DSHS Grand Rounds

April 6

Chagas Disease in Texas

Presenters: Sarah A. Hamer, MS PhD DVM, Assistant Professor and Associate Wildlife Biologist®, Texas A&M University; Tom J. Sidwa, DVM, MPH, State Public Health Veterinarian & Manager, Zoonosis Control, DSHS; Edward J Wozniak, DVM, PhD, State Veterinarian, Health Service Region 8, South Central Texas, DSHS

TEXAS Department of State Health Services

Logistics

Slides

Slides available at: http://www.dshs.state.tx.us/grandrounds

Registration questions?

For registration questions, please contact Laura Wells, MPH at CE.Service@dshs.state.tx.us

For technical difficulties, please contact:

GoToWebinar 1-800-263-6317(toll free) or 1-805-617-7000

Questions?

There will be a question and answer period at the end of the presentation. Remote sites can send in questions throughout the presentation by using the GoToWebinar chat box or email GrandRounds@dshs.state.tx.us.

For those in the auditorium, please come to the microphone to ask your question.

2

Disclosure to the Learner

Requirement of Learner

Participants requesting continuing education contact hours or a certificate of attendance must 1. register for the event, 2. attend the entire session, and 3. complete the online evaluation within one week of the presentation.

Commercial Support

This educational activity received no commercial support.

Disclosure of Financial Conflict of Interest

The speaker and planning committee have no relevant financial relationships to disclose.

Off Label Use

There will be no discussion of off-label use during this presentation.

Non-Endorsement Statement

Accredited status does not imply endorsement by Department of State Health Services - Continuing Education Services, Texas Medical Association, or American Nurses Credentialing Center of any commercial products displayed in conjunction with an activity.

3

Additional Readings

1. Messenger LA, Miles MA, Bern C. Between a bug and a hard place: Trypanosoma cruzi genetic diversity and the clinical outcomes of Chagas disease. Expert Rev Anti Infect Ther. 2015 Aug;13(8):995-1029. doi: 10.1586/14787210.2015.1056158.

2. Garcia MN, Murphy SK, Gross A, Wagner J, Murray KO. Knowledge, attitudes, and practices of Texas hunters: a potentially high-risk population for exposure to the parasite that causes Chagas disease. Parasit Vectors. 2015 Apr 1;8:197. doi: 10.1186/s13071-015-0815-4.

3. Nouvellet P, Cucunubá ZM, Gourbière S. Ecology, evolution and control of Chagas disease: a century of neglected modelling and a promising future. Adv Parasitol. 2015 Mar;87:135-91. doi: 10.1016/bs.apar.2014.12.004. Epub 2015 Feb 9.

4

Introductions

John Hellerstedt, MD
DSHS Commissioner is pleased to
introduce our DSHS Grand Rounds speakers

5

Chagas Disease in Texas

Sarah A. Hamer, MS, PhD, DVM Assistant
Professor and Associate Wildlife Biologist®
Texas A&M University

Tom J. Sidwa, DVM, MPH
State Public Health Veterinarian &
Manager, Zoonosis Control, DSHS

Edward J. Wozniak, DVM, PhD
State Veterinarian, Health Service Region 8
South Central Texas, DSHS

6

Chagas Disease in Texas

- Discovery of Chagas disease
- Distribution and prevalence in the Americas
- Transmission
- Clinical presentation
- Diagnosis
- Treatment
- Case counts and distribution in Texas

Tom Sidwa, DVM, MPH

7

Discovery of Chagas Disease

- Carlos Chagas was born in 1879 in Brazil
- M.D. thesis on the "Hematological Aspects of Malaria"
- In 1908, investigated deaths of railroad workers thought to be due to malaria
- Chagas determined some symptoms not consistent with malaria
- Discovered flagellates in hindgut of insects feeding on the blood of workers at night
  - protozoa similar to those causing African sleeping sickness…named the new agent *Trypanosoma cruzi*.
- In 1909, he discovered the same *Trypanosoma* parasite in the blood of a three-year-old girl
- Chagas described the pathology of both acute and chronic forms of the disease

