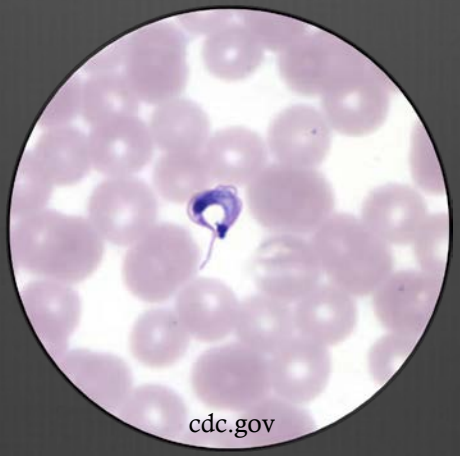
Chagas Disease Ecology in Texas: A Look at Geographic Distribution of Vector Species and Parasite Strains



Rachel Curtis, Edward Wozniak,
Karen Snowden, Gabriel Hamer, Sarah Hamer

Texas A&M University and Texas Department of State Health Services

Outline

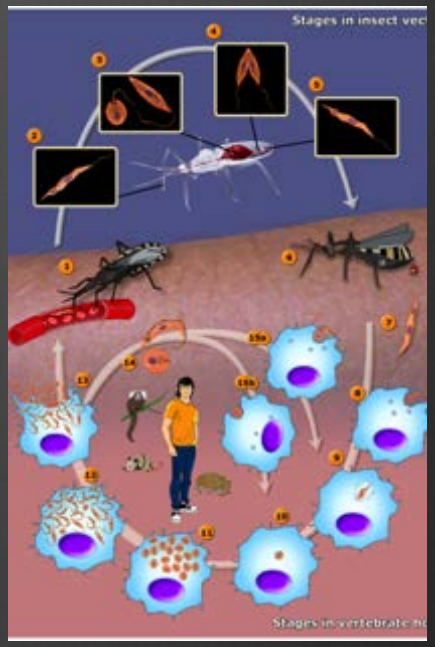
Overview of Chagas disease

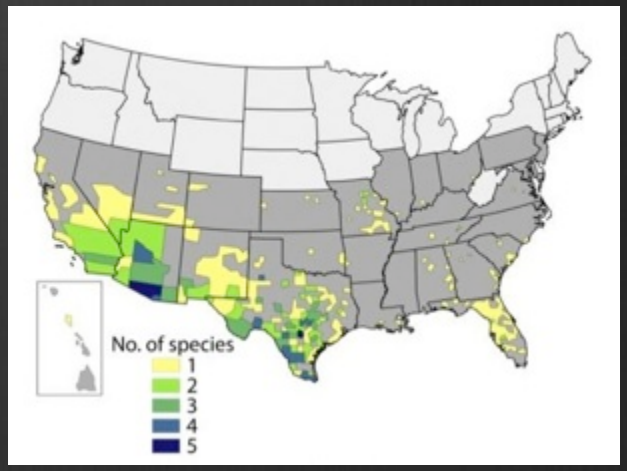
Kissing bugs in the US

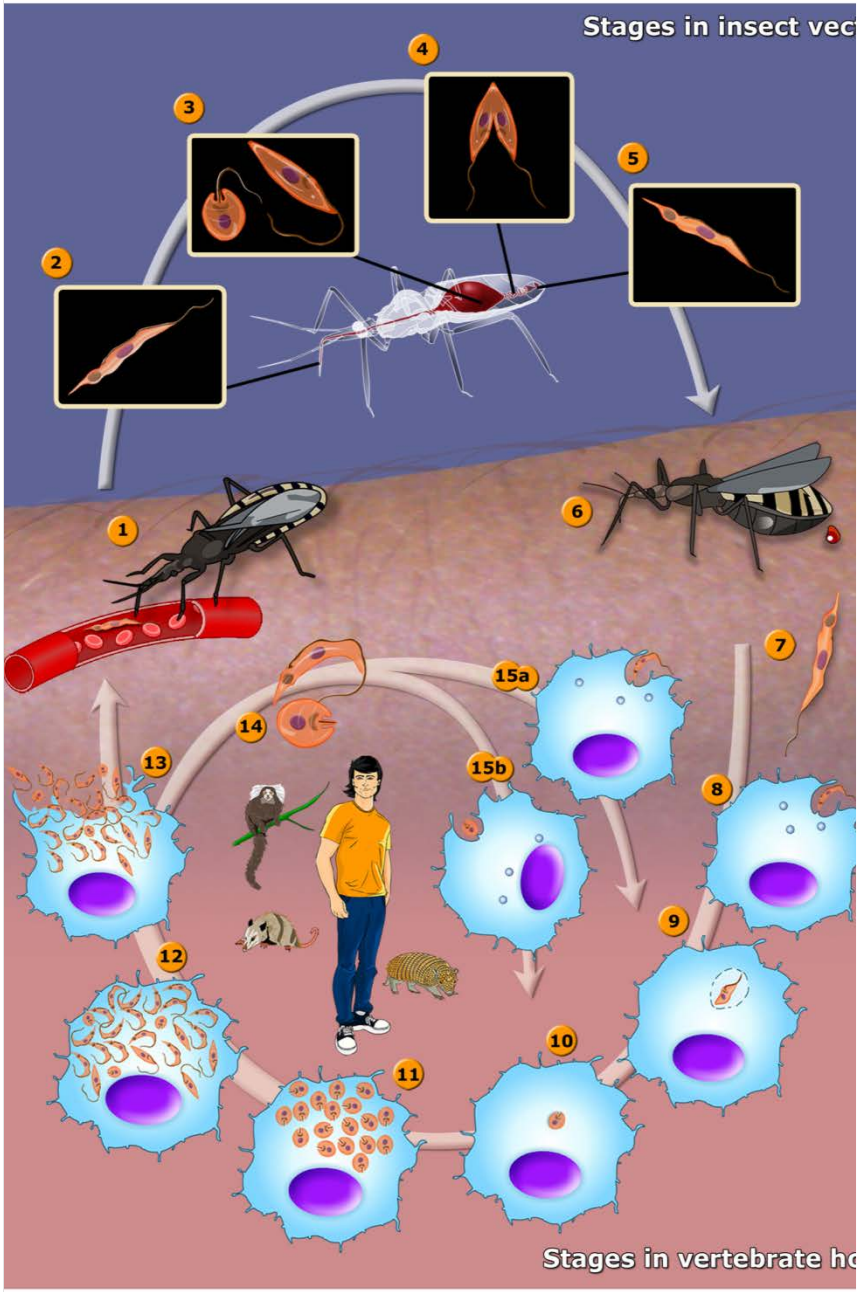
Our research and what we've learned

- Canine infection
- Reservoir host field work
- Citizen science
- Kissing bug studies
- Vector mapping
- Parasite strain-typing

Future research directions







Life cycle

Triatomine bugs (Reduviidae)

- Nocturnal
- Bloodfeeding
- Attracted to light, CO_2, heat, pheromones

Trypanosoma cruzi

- Amastigotes in cardiac tissue

Mammalian hosts

- Opossums, skunks, raccoons, rodents
- Dogs, humans

Teixeira *et al*. 2012. PLoS Negl Trop Dis 6(8): e1749.

