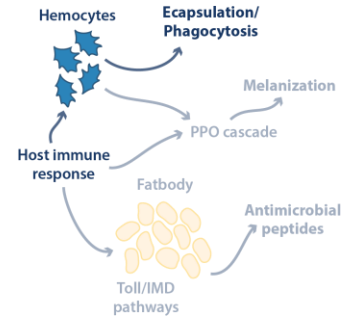






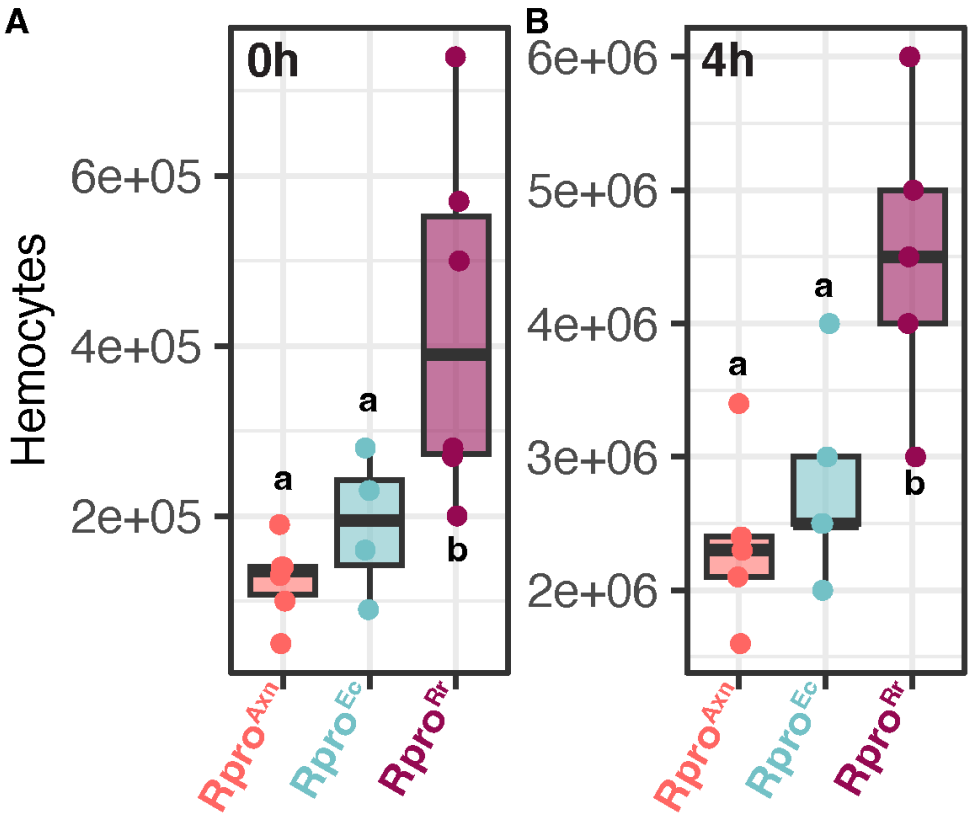

Hemocytes
Ecapsulation/
Phagocytosis
Melanization
PPO cascade
Host immune
response
Microbial
antigens
Fatbody
Antimicrobial
peptides
Toll/IMD
pathways

Does the cellular immune response vary between states?



