

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



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Outline

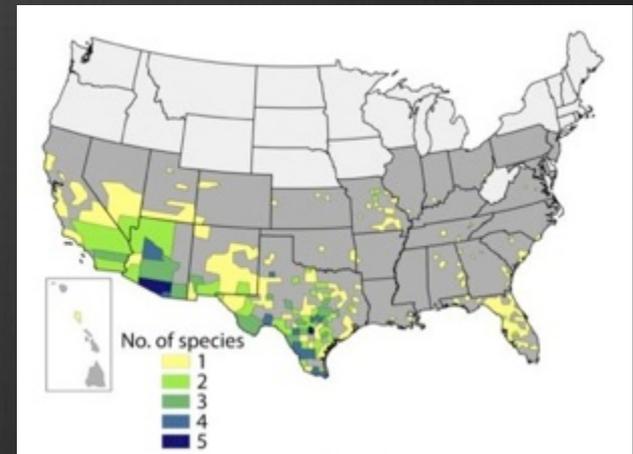
Overview of Chagas disease

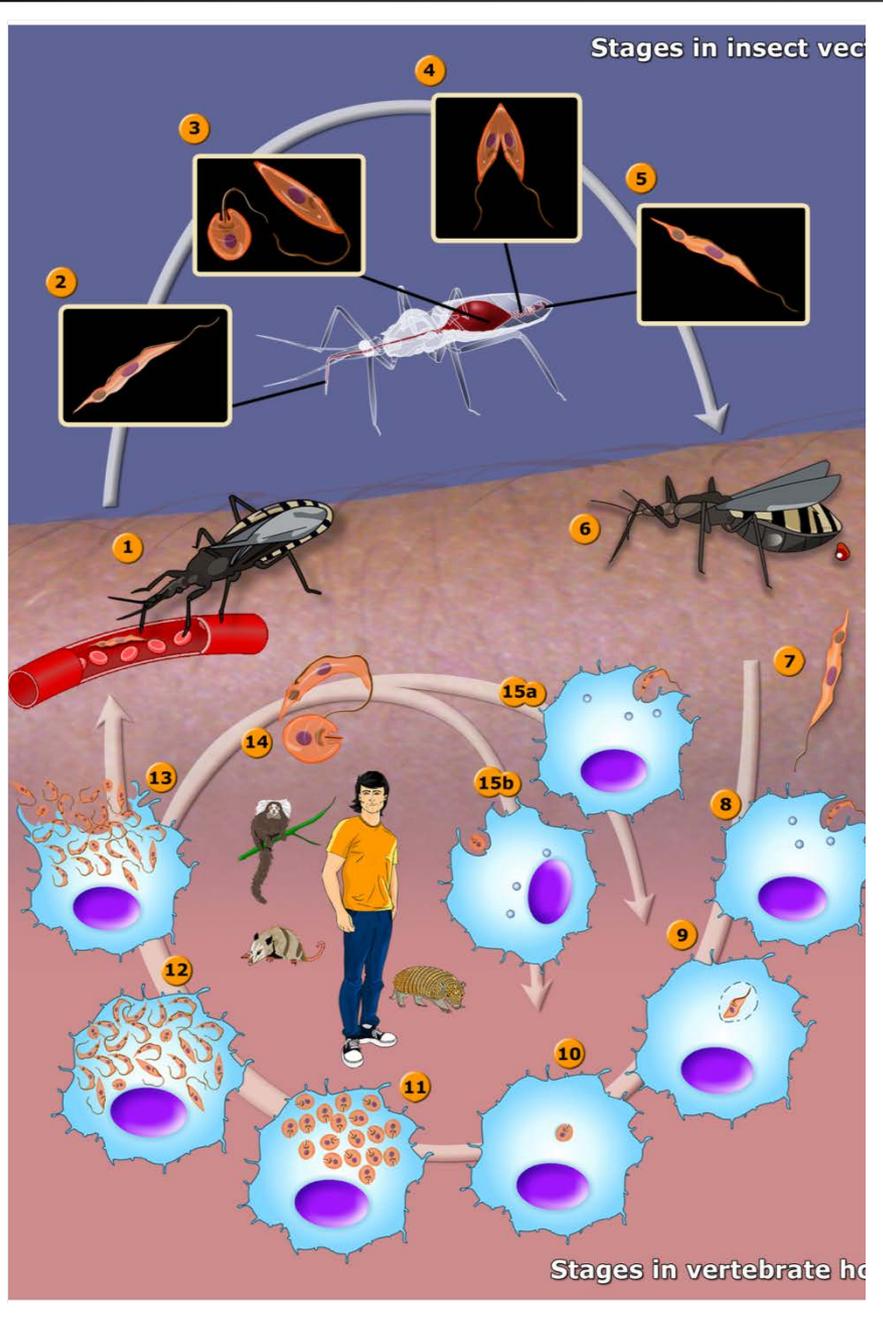
Kissing bugs in the US

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, CO₂, heat, pheromones

Trypanosoma cruzi