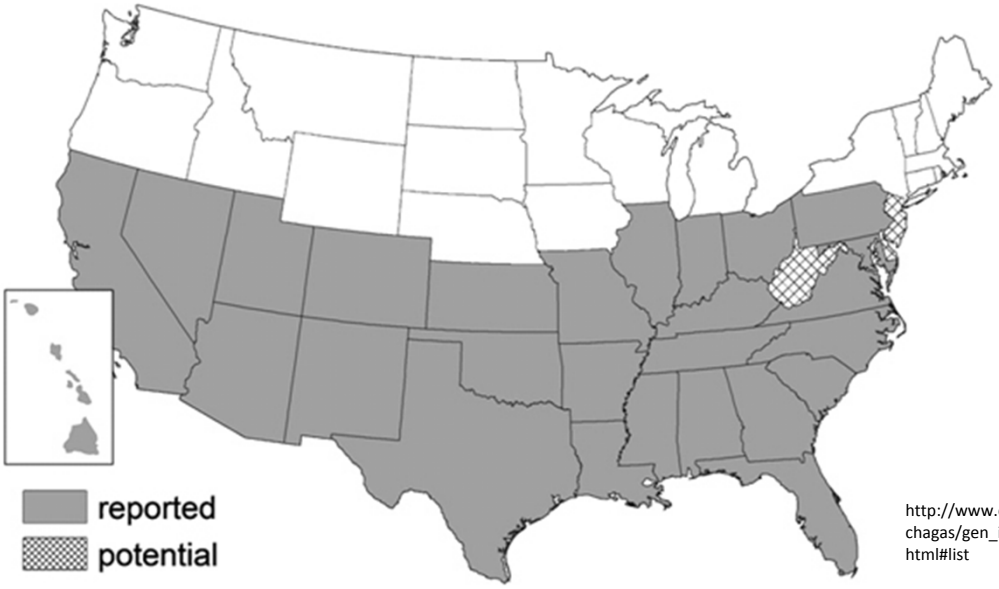
8

Chagas Disease - Distribution

- Endemic in the Americas - known range extends from north of the Patagonia region of South America to approximately the southern half of the U.S.

9

Triatomine Bug Occurrence by State



http://www.cdc.gov/parasites/chagas/gen_info/vectors/index.html#list

10

Chagas Disease - Prevalence

- An estimated 8 million people are infected in Mexico, Central and South America
- CDC estimates that >300,000 persons with Chagas disease live in the U.S. (*most acquired infections in endemic countries*)

11

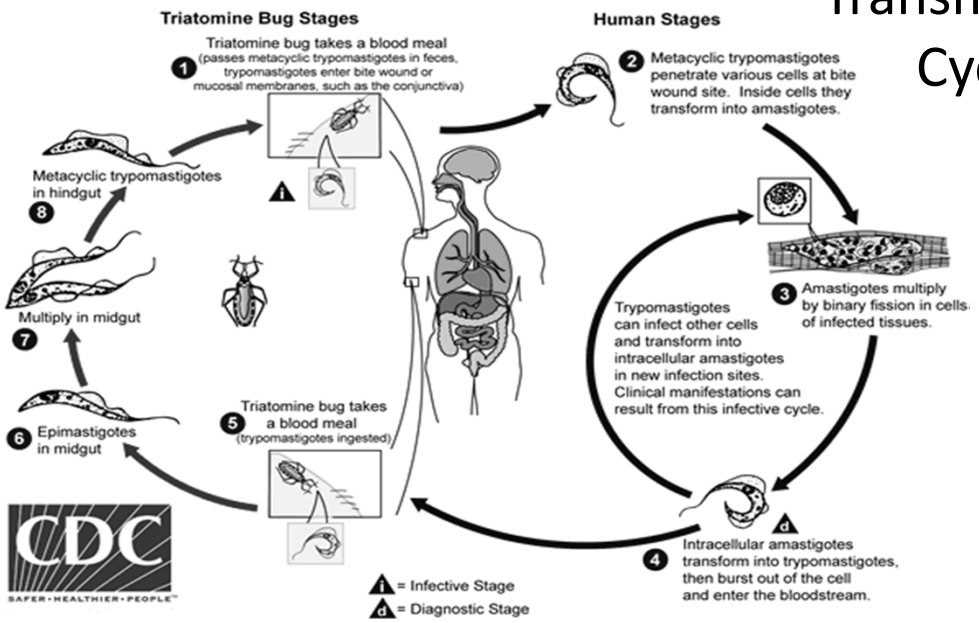
Transmission

Courtesy of Dr. Ed Wozniak

- Vector-borne disease with many animal reservoirs
- Most commonly acquired through contact with the feces of an infected triatomine bug
- Other possible modes
  - Congenital
  - Blood products
  - Solid organ transplantation
  - Laboratory accident
  - Contaminated food or drink

12

Transmission Cycle



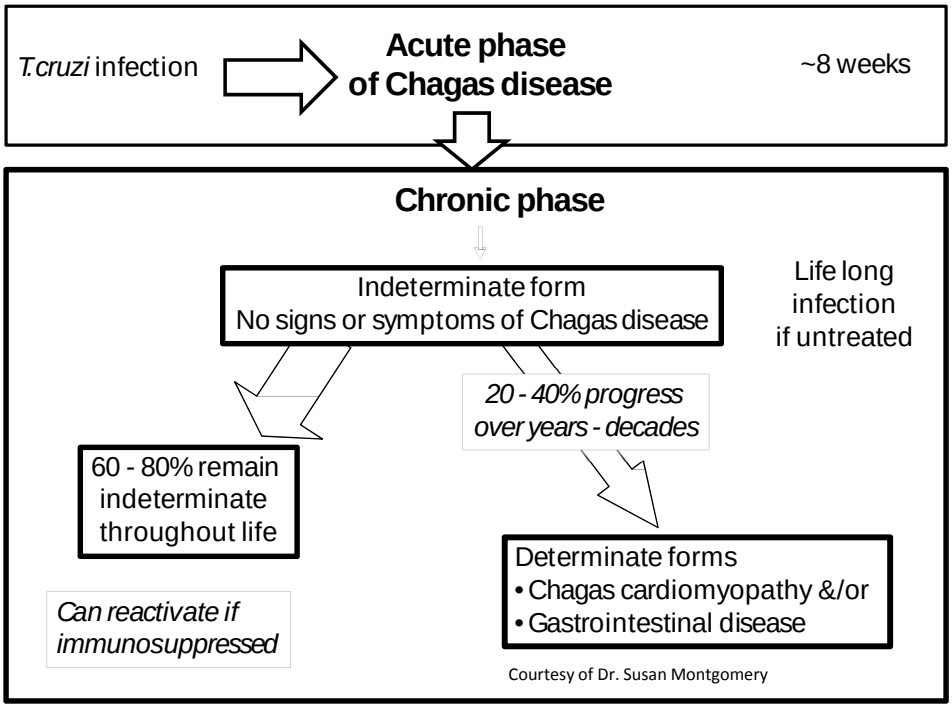
http://www.cdc.gov/parasites/chagas/biology.html