Circulating hemocytes are higher in *R. rhodnii*-inoculated insects

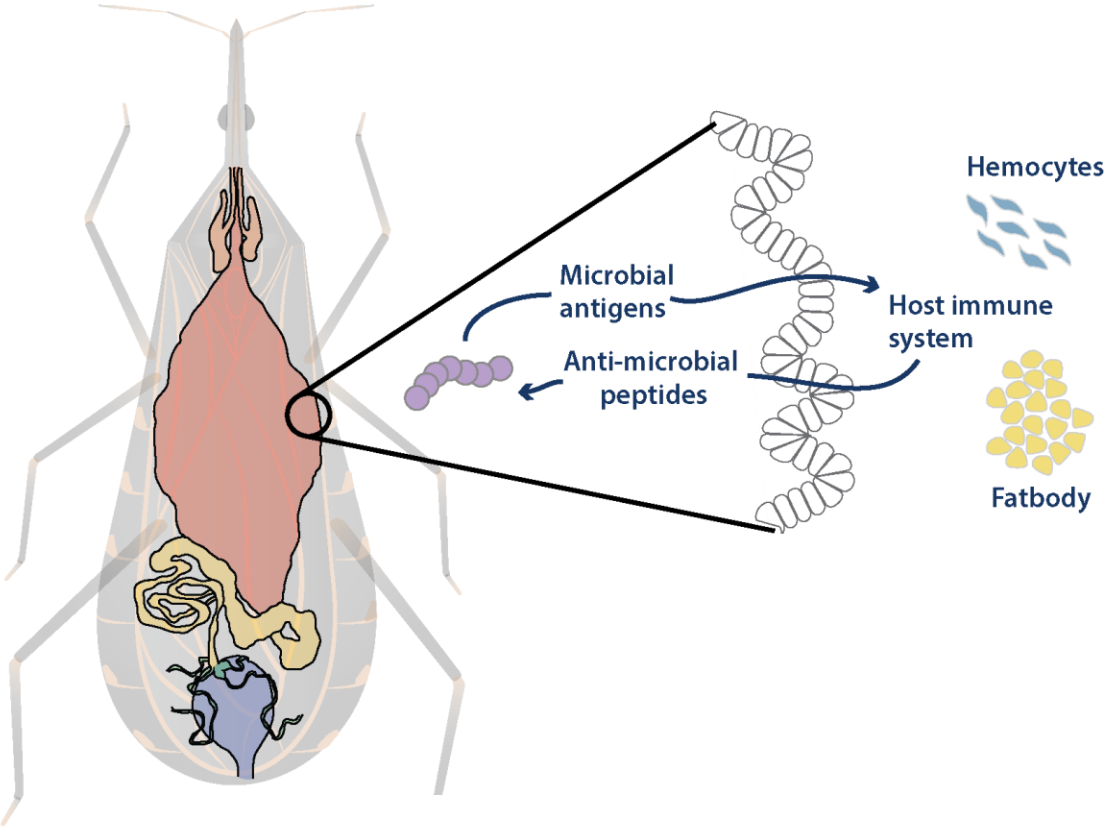
Depletion of hemocytes in *E. coli* challenged *R. rhodnii*-inoculated insects decreases survival