Amastigotes in cardiac tissue

Mammalian hosts

Opossums, skunks, raccoons, rodents

Dogs, humans

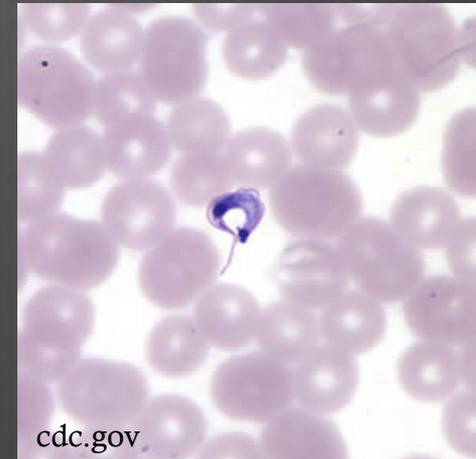
Chagas disease

Parasite transmission

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

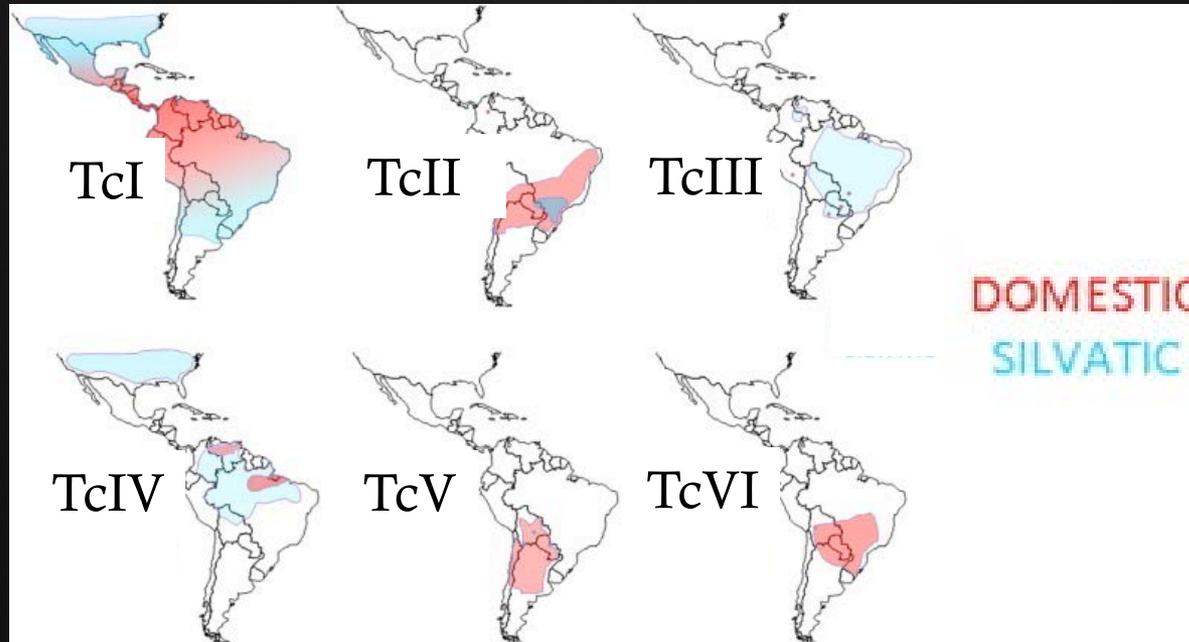
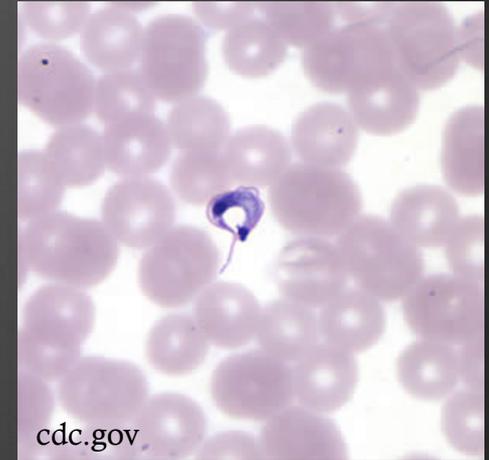
Clinical manifestations