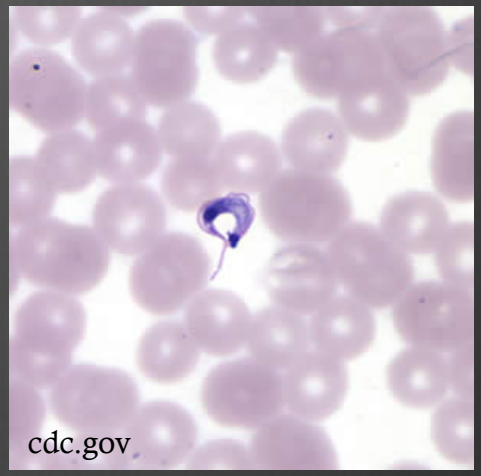
Chagas disease

Parasite transmission

- Vector-borne
- Oral route
- Congenital
- Blood transfusion
- Organ transplant

Clinical manifestations

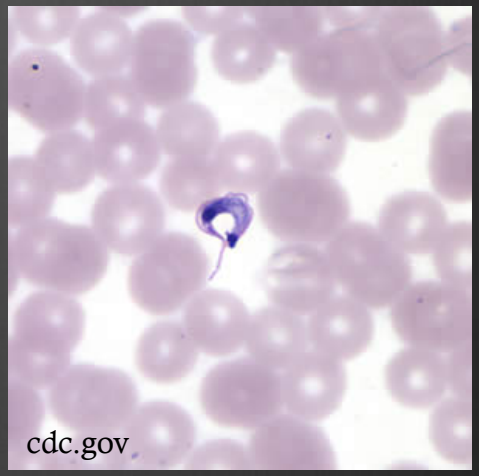
- Acute phase: non-specific
- Latent phase: asymptomatic
- Chronic phase: cardiac, digestive
- Strain-type variations

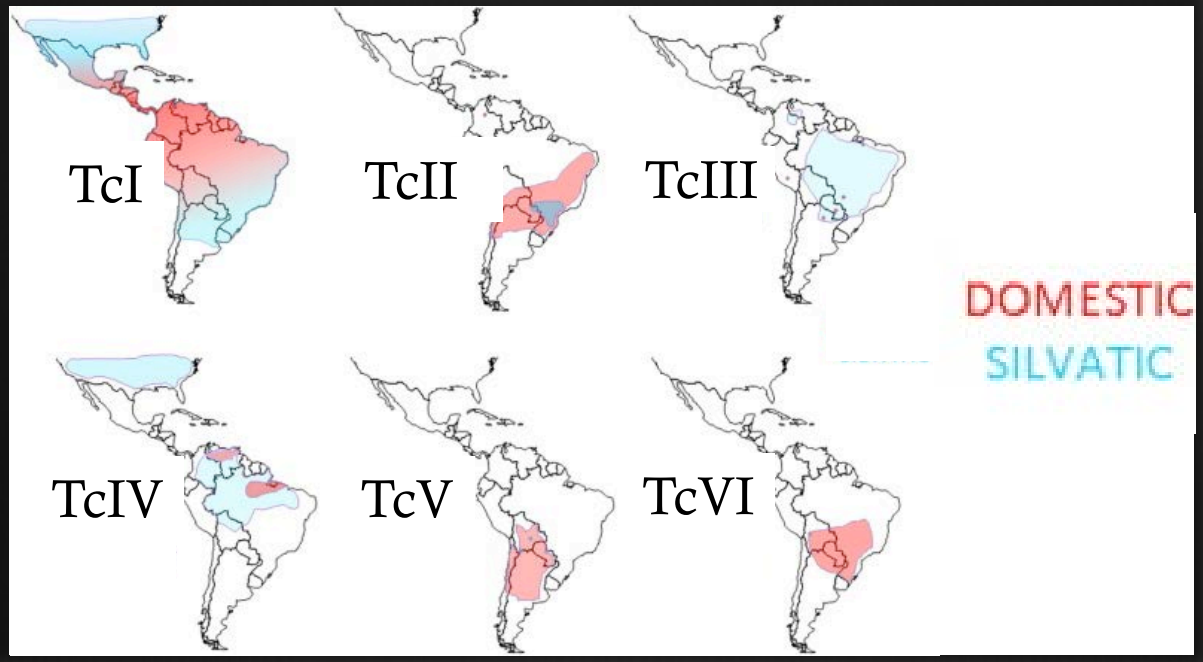

cdc.gov


cdc.gov

Strain-typing of *T. cruzi*

- Six accepted discrete typing units (TcI-VI)
- Epidemiologically meaningful
  - Strain-dependent clinical manifestations
- Ecologically important
  - Vertebrate, vector, geographic associations





Zingales *et al*. 2012. Infection, Genetics and Evolution 12: 240-253.

Who, how, what and where? Nature 465, S8-S9, 2010.

No. of species
1
2
3
4
5

Bern et al. 2011. Clinical Microbiology Reviews 24:4, 655-681.