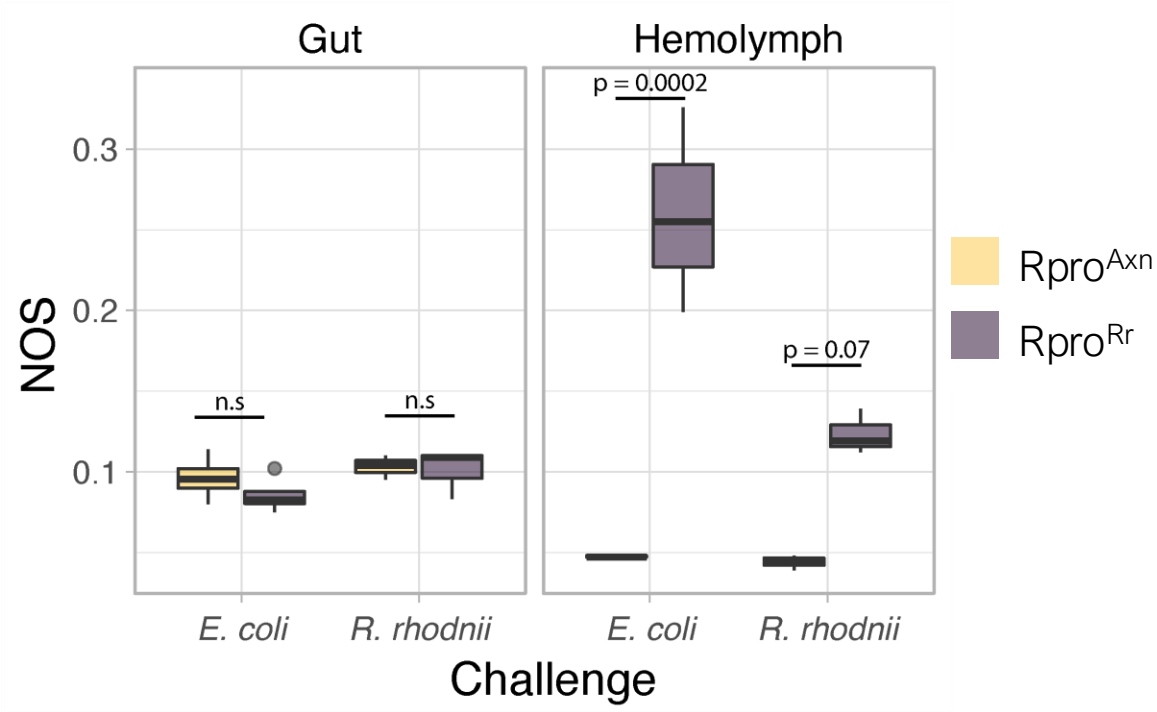
Gilliland et al, *in revision*

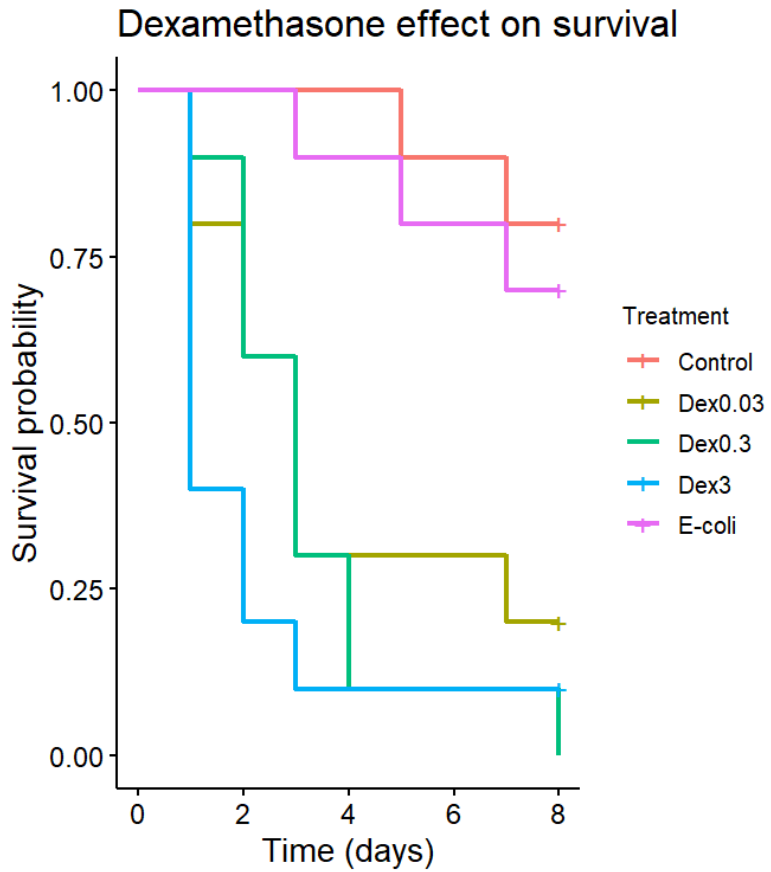
How do gut bacteria stimulate an insect-wide immune response?

R. rhodnii never found outside the gut



What signaling mechanisms underly resistance to pathogens?





Other major projects in the lab…

Role of *R. rhodnii* in *R. prolixus* lipid metabolism

Axenic insects have reduced lipid stores, cuticular hydrocarbons

Comparative genomics of Triatominae

New or improved assemblies and annotations of several KBs (Eva Novakova, U S. Bohemia)
Population genomics of *Triatoma sangiusuga* species complex (Jenni Petersen, U Delaware)
Nuclear integration of *Wolbachia* into *R. prolixus* genome

Interaction of bugs, microbiomes, and parasites

How does *R. rhodnii* influence *T. cruzi* growth and development in the bug?
How does bug species, *T. cruzi* strain influence this?

What *R. rhodnii* genes are important for colonization and symbiosis?

Dual RNAseq and TnSeq approach

Isolation of wild *T. cruzi* strains from N. America (Ruby Harrison, UGA)

Genome sequencing

Vogel Lab

Graduate students

Carissa Gilliland*
Nia Meyers
Ashley McCormick
Liam Ash
Q. Collins
Sara Martin

Postdocs

Sandra Mendiola*
Loretta Mugo*
Yin Wang
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Dr. Gilliland's defense party

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Drew Ethridge (UGA)
Ruby Harrison (UGA)
Jennifer Peterson (University of Delaware)
Scott Geib (USDA Hilo)

Photos

Jena Johnson

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