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



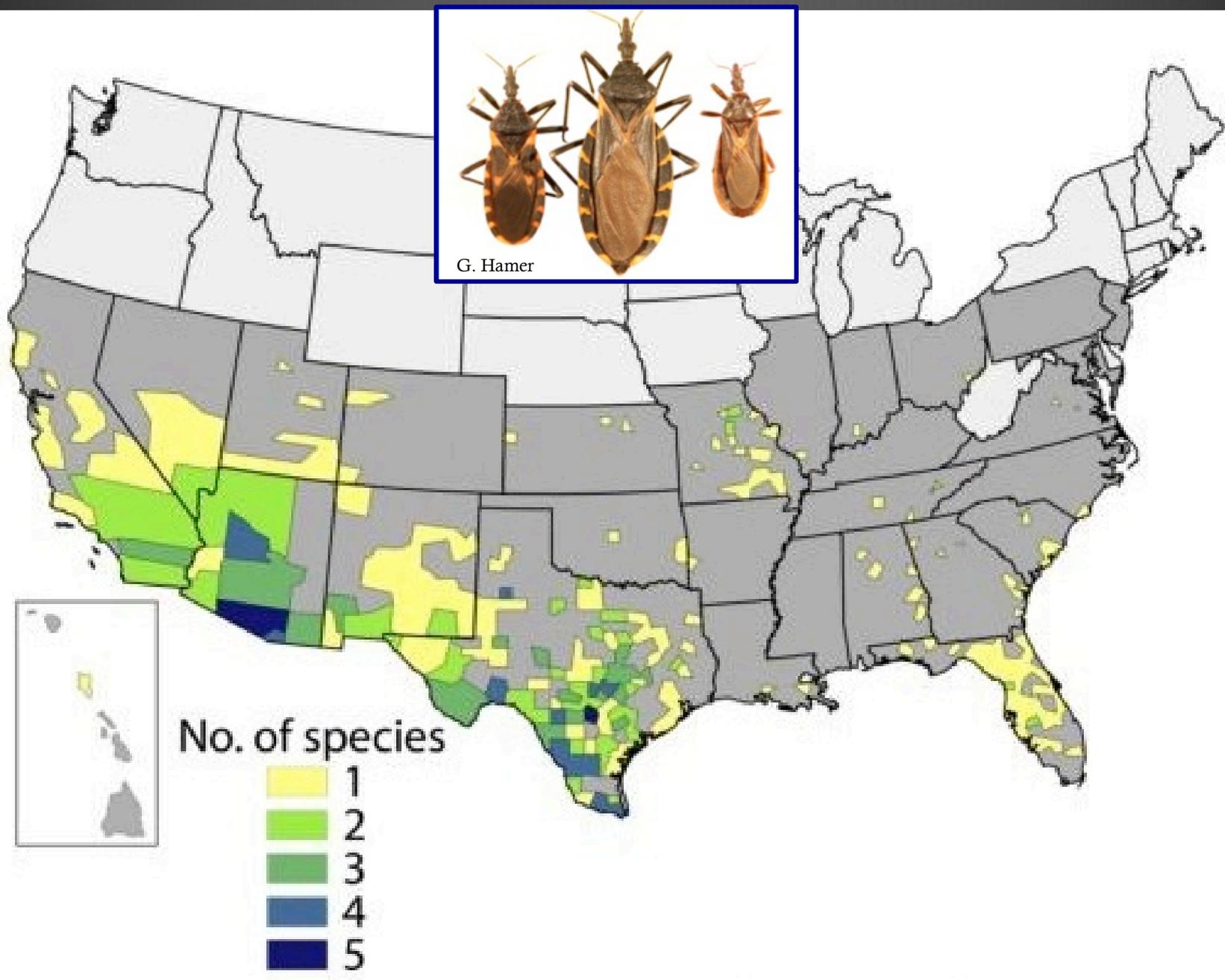
Strain-typing of *T. cruzi*

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