13

Portals of Entry

http://www.cdc.gov/parasites/chagas/disease.html

14



15

Acute Phase of Chagas

- Onset immediately after infection
- Lasts a few weeks or months
- Infection generally asymptomatic or mild
- May be fever, chagoma, anorexia, lymphadenopathy, mild hepatosplenomegaly
- Severe manifestation rare in the acute phase
  - Cardiomyopathy, meningitis

16

Chronic Indeterminate Phase of Chagas

- Follows the acute phase
- Most remain in this phase for life
  - Prolonged asymptomatic form of disease
  - Most are unaware of their infection
  - Estimated 20 - 40% of those in Chronic Indeterminate phase will progress to the Chronic Determinate phase

17

Chronic Determinate Phase of Chagas

- Predominantly cardiac damage
  - Conduction abnormalities
    - E.g. right bundle branch block and/or left anterior fascicular block
  - Years later, may see dilated cardiomyopathy
    - Potential late manifestation with apical aneurysm and thrombus formation
- Less frequently - Gastrointestinal Megasyndromes
  - Megaesophagus
  - Megacolon
  - Associated with parasite from Central and South America

18

Diagnosis in Acute Phase

- Microscopy
  - Identification of trypomastigotes in blood or CSF
  - Most effective during acute infections
  - Circulating parasite levels decrease rapidly within a few months and are undetectable by most methods during the chronic phase
- Blood cultures
- PCR can have limited sensitivity

19

Diagnosis in Chronic Phase

- Consider patient's clinical findings and likelihood of being infected
- Serology to detect antibody to the parasite
  - No single test with sufficient sensitivity and specificity to make the diagnosis; use two or more tests that use different techniques and/or that detect antibodies to different antigens
    - Two commonly used techniques are enzyme-linked immunosorbent assay (ELISA) and immunofluorescent antibody test (IFA)
  - Potential cross-reactivity can occur with sera from patients with leishmaniasis

20

Anti-parasitic Treatment

- Nifurtimox and benznidazole
- Most effective during early infection
- Not well tolerated
- Not FDA approved
  - Available only through CDC as investigational new drugs

Courtesy of Dr. Susan Montgomery

21

Chagas Disease – Human Disease Data

Chagas disease became reportable in Texas in 2013
http://www.dshs.state.tx.us/idcu/disease/chagas/data/

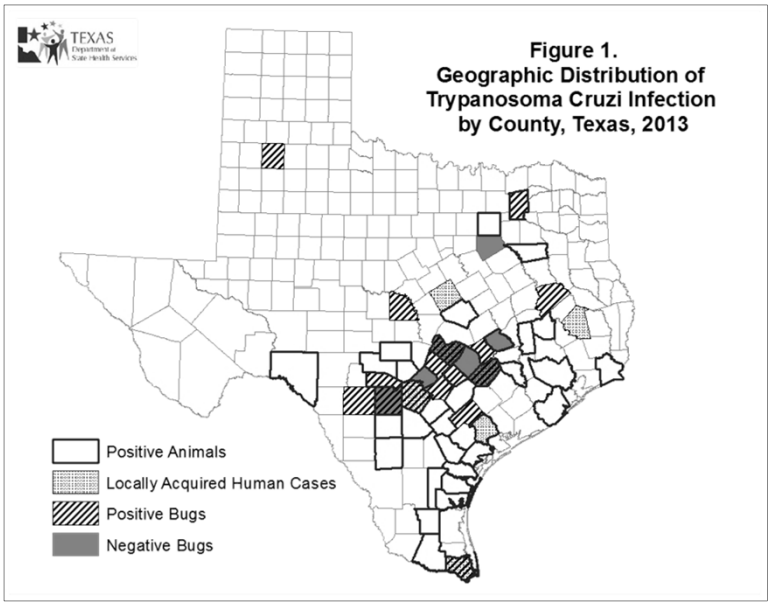
Human Chagas *Cases Reported, by County and Acquisition Method, Texas, 2013-2014

County	Locally Acquired	Imported	Unknown	Grand Total
Atascosa County	1			1
Bexar County	3	1	1	5
Brooks County	1			1
Cameron County	1	3		4
Coryell County	1			1
Dallas County		7		7
Fayette County	1			1
Fort Bend County		1		1
Harris County		7	1	8
Hidalgo County		2	1	3
Lee County	1			1
McLennan County		1		1
Polk County	1			1
Shelby County		1		1
Travis County	1			1
Victoria County	1	1		2
Total	12	24	3	39