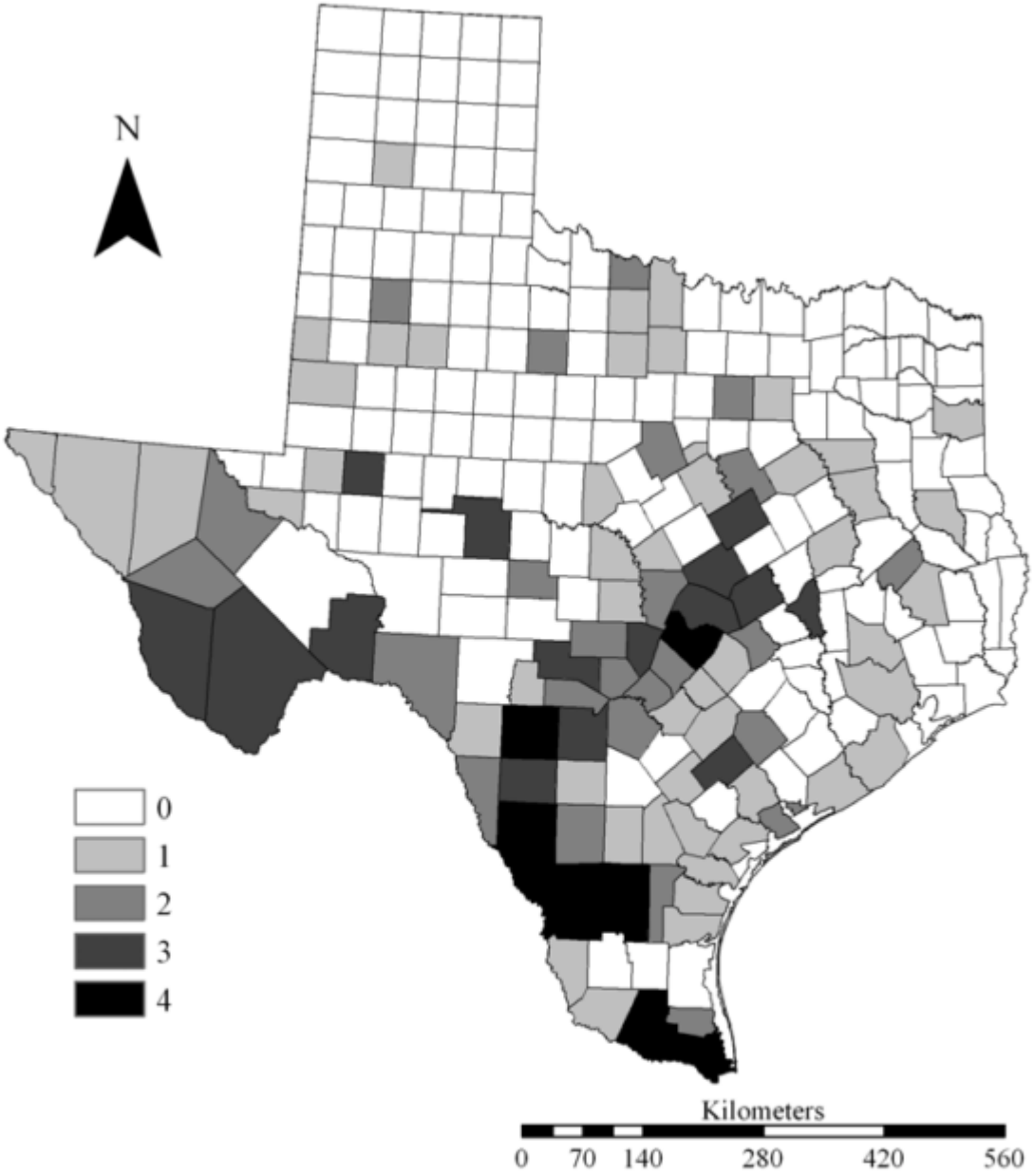
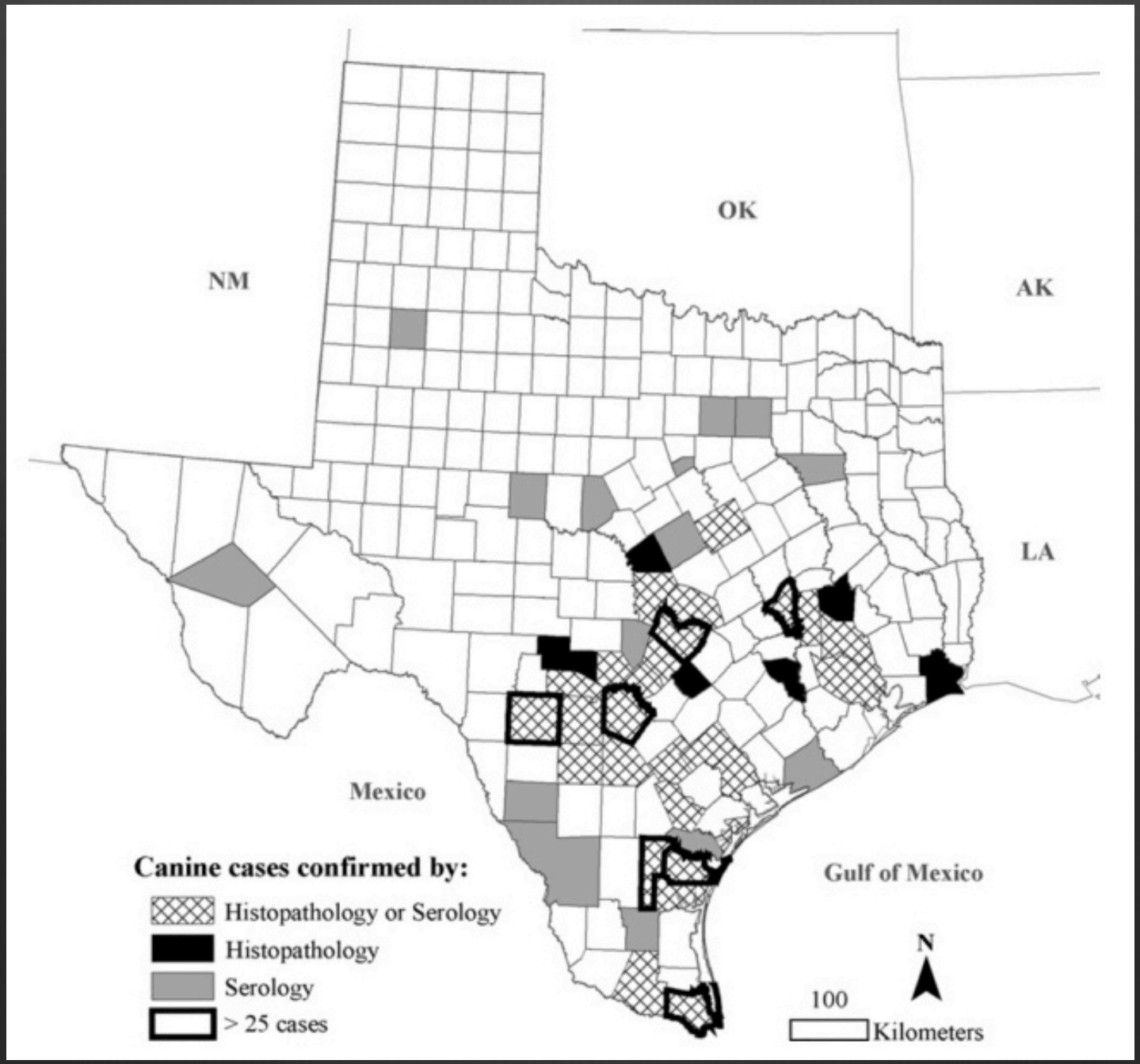