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



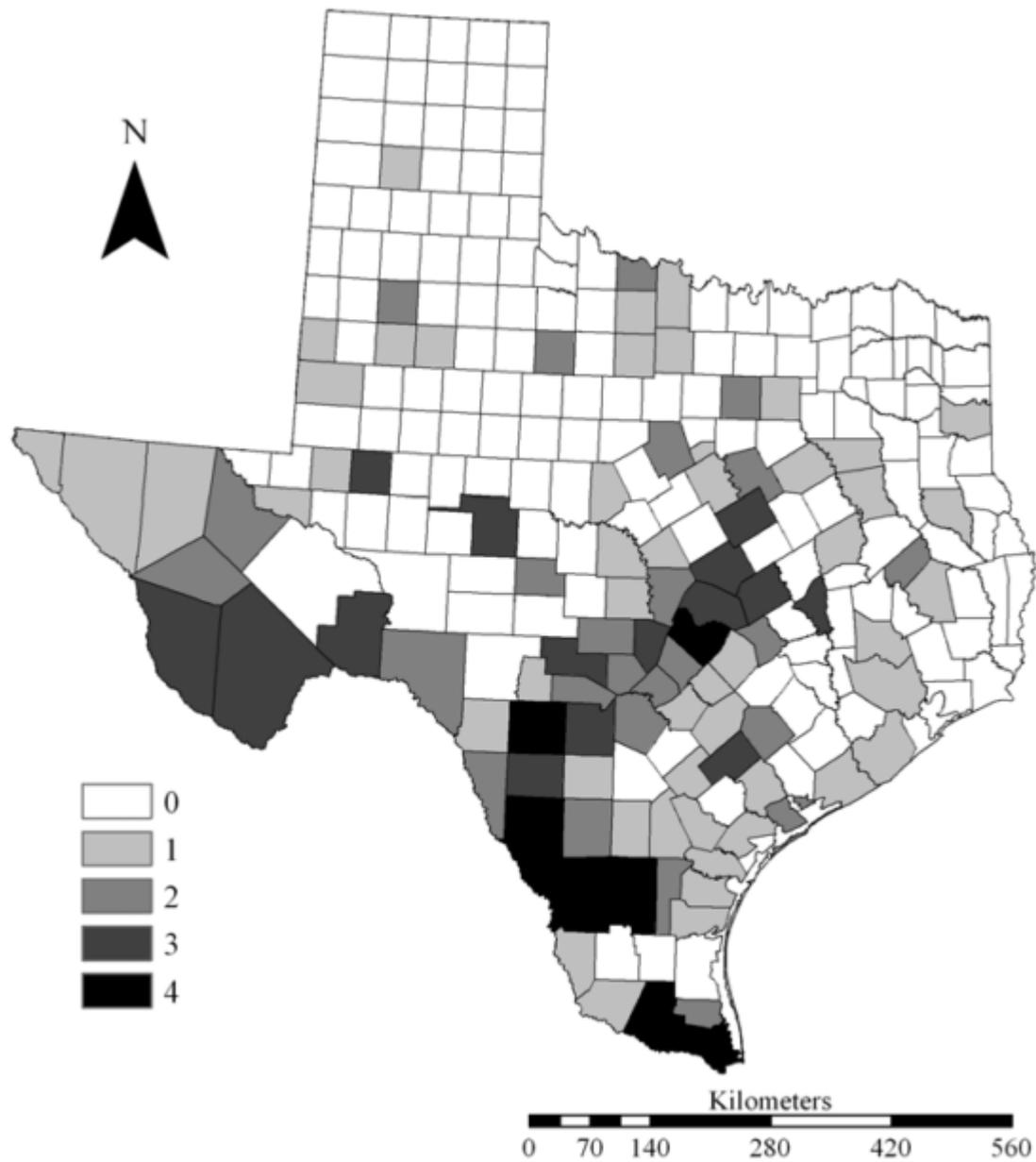
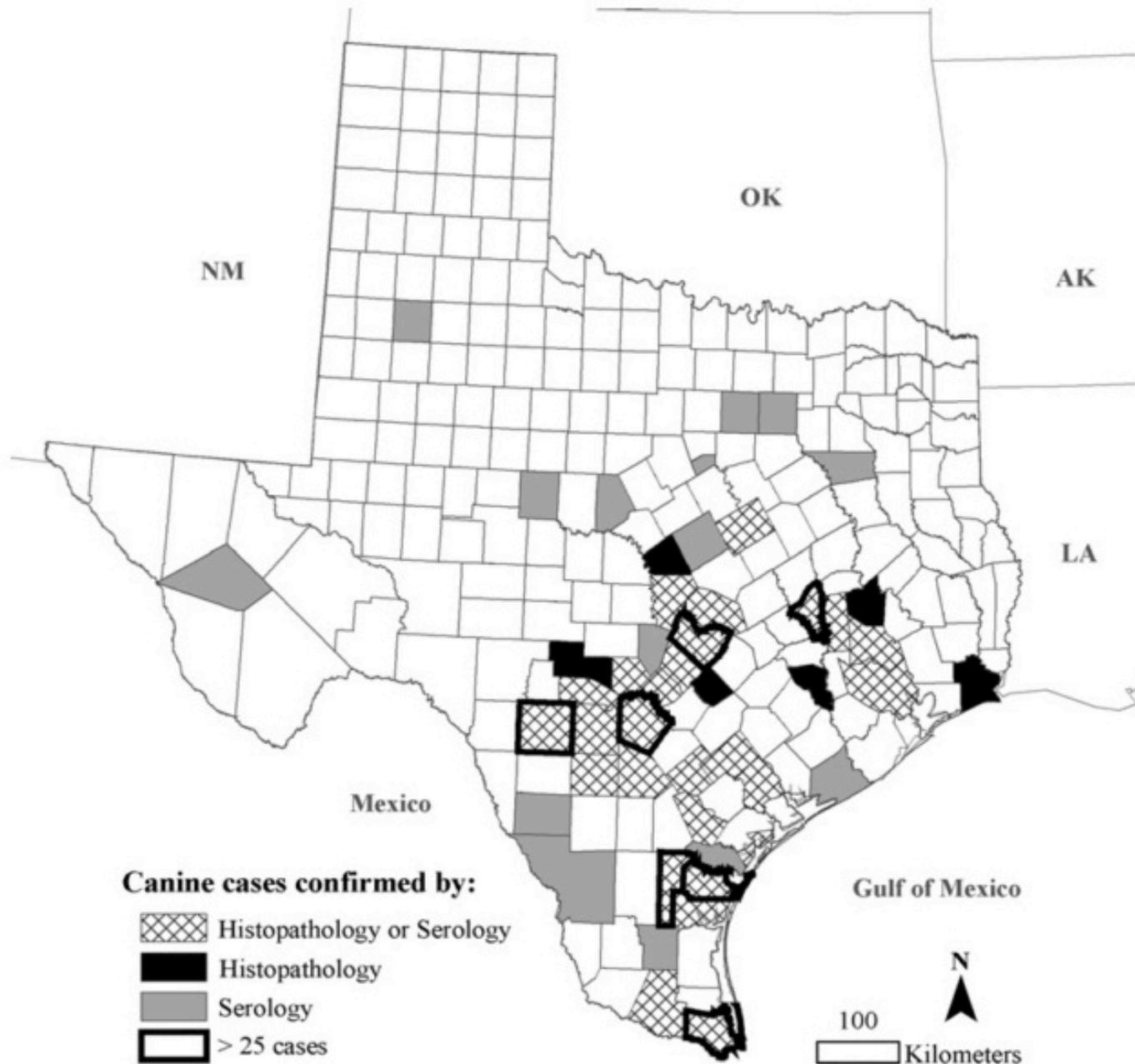
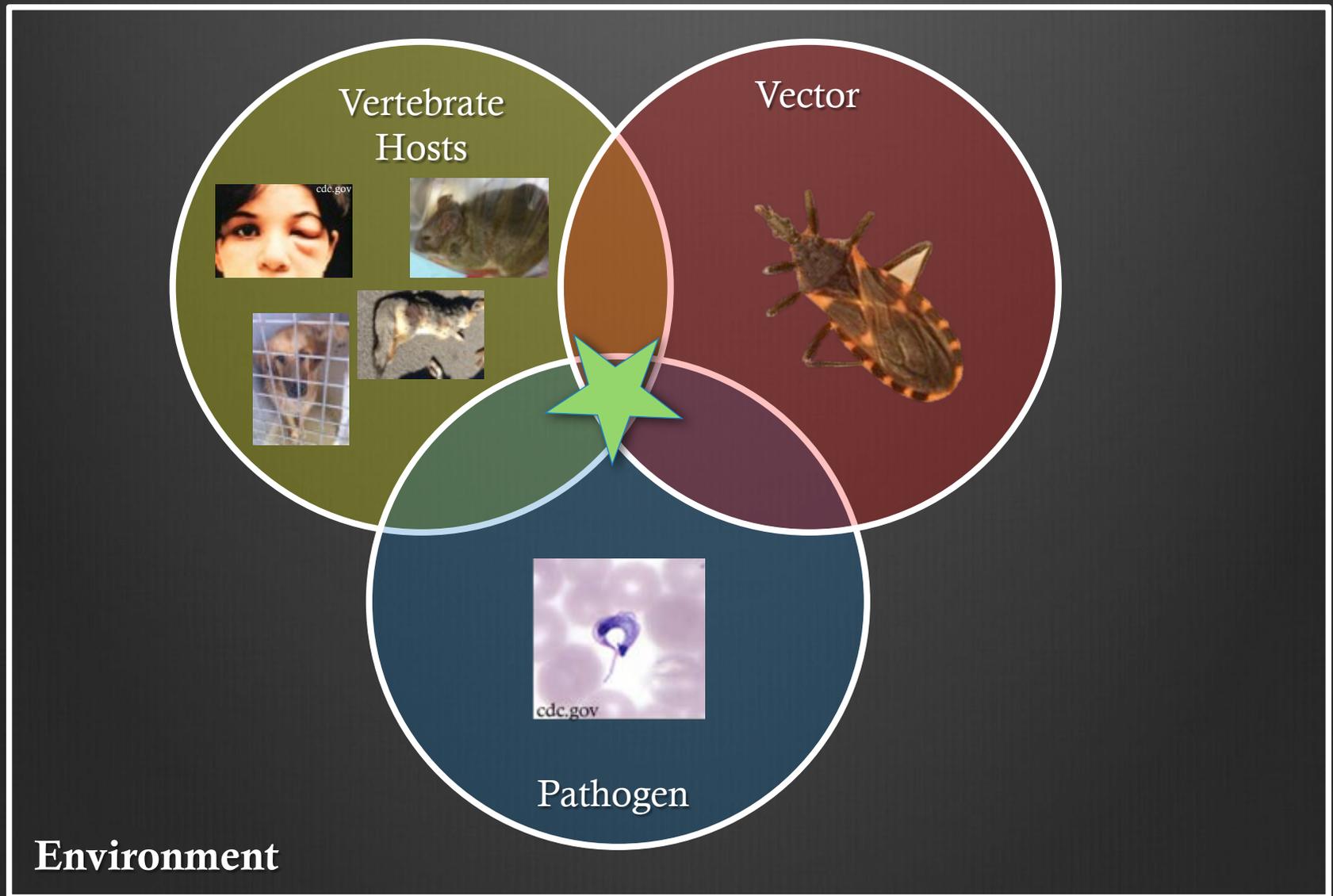