*33 chronic indeterminate and 6 chronic symptomatic

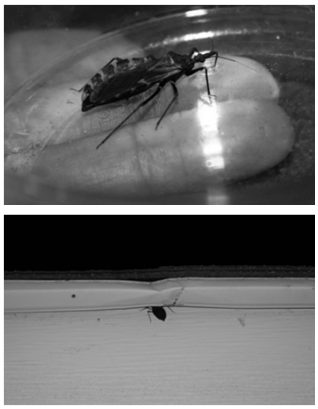
22

Chagas Disease – Reported Case Distribution, 2013



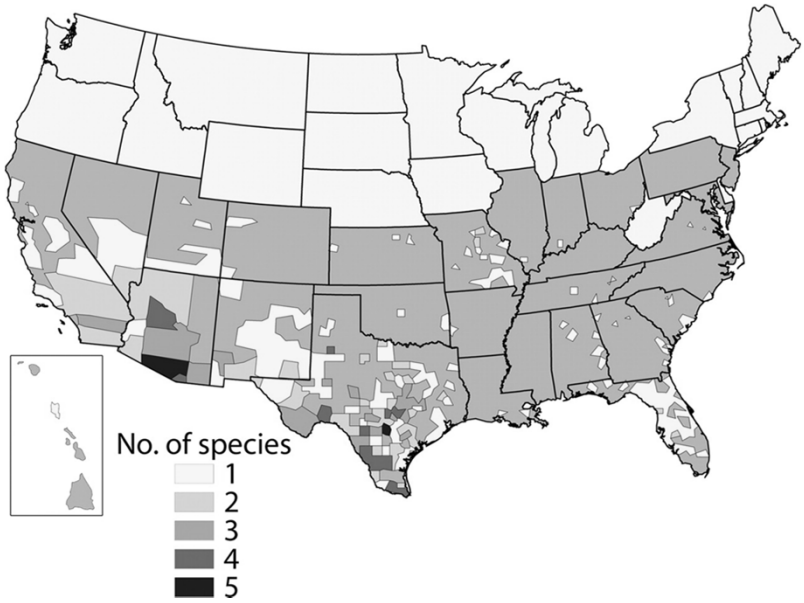
23

The Biology of Peridomestic *Triatoma gerstaeckeri* in Texas



Edward J. Wozniak DVM, PhD, MPH
Regional Public Health Veterinarian
Texas Department of State Health Services
Public Health Officer (Lt Col), Texas State Guard Medical Brigade

Species of Triatomines in North America



25

Triatoma spp. collected in Texas HSR-8 2010 - 2013

T. lecticularia

T. sanguisuga

T. gerstaeckeri

T. protracta woodi

T. indictiva

County of Origin for Illustrated Specimens

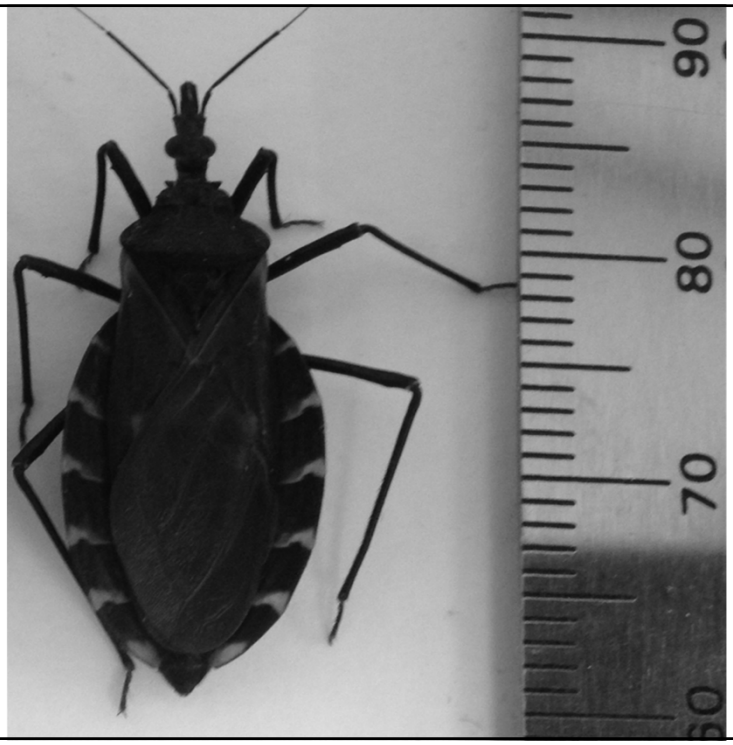
Medina Medina Bandera Uvalde Gillespie

26

Triatomine Collection Summary for Texas HSR 8 2010-2013

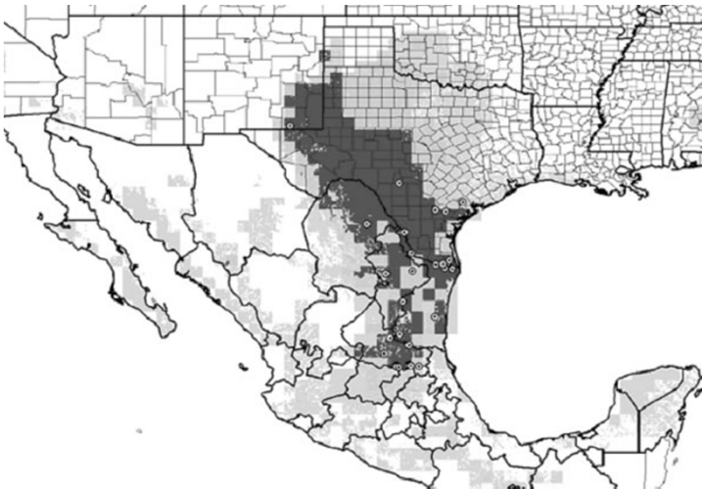
Triatoma Species	Total Collected	Peridomestic total	% Infected
T. gerstaeckeri	449	357	64%
T. lecticularia	19	17	83%
T. protracta woodi	9	7	75%
T. sanguisuga	11	9	67%
T. indictiva	1	1	0%
Triatoma spp. nymphs	56	8	33%
TOTAL	**545**	**399**	**64.4%**