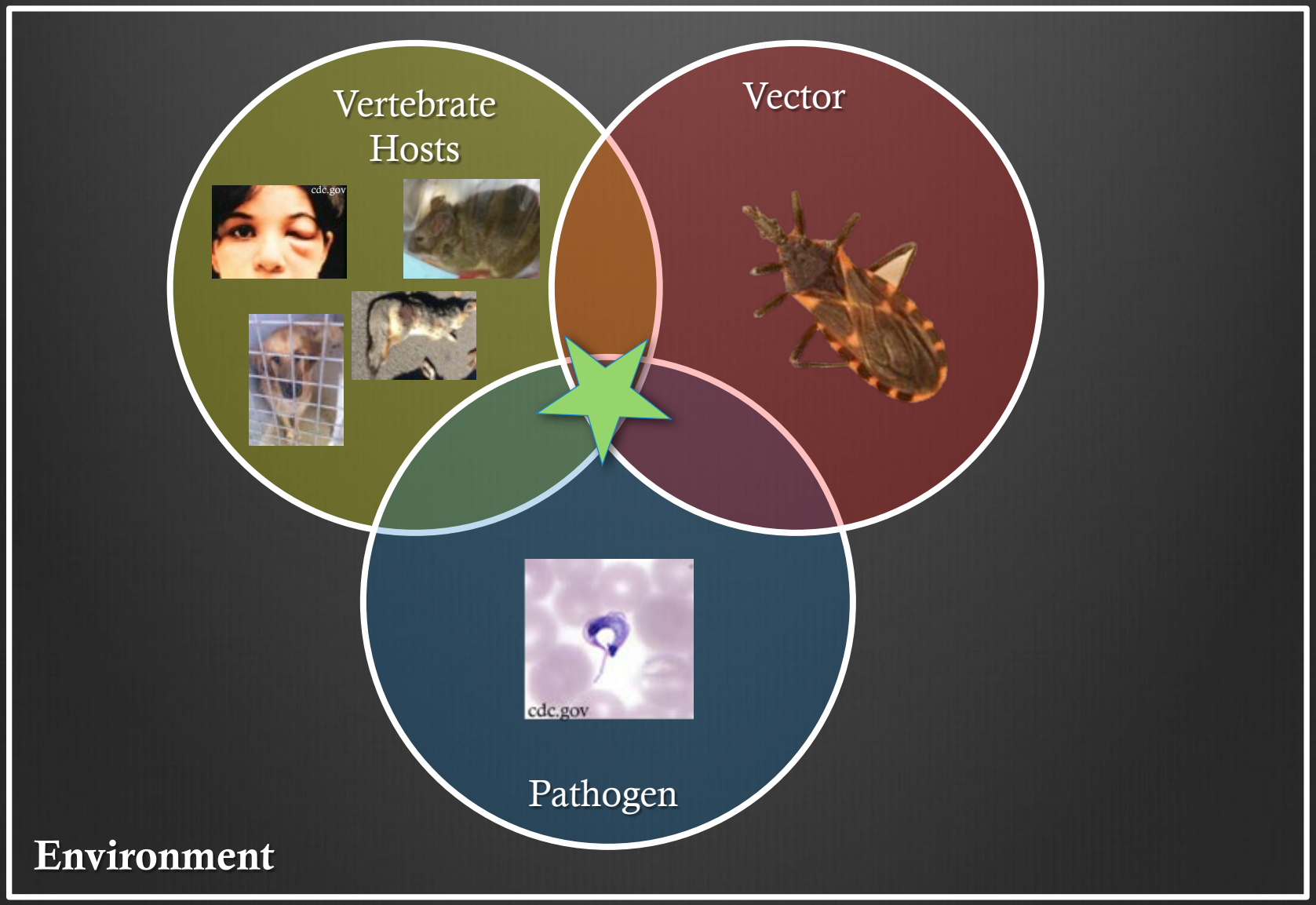
Figure 9. Triatomine bug species diversity in Texas by county, 1928-2006.

Kjos, 2007



Kjos et al. 2008. Veterinary Parasitology 152: 249-256.

A Comprehensive Ecological Research Approach

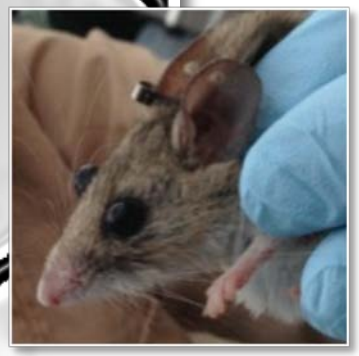


Hamer Lab Chagas Disease Group at Texas A&M University

Determine variations in prevalence of *T. cruzi* infection in kissing bugs across Texas.

Examine vector distribution in relation to environmental variables.

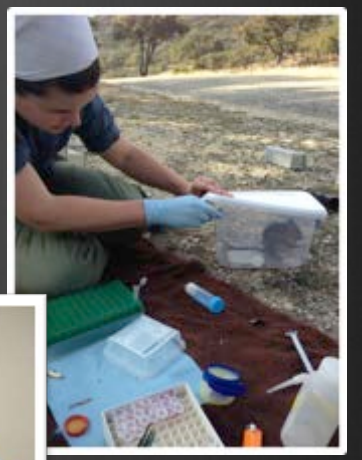
Determine variations in prevalence of *T. cruzi* infection in domestic dogs across Texas.



Determine variations in prevalence of *T. cruzi* infection in small mammals across Texas.

Key components

- Field component
  - Canine shelter sampling
  - Privately-owned canine sampling
  - Rodent trapping
  - Hunter-harvested predators
  - Feral hog sampling
  - Kissing bug sampling
- Laboratory component
  - Infection prevalence
  - *T.* cruzi strain-typing
  - Blood meal analysis
  - Triatomine molecular ID
- Mapping component
  - Vector presence
  - Landscape ecology



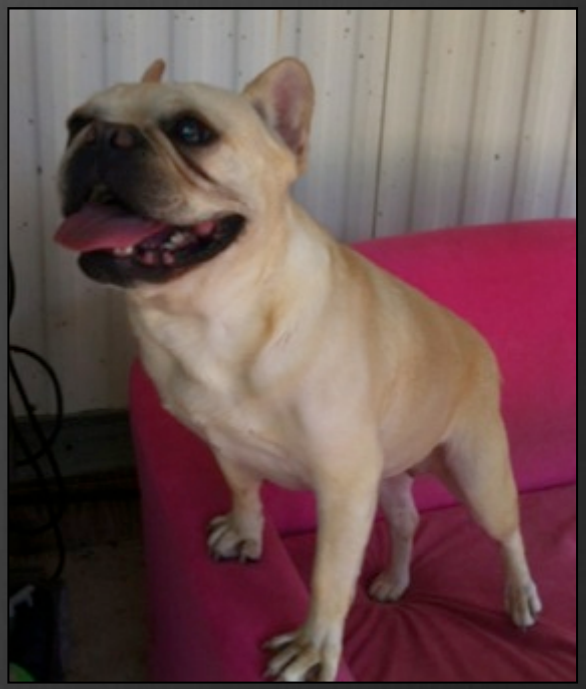
Canine Testing and Treatment

- Parasite detection
  - Visual inspection of tissue (post-mortem)
  - Detection of parasite DNA

- Antibody detection
  - Indicates previous exposure to parasite
  - TVMDL

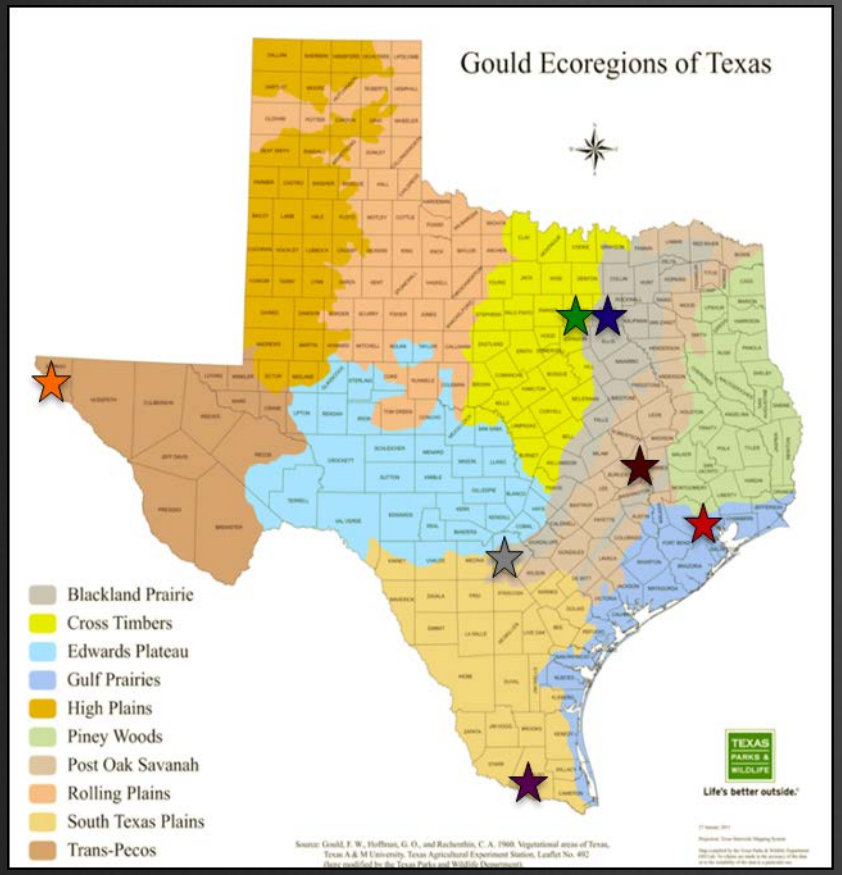
•Treatment options are limited

•Symptom management



Angel, TAMU-CVM pacemaker patient

Shelter dogs



- 7 shelters across Texas
- "high risk" populations
- Sentinels for disease risk?
- 9% prevalence (antibody positive)