Figure 9. Triatomine bug species diversity in Texas by county, 1928-2006.



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

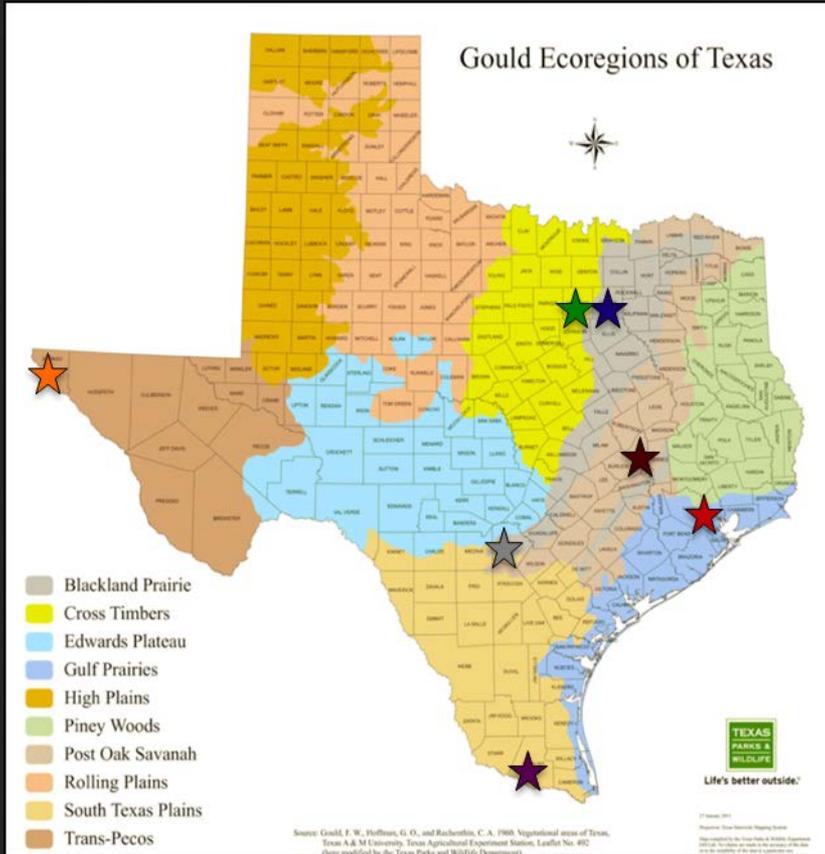


- Treatment options are limited
- Symptom management

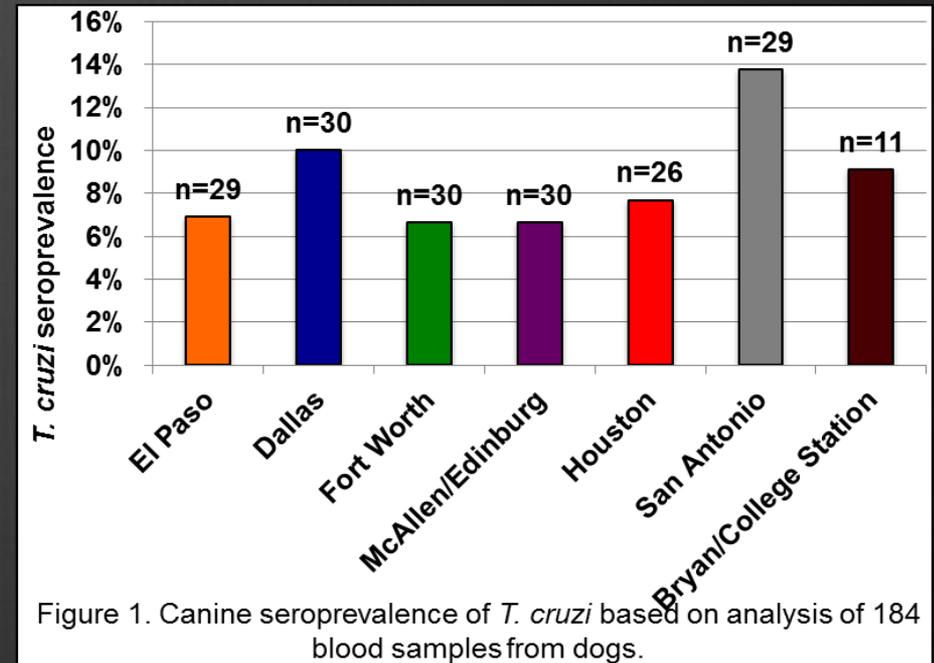


Angel, TAMU-CVM
pacemaker patient

Shelter dogs



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



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

Kissing bugs in Texas



Adult female
Triatoma sanguisuga

The screenshot shows the Sarah A. Hamer Lab website. The header includes navigation links for Directory, Maps & Directions, Schedule A Tour, Careers & Externships, and Giving. The main navigation bar lists About Us, Education, Animal Care, and Research. The page title is "Chagas disease eco-epidemiology". The content includes a paragraph about the lab's approach to understanding Chagas disease, a list of publications, and a section for the Citizen Science Initiative. The Citizen Science Initiative section states: "Our lab is currently accepting carefully-collected kissing bugs from across the southern US for research purposes. We will identify bugs and test for the presence of *Trypanosoma cruzi*. It is critical that you do not come in direct contact with bug, its feces, or areas contaminated by the bug. Please note that bugs associated with human bites may be submitted to the CDC for identification and testing, and we will be happy to provide details for this. Citizen submissions are boosting our sample size and geographic area of analysis, and greatly broadening the impact of our science. For more details including requirements for mailing bugs safely, please send an email to: KissingBug@cvm.tamu.edu".

KissingBug@cvm.tamu.edu

Chagas disease in Texas

Information for
veterinary professionals
with canine patients

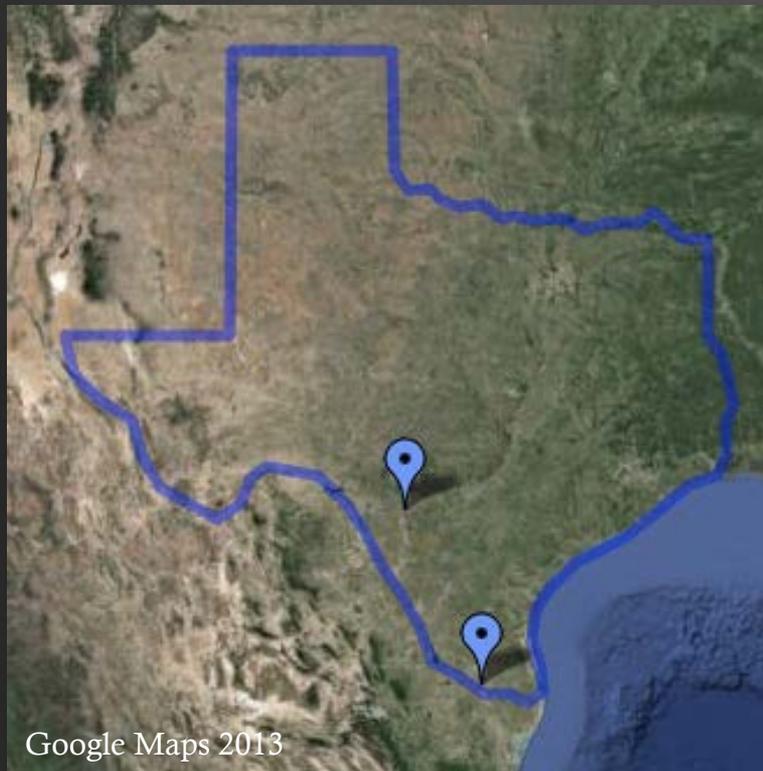


and Mrs. L. L. Farnham and Mr. and Mrs. Joseph P. Klein. The effort to collect bugs may have been stimulated by the campaign slogan for 1941 which appeared on the large collecting cans supplied the mining houses, namely, "Nab that bug at one cent each for Dr. Wood at City College to keep."