27



28

Triatoma gerstaeckeri CDC Predicted Distribution

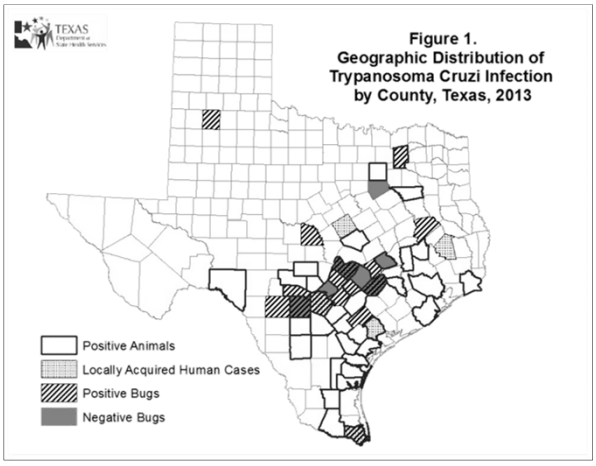


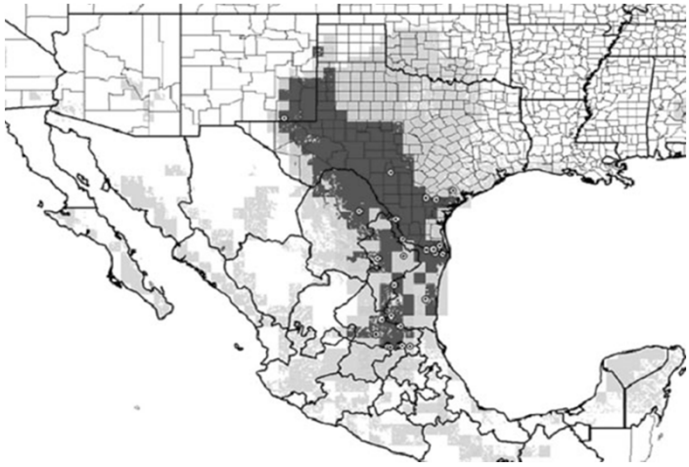
Between -96 to -104 parallels

Up to ~ 33.5 N along western edge

29

Distribution of Human & Animal Cases Reflect the Importance of *Triatoma gerstaseckeri* as a Peridomestic Vector





30

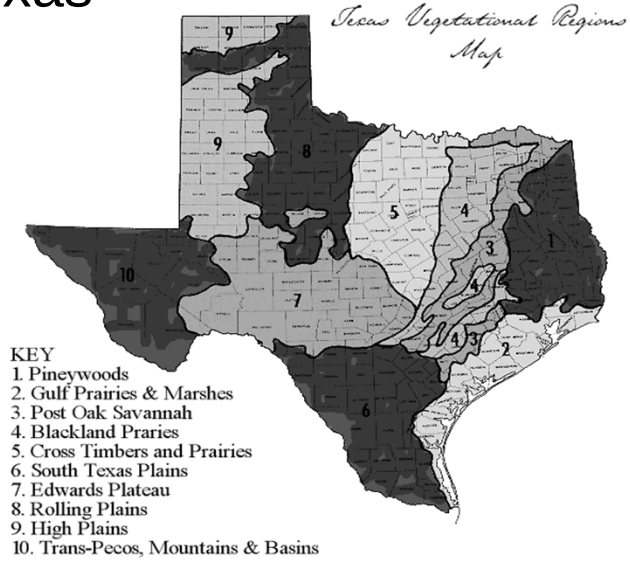
Baylor College of Medicine Texas Blood Donor Study

- Houston and San Antonio Blood Banks
- 1/6500 prospective donors tested positive
- 41% with EKG changes indicative of Chagas disease
  - Houston 36% locally acquired
  - San Antonio 73% locally acquired!