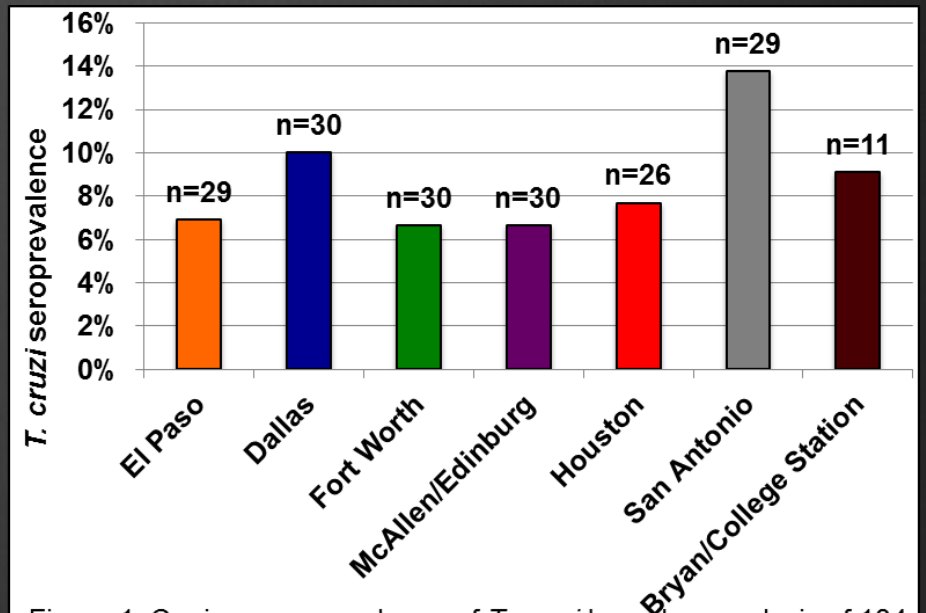


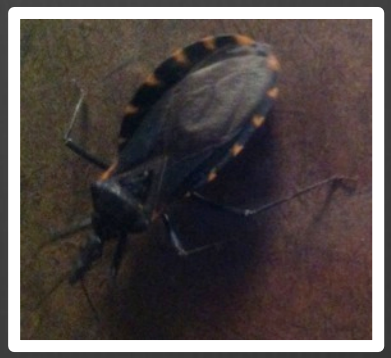
Figure 1. Canine seroprevalence of *T. cruzi* based on analysis of 184 blood samples from dogs.

Public health implications of seropositive dogs?

- Seropositive dogs in chronic phase of disease
- Usually **not** parasites circulating in blood
- If dog has parasites in blood, potential for increased human risk:
  - direct blood to blood contact
  - dogs are reservoirs for feeding bugs
- Positive dogs are typically indicative of a landscape conducive to transmission

Wildlife Projects

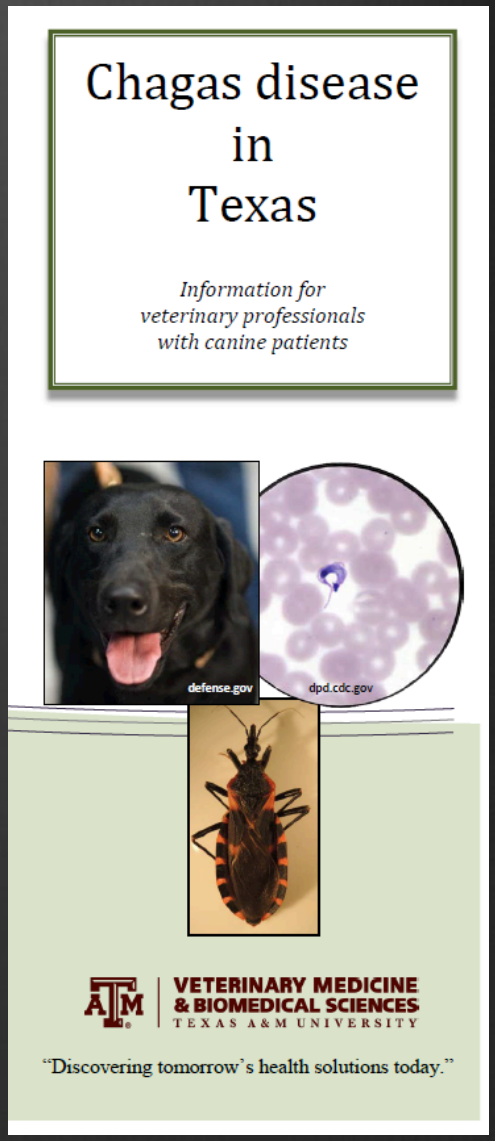
- Predator hearts
  - 12 counties in west Texas
    - ~110 samples of coyote, fox, bobcat
  - 15 counties in central Texas
    - ~200 samples of coyote, fox, bobcat, raccoon
    - 50% infection prevalence in raccoons (n=50)
- Feral hogs
  - Ongoing sampling
- Small mammal trapping
  - Rodents across the state
- Kissing bugs
  - 120 bugs / 5 nights