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

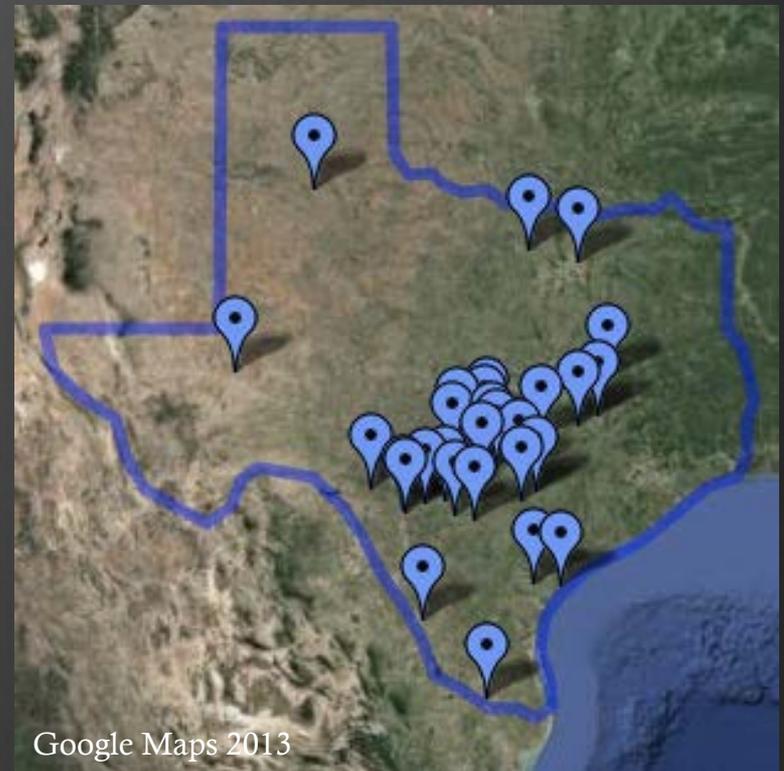
Citizen Science

Without public submissions



120 bugs

With public submissions



Over 1200 bugs





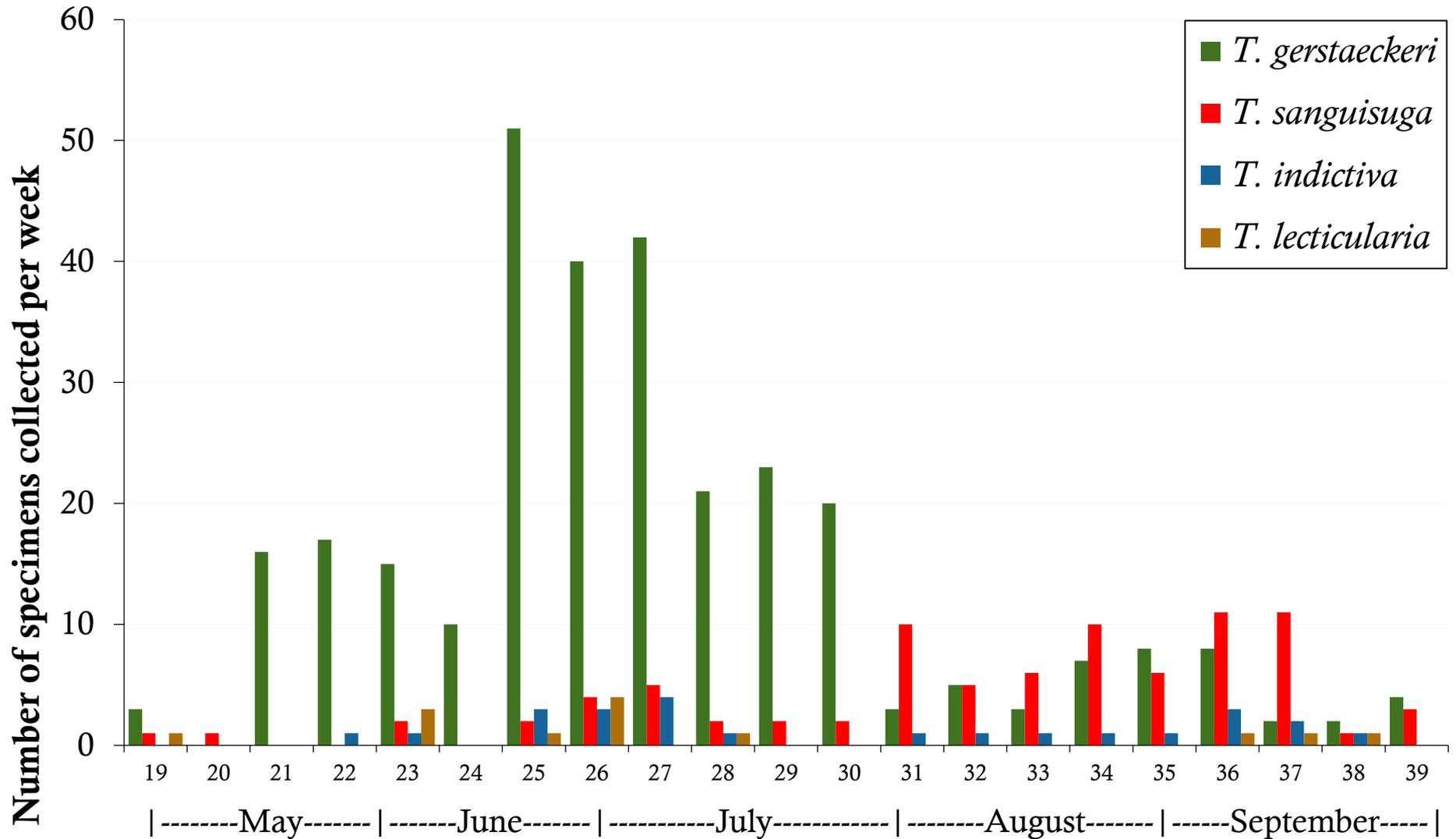


Triatomine Identification



G. Hamer

Kissing bug phenology



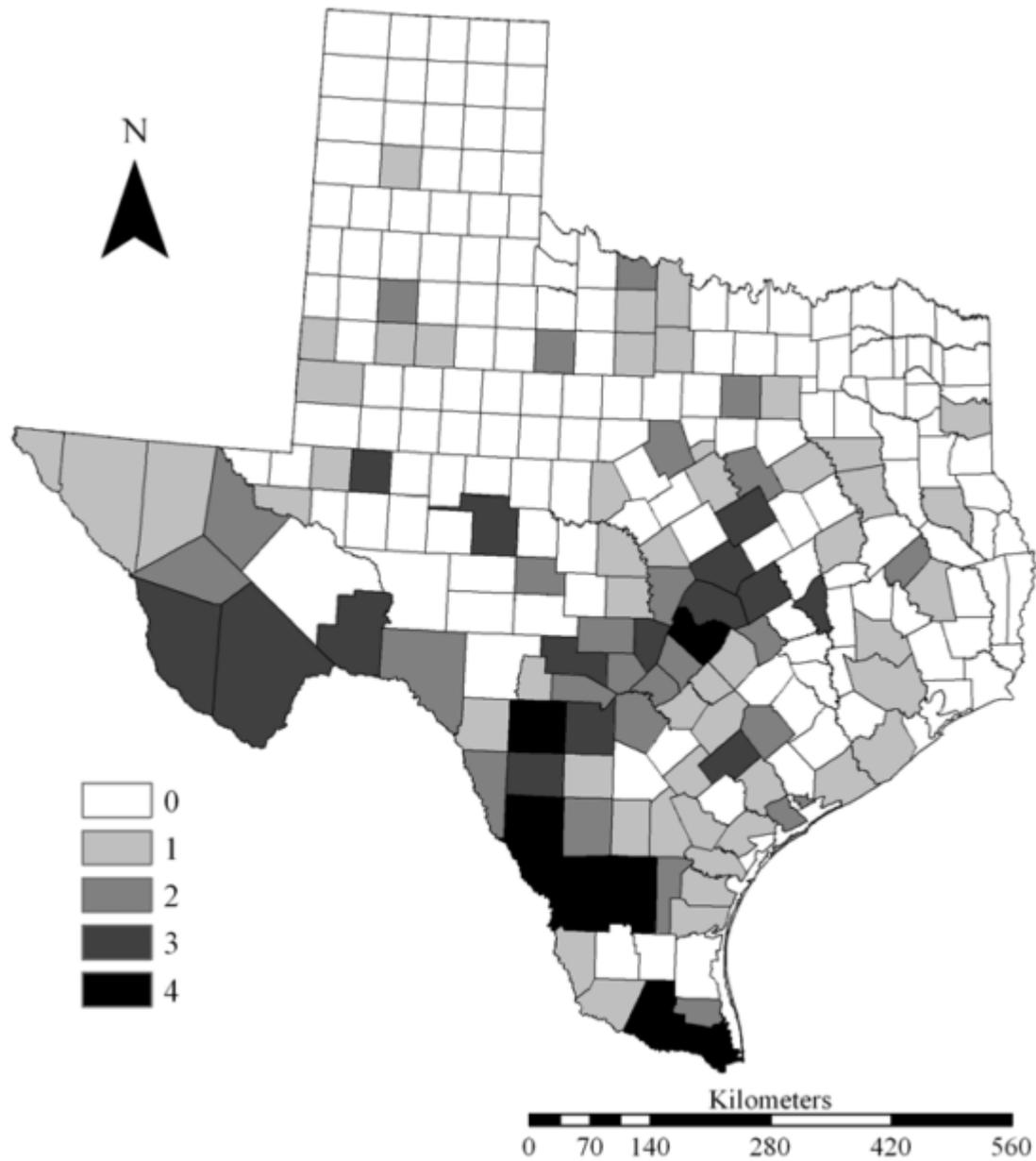
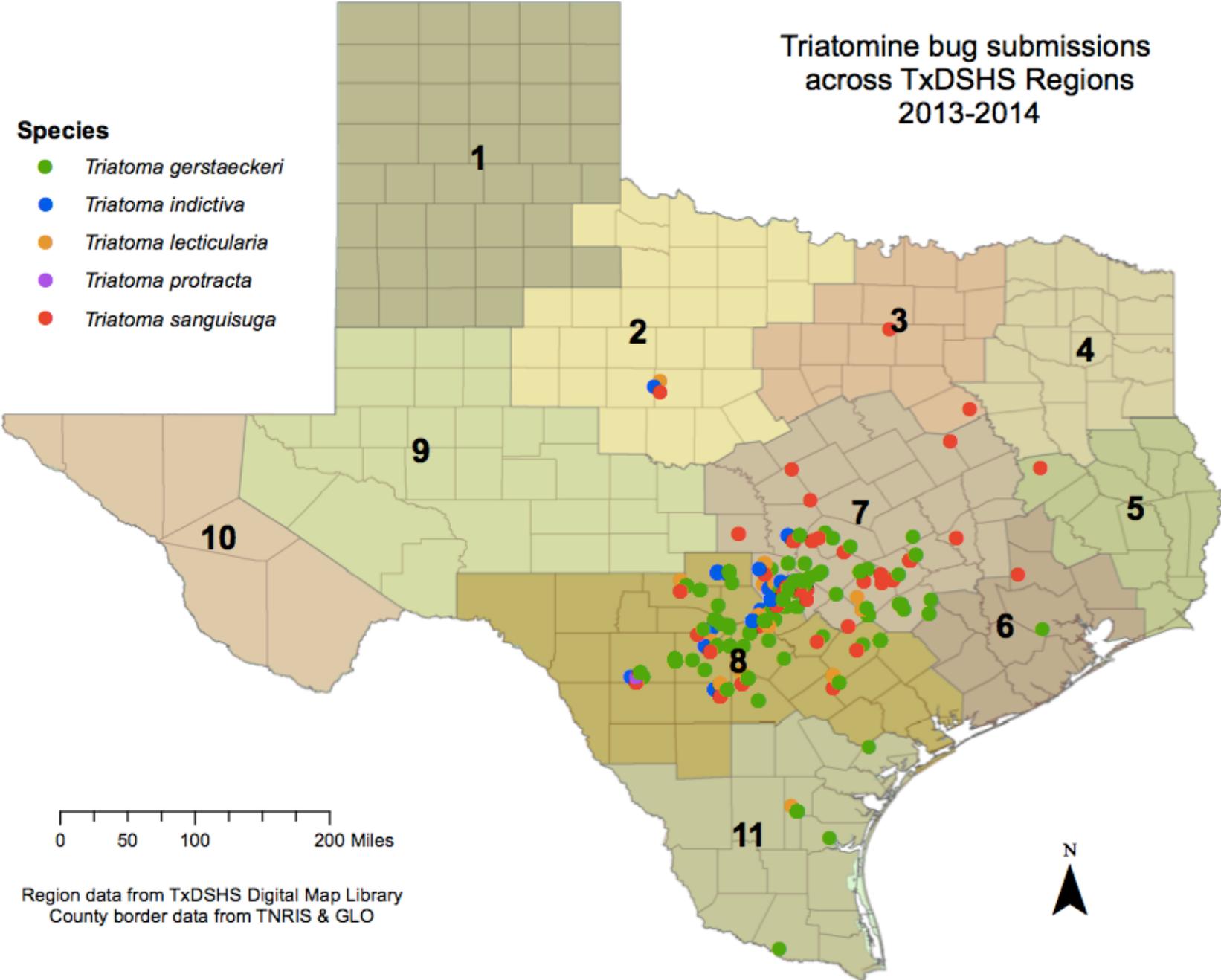