Data provided by Dr. Melisa Garcia-Nolan, Baylor School of Tropical Medicine

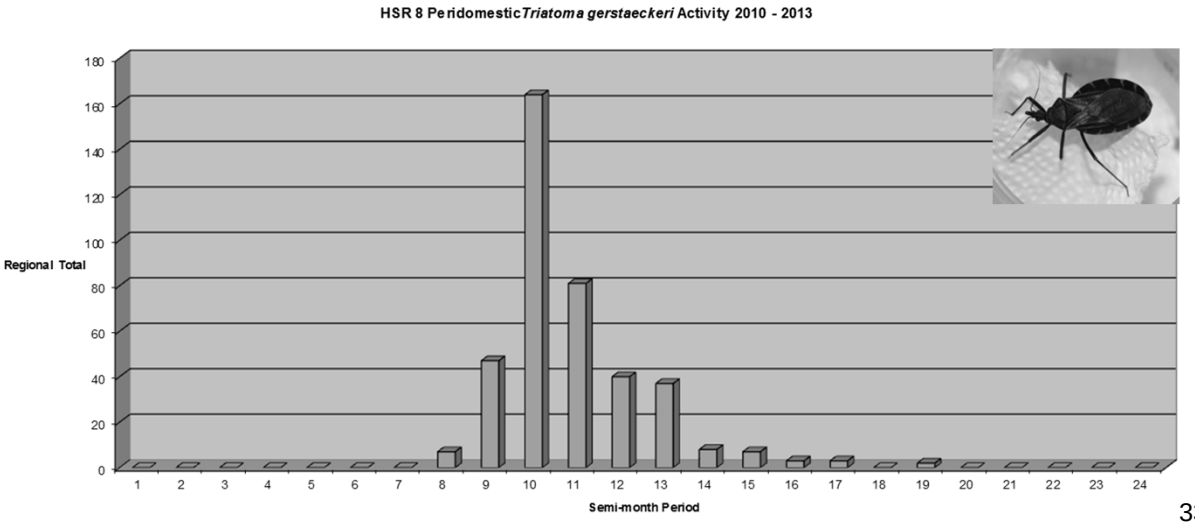
31

Habitats *Triatoma gerstaeckeri* in Texas



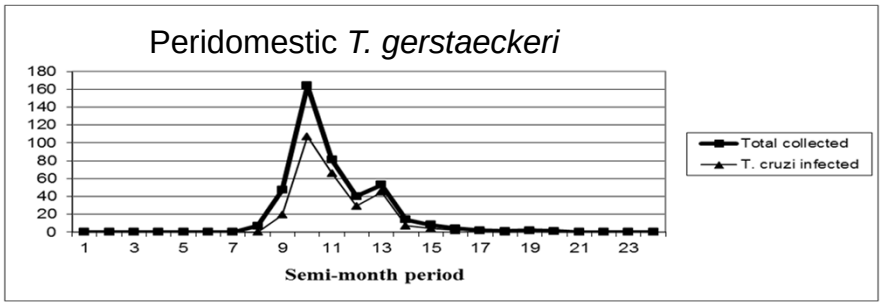
32

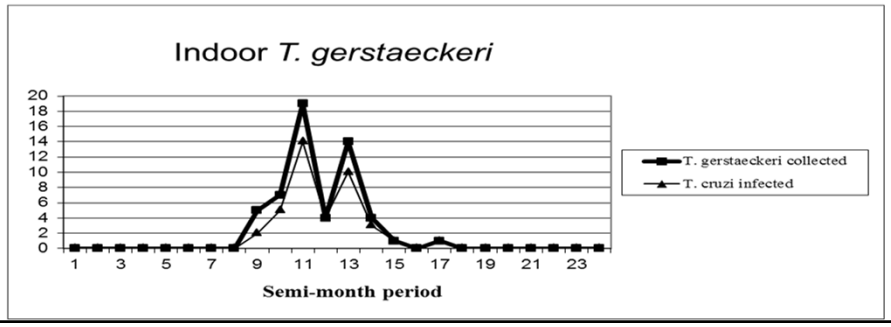
Adult Stage *Triatoma gerstaeckeri* Activity across HSR 8 by Half-month 2010 - 2013



33

Comparison of Activity & *T. cruzi* Infection Rate in HSR 8 Peridomestic & Indoor Adult Stage *T. gerstaeckeri*





34

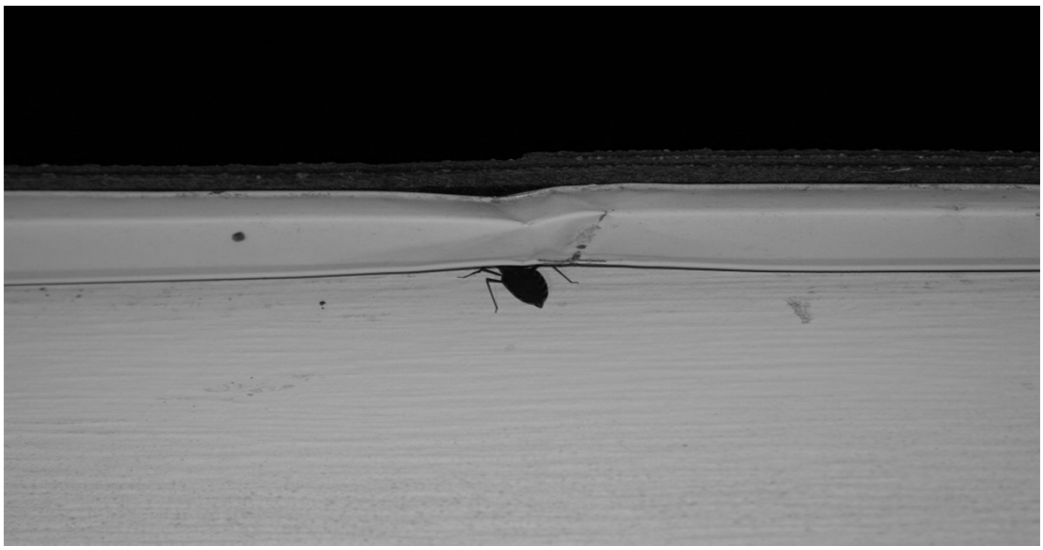
Bug Hideouts in or on Modern Houses

35

Bug refuge (gaps under siding)