Rachel's 1st bug

Citizen Science Initiative

KissingBug@cvm.tamu.edu

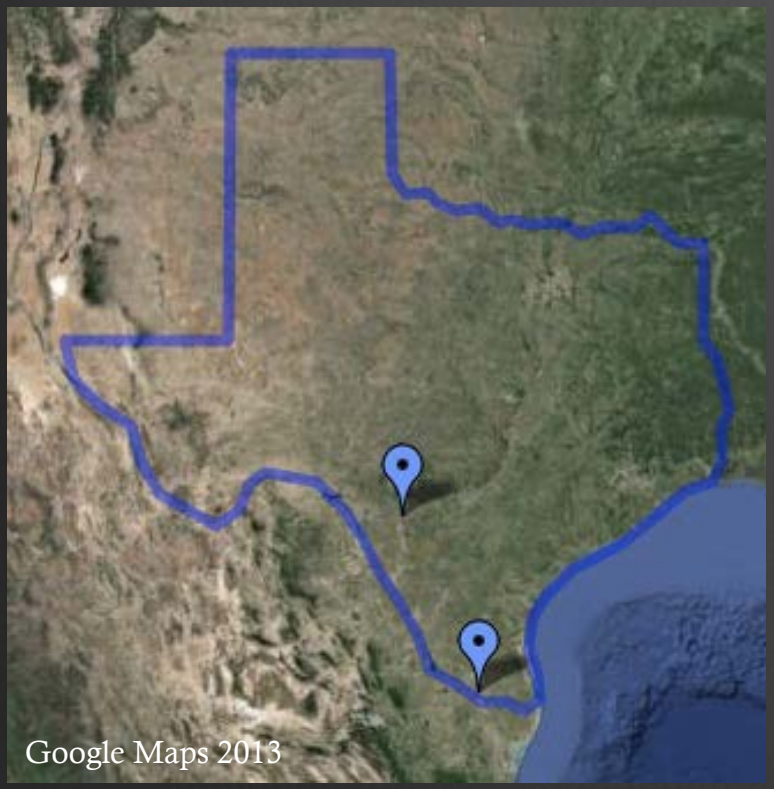


and Mrs. L. L. Farnham and Mr. and Mrs. Joseph P. Klein. The effort to collect bugs may have been stimulated by the campaign slogan for 1941 which appeared on the large collecting cans supplied the mining houses, namely, "Nab that bug at one cent each for Dr. Wood at City College to keep."

Wood S (1943) Observations on vectors of Chagas' disease in the United States, II. Arizona. *American Journal of Tropical Medicine* 23: 315-320.

Citizen Science

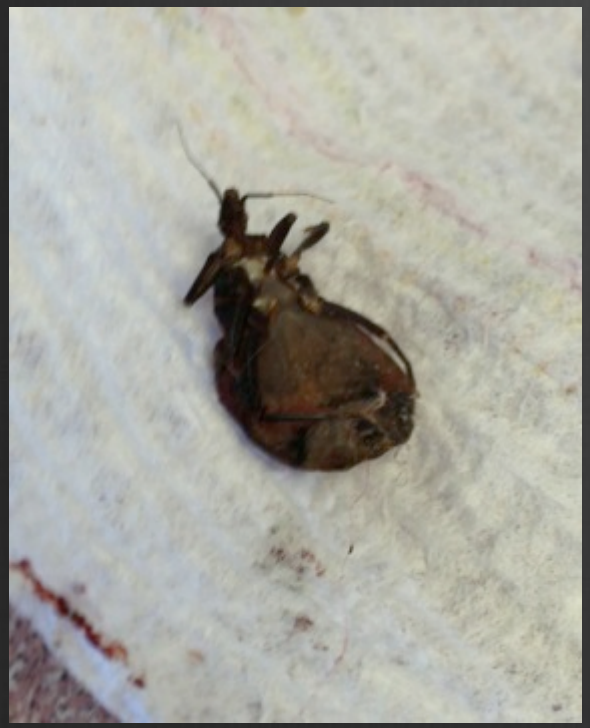
Without public submissions



120 bugs

With public submissions

Over 1200 bugs




Hamer
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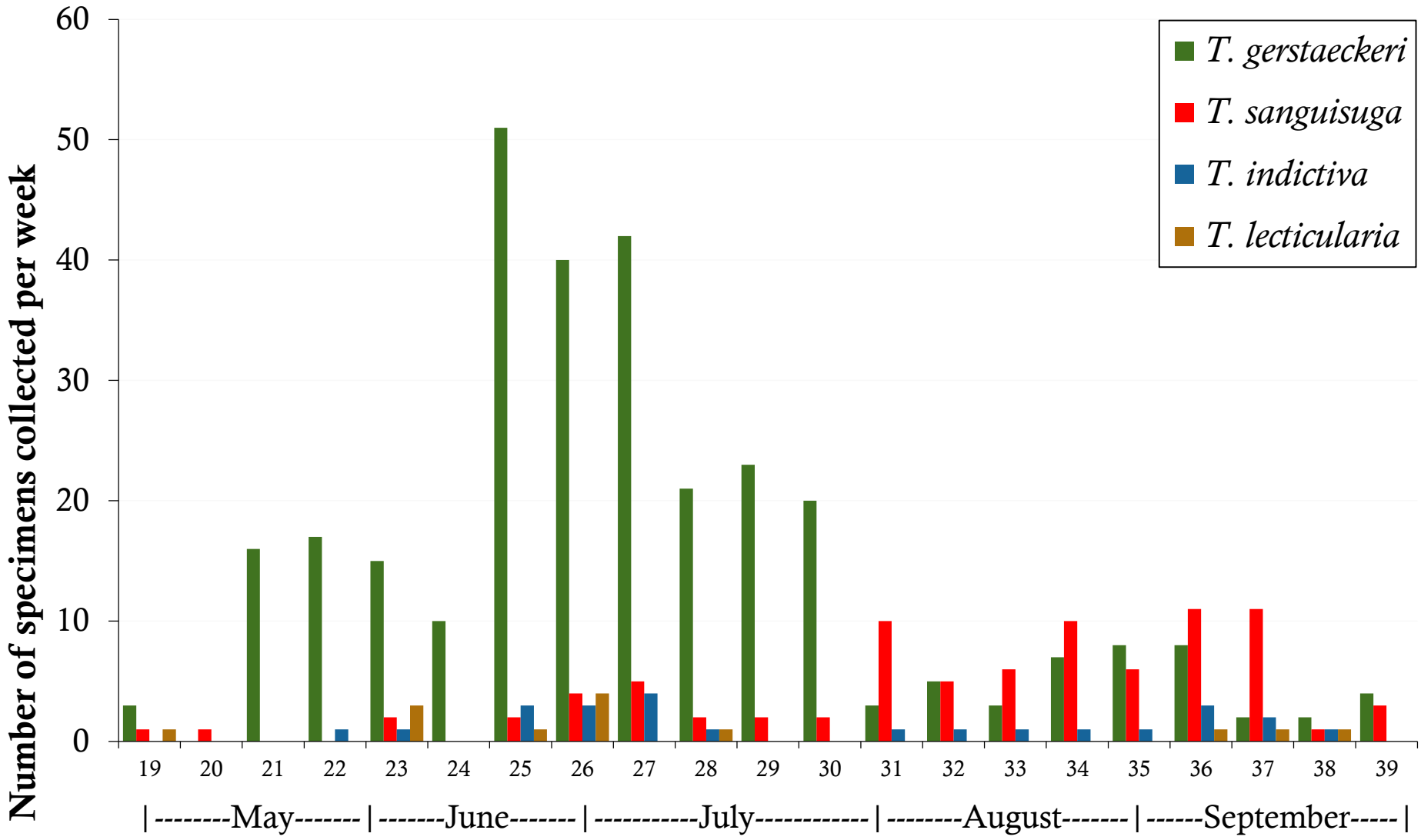
Triatomine Identification