Figure 9. Triatomine bug species diversity in Texas by county, 1928-2006.

Triatomine bug submissions across TxDSHS Regions 2013-2014

Species

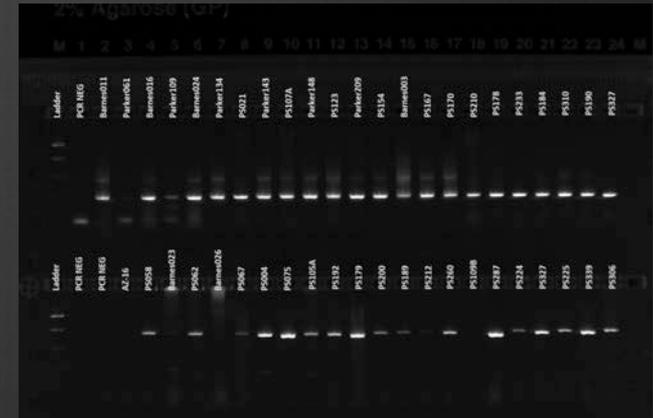
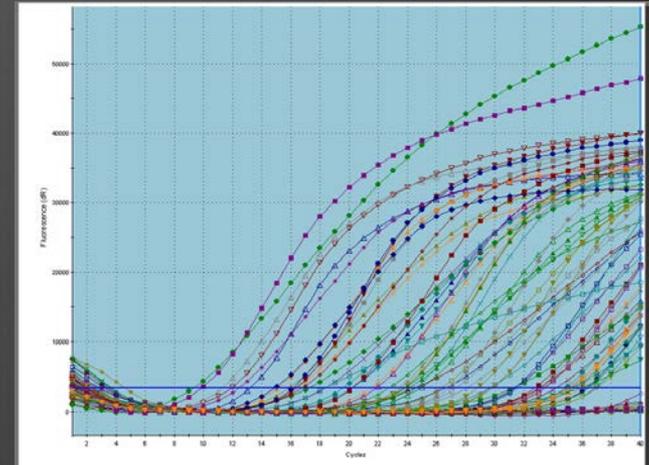
- *Triatoma gerstaeckeri*
- *Triatoma indictiva*
- *Triatoma lecticularia*
- *Triatoma protracta*
- *Triatoma sanguisuga*