G. Hamer

Kissing bug phenology



Kjos dissertation

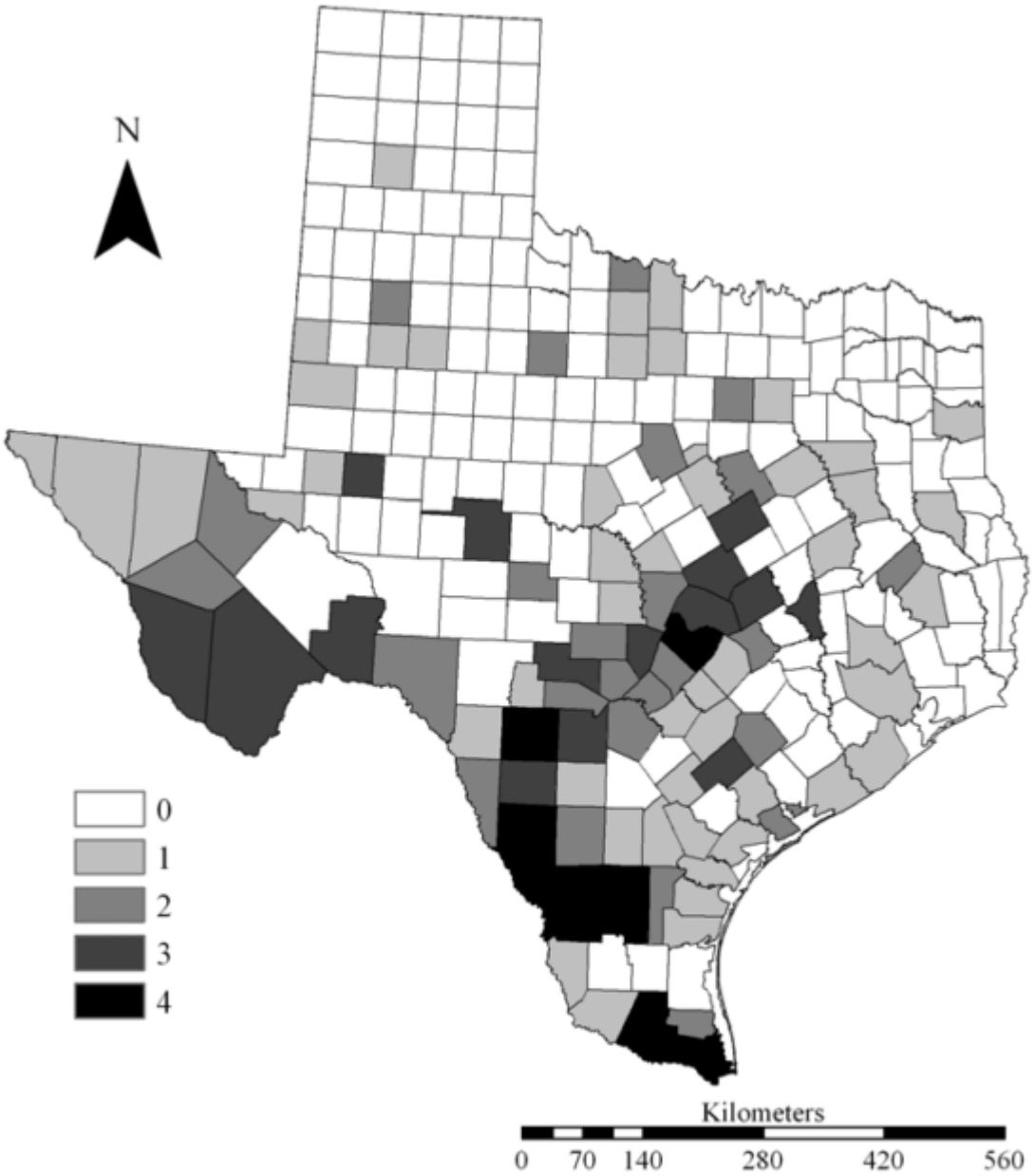
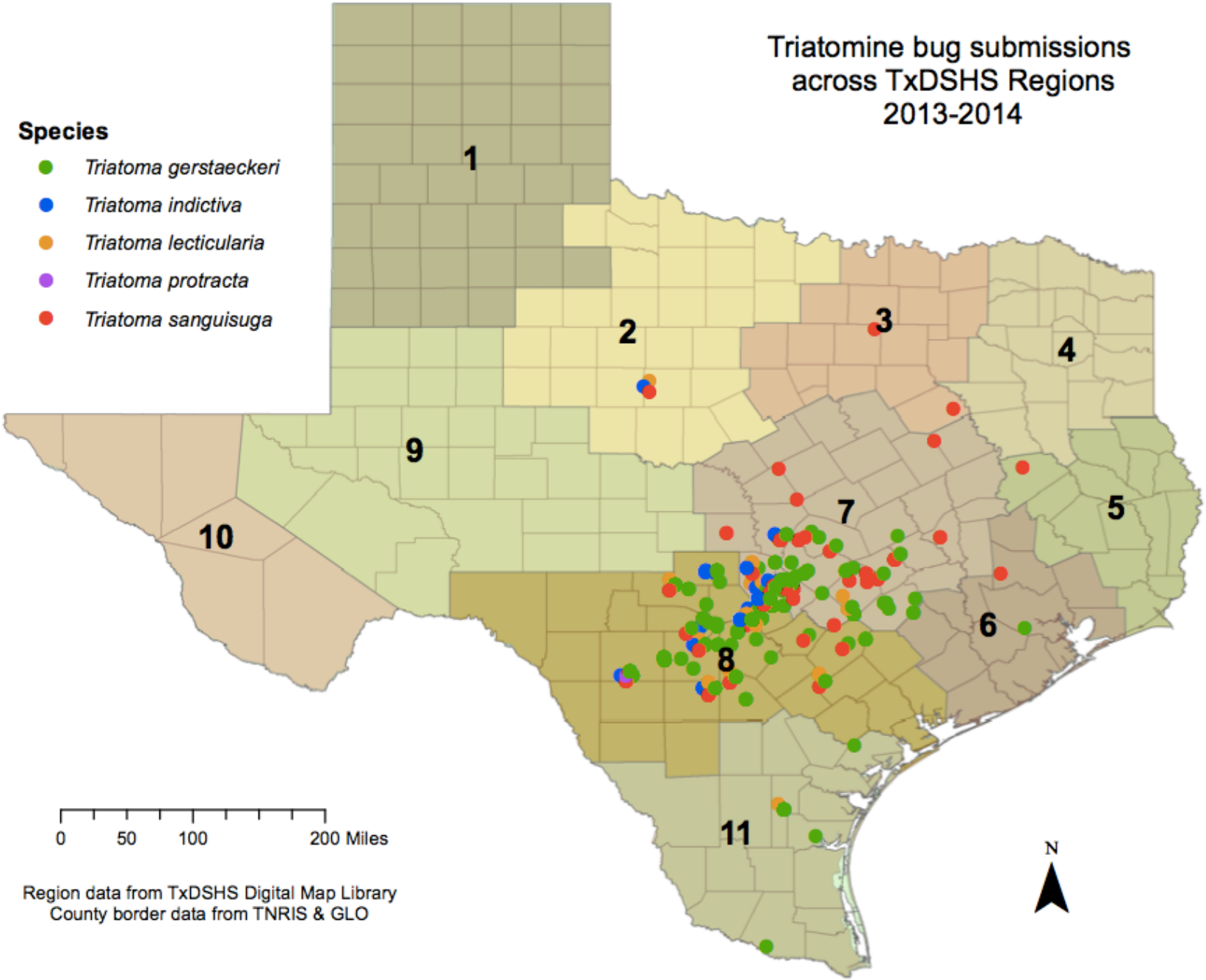
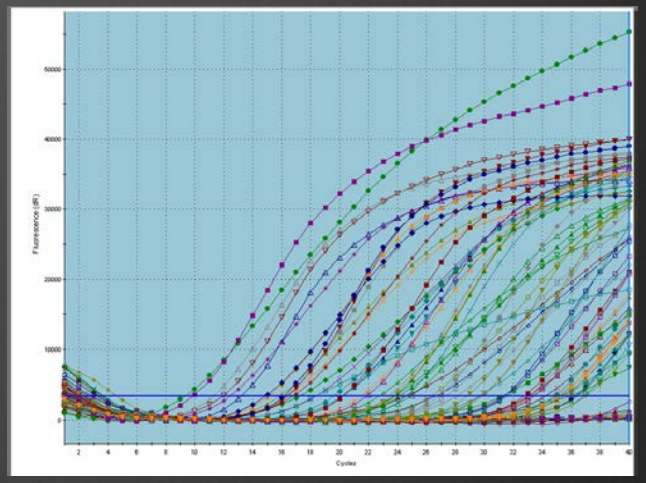


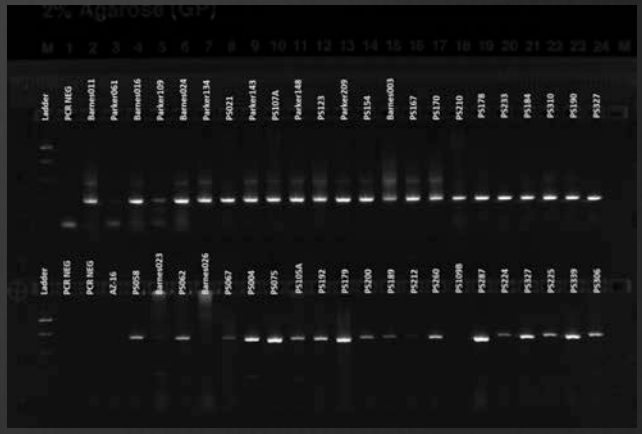
Figure 9. Triatomine bug species diversity in Texas by county, 1928-2006.


Triatomine bug submissions
across TxDSHS Regions
2013-2014
Species
Triatoma gerstaeckeri
Triatoma indictiva
Triatoma lecticularia
Triatoma protracta
Triatoma sanguisuga
1
2
3
4
5
6
7
8
9
10
11
0
50
100
200 Miles
Region data from TxDSHS Digital Map Library
County border data from TNRIS & GLO
N

Infection Prevalence

- 1200+ bugs received
- 120 bugs subjected to PCR
  - Screening qPCR
  - Strain-typing gel-based PCR
- 75% *T. cruzi* infection prevalence
- Positive bugs from across Texas



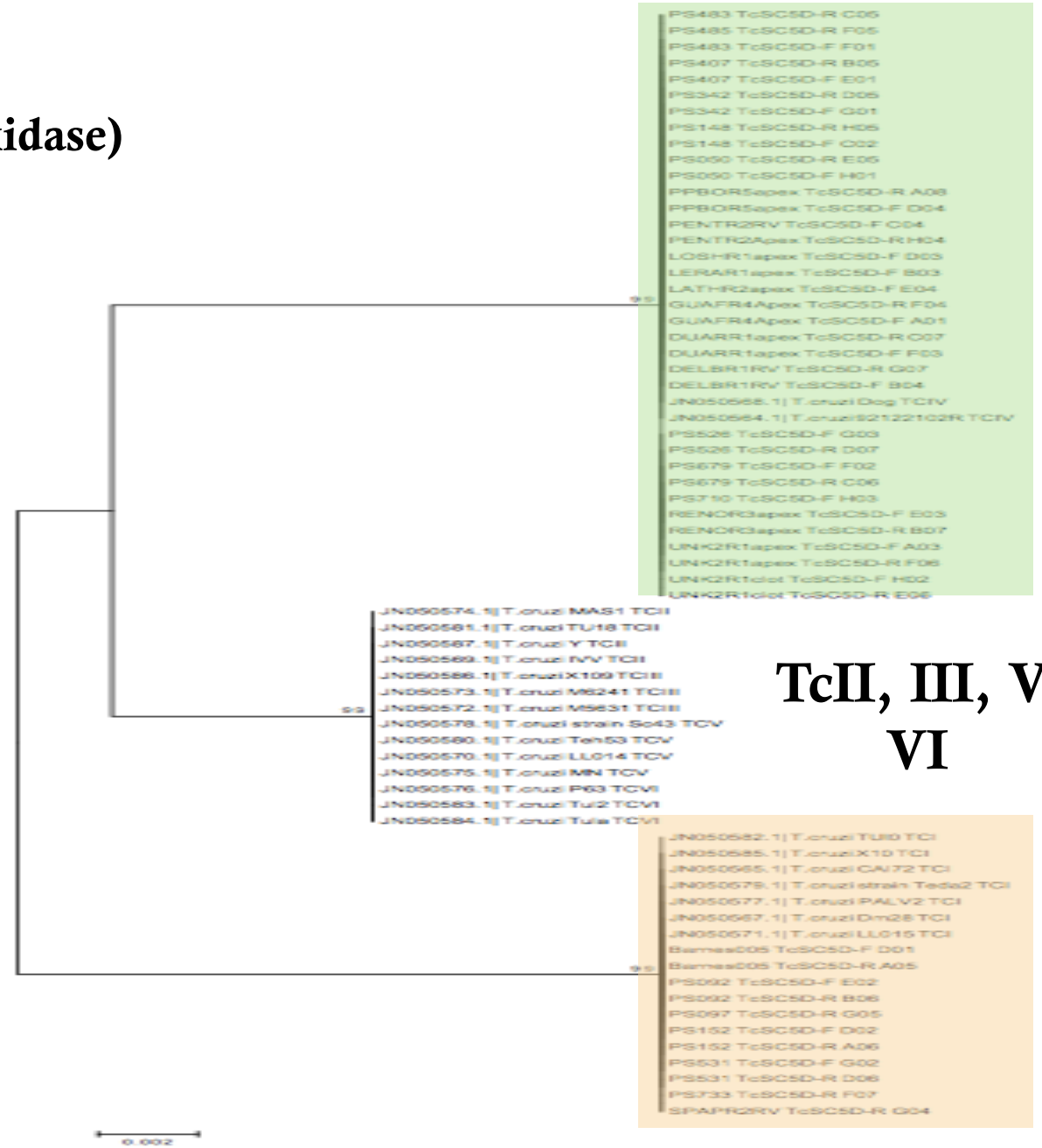


T. cruzi

SC5D gene

(lathosterol oxidase)

832 bp



TcIV

TcII, III, V, VI

TcI

Future Directions

- Continue processing samples
- Mapping of strain-type distributions
- Continued field sampling
- Inclusion of samples from other states
- Continued public outreach

In collaboration with the Department of Geography at Texas A&M University

Anticipated launch in July 2014

Acknowledgements

- Committee members: Sarah Hamer, Gabriel Hamer, Karen Snowden, Edward Wozniak, Robert Coulsen
- Lisa Auckland
- Texas EcoLab Program
- Citizen science
- Volunteer and paid field and laboratory assistants
- This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant No. 1252521.

Citizen Science Initiative

Our lab would love to receive your submissions of kissing bugs

For safe collection and shipping instructions, please contact:
KissingBug@cvm.tamu.edu