Region data from TxDSHS Digital Map Library
County border data from TNRIS & GLO

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

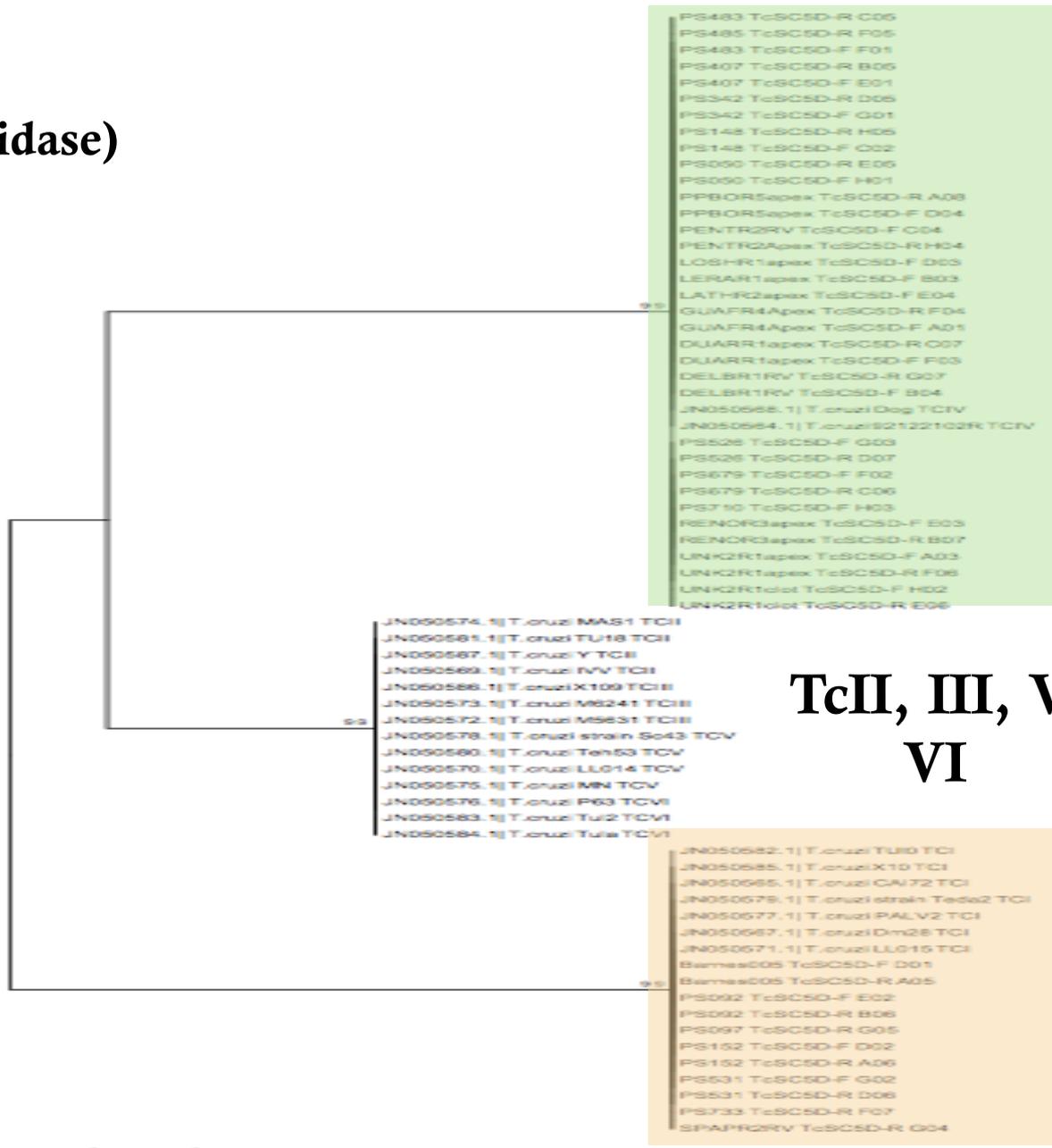


T. cruzi

SC5D gene

(lathosterol oxidase)

832 bp



- PS483 TcSC5D-R C05
- PS485 TcSC5D-R F05
- PS483 TcSC5D-F F01
- PS407 TcSC5D-R B05
- PS407 TcSC5D-F E01
- PS342 TcSC5D-R D05
- PS342 TcSC5D-F G01
- PS148 TcSC5D-R H05
- PS148 TcSC5D-F C02
- PS050 TcSC5D-R E05
- PS050 TcSC5D-F H01
- PPBOR5apex TcSC5D-R A08
- PPBOR5apex TcSC5D-F D04
- PENTR2RV TcSC5D-F C04
- PENTR2Apex TcSC5D-R H04
- LOSHR1apex TcSC5D-F D03
- LERAR1apex TcSC5D-F B03
- LATHR2apex TcSC5D-F E04
- GUAFR4Apex TcSC5D-R F04
- GUAFR4Apex TcSC5D-F A01
- DUARR1apex TcSC5D-R C07
- DUARR1apex TcSC5D-F F03
- DELBR1RV TcSC5D-R G07
- DELBR1RV TcSC5D-F B04
- JN050565.1 | *T. cruzi* Dog TCIV
- JN050564.1 | *T. cruzi* S21221G2R TCIV
- PS526 TcSC5D-F G03
- PS526 TcSC5D-R D07
- PS679 TcSC5D-F F02
- PS679 TcSC5D-R C06
- PS710 TcSC5D-F H03
- RENOR3apex TcSC5D-F E03
- RENOR3apex TcSC5D-R B07
- UNK2R1apex TcSC5D-F A03
- UNK2R1apex TcSC5D-R F05
- UNK2R1clot TcSC5D-F H02
- UNK2R1clot TcSC5D-R E05

TcIV

**TcII, III, V,
VI**

- JN050582.1 | *T. cruzi* TUI0 TC1
- JN050585.1 | *T. cruzi* X10 TC1
- JN050665.1 | *T. cruzi* CA72 TC1
- JN050675.1 | *T. cruzi* strain Teda2 TC1
- JN050677.1 | *T. cruzi* PALV2 TC1
- JN050667.1 | *T. cruzi* Dm28 TC1
- JN050671.1 | *T. cruzi* LL015 TC1
- Bama005 TcSC5D-F D01
- Bama005 TcSC5D-R A05
- PS092 TcSC5D-F E02
- PS092 TcSC5D-R B06
- PS097 TcSC5D-R G05
- PS152 TcSC5D-F D02
- PS152 TcSC5D-R A06
- PS531 TcSC5D-F G02
- PS531 TcSC5D-R D06
- PS733 TcSC5D-R F07
- SPAPR2RV TcSC5D-R G04

TcI

0.002

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

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- 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