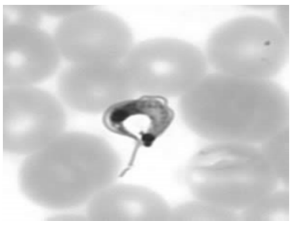
36

Adult *T. gerstaeckeri* were observed entering/leaving available gaps in exterior walls



37

Feeding to Defecation Interval



- Adult *T. gerstaeckeri* - quite variable
- Some defecate <u>while feeding</u>
- Trypanosome +
  - recovered from fresh feces
  - large kinetoplast
  - PCR (TCZ & minicircle)

39

Observed Species-Specific Differences

Triatoma lecticularia, T protracta & T. sanguisuga

- Flew to & landed on UV illuminated sheets
- Active in early evening
  - Seldom found after 11 PM
- When found on homes, often in lighted areas
- Sporadically encountered

Triatoma gerstaeckeri

- Never flew directly to lights
  - Heard, but rarely seen in flight Typically recovered from the ground around attractant set-up
- Late night species
  - seldom seen before 11 PM, often active beyond 2 AM
- Found in both lighted and dark areas on home exteriors
  - Observed utilizing available crevices on building exterior
- Frequently encountered in and around homes.

40

Triatomine Nymphs Recovered from Inside Texas Homes

Variably-sized nymphs from bed

Large N5 nymph from crib, Kerr County

<u>Variably sized & staged nymphs in a home is evidence of colonization!</u>

41

Summary

- South Central Texas has Endemic *Trypanosoma cruzi* and 5 Indigenous Species of Competent Triatomine vectors.
  - *Triatoma gerstaeckeri* found to be the dominant peridomestic species
    - High *Trypanosoma cruzi* infection rate (64%)
    - Often found in or on homes
    - Infestation involves primarily winged adults
      - Largely seasonal & transient
      - Some level of home colonization (indoor nymphs)
    - Readily feeds upon humans

- *Triatoma gerstaeckeri* Ecology May Be Changing
  - Residents report increased sightings in or on homes over last 5 years
  - Increased reports of exposures

42

Summary Cont.

- *T. cruzi* infection rate & tendency for adult stage *T. gerstaeckeri* to invade human dwellings both increased over the period of seasonal emergence (p <0.01).
  - Parasite-induced behavioral change???

- Variable Feeding-Defecation Interval
  - *Triatoma gerstaeckeri* adults often defecate while or shortly after feeding
- Locally acquired human and domestic animal cases more common in *Triatoma gerstaeckeri's* native range.

43

Chagas' Disease Biology
'The Tropics' vs South Central Texas

Bug Colonization of human habitation	Bug Colonization of human habitation
Roofs, walls and other sites	Exterior walls, yard, some inside
Regular/continued exposure likely	Intermittent exposure possible
Bug infection rate 21 - 46%	Bug infection rate ~ 64%

T. infestans

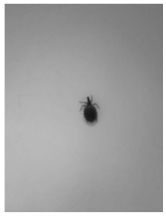
Similar to Chiapas MX (Sarkar)

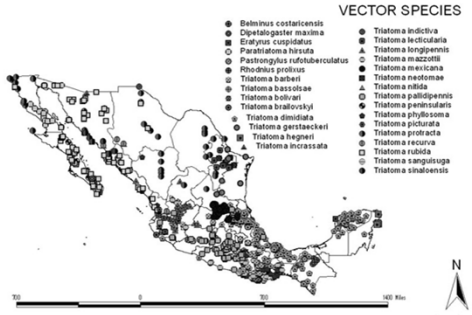
T. gerstaeckeri

44

South Texas is Similar to Parts of Mexico in Terms of Chagas' Ecology & Epidemiology

- *Triatoma gerstaeckeri* is biologically similar to
  - *Triatoma dimidiata*
  - *Triatoma pallidipennis*
- Indoor infestations
  - Seasonally transient adult stage insects
  - Some level of home colonization





45

Chagas Disease Research in Texas:

Citizen Science, Dogs, Wildlife, and Border Communities

Sarah A. Hamer PhD DVM

shamer@msu.edu

Department of Veterinary Integrative Biosciences

TEXAS A&M UNIVERSITY

46

Education and Outreach for Chagas Disease in South Texas

- Centers for Disease Control and Prevention
- Grant for 5 years
  - beginning July 1, 2015
- Approximately $544,000
- PI: Paula Stigler Granados, PhD
- Co-PI: Jose Betancourt, DrPH
- Subcontract with Texas A&M

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

UTHealth
The University of Texas
Health Science Center at Houston
School of Public Health
San Antonio Regional Campus

47

Education and Outreach for Chagas Disease in South Texas

Goals:

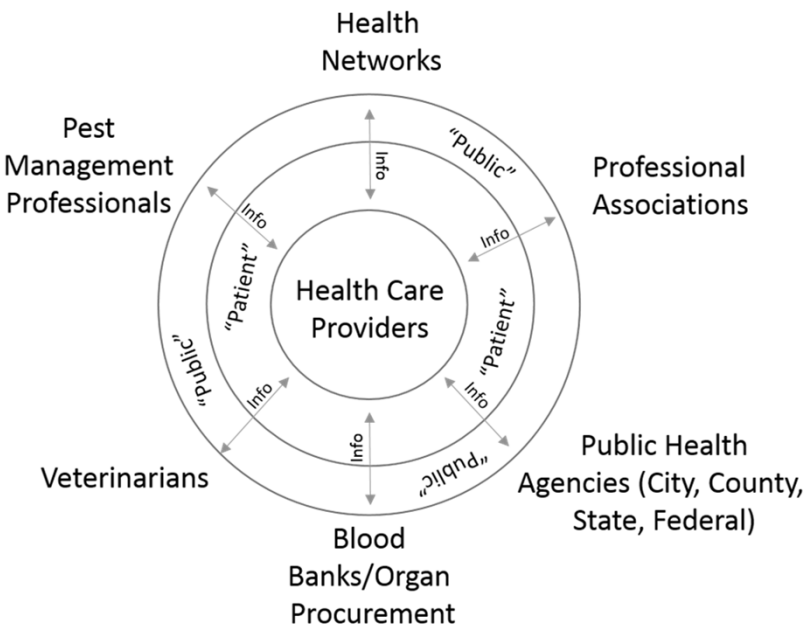
- **Increase awareness** of the presence of Chagas disease in South Texas, especially with Health Care Providers
- **Improve knowledge** regarding appropriate screening, diagnosis and treatment
- **Encourage communication** regarding prevention measures

Method:

- Convene a **Texas Chagas Task Force** with expertise the field of Chagas disease and community health
- Develop region specific **educational and outreach materials** for targeted outreach
- Provide **workshops, trainings and lectures** on Chagas disease for health care professionals and medical students

48

MODEL FOR TARGETED OUTREACH



Contact:
Paula Stigler Granados
Paula.E.Stigler@uth.tmc.edu
210-276-9024

49

Highlights of Projects Underway

1. **Citizen science and vector distributions**
2. **Shelter dogs as disease sentinels**
3. **Wildlife reservoirs of diverse parasite strains**
4. **Risk assessment along the border**

50

Outreach and Citizen Science Approach

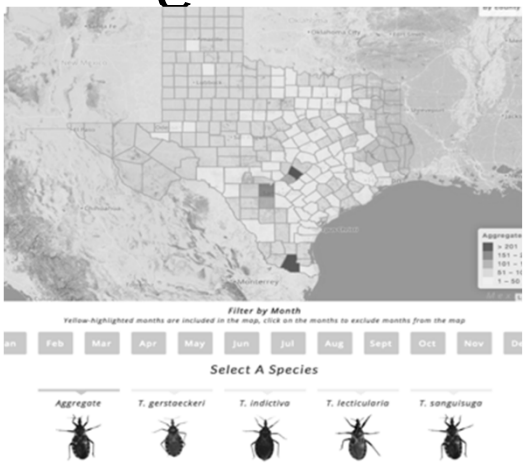
KissingBug@cvm.tamu.edu

51

Curtis-Robles et al.,
2015 PLoS Neglected Tropical Diseases

Website for citizen science program

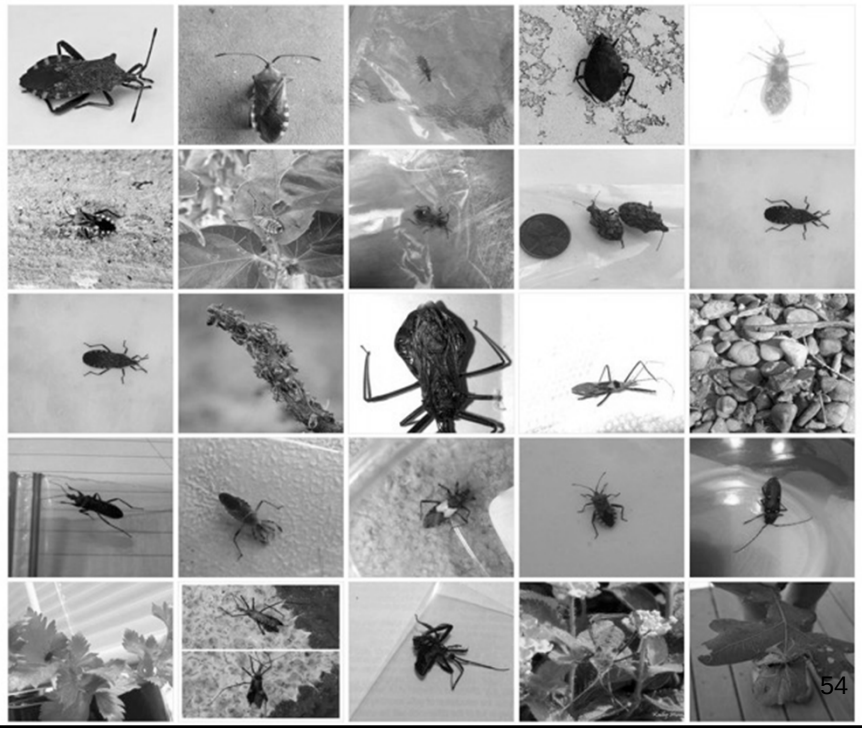
kissingbug.tamu.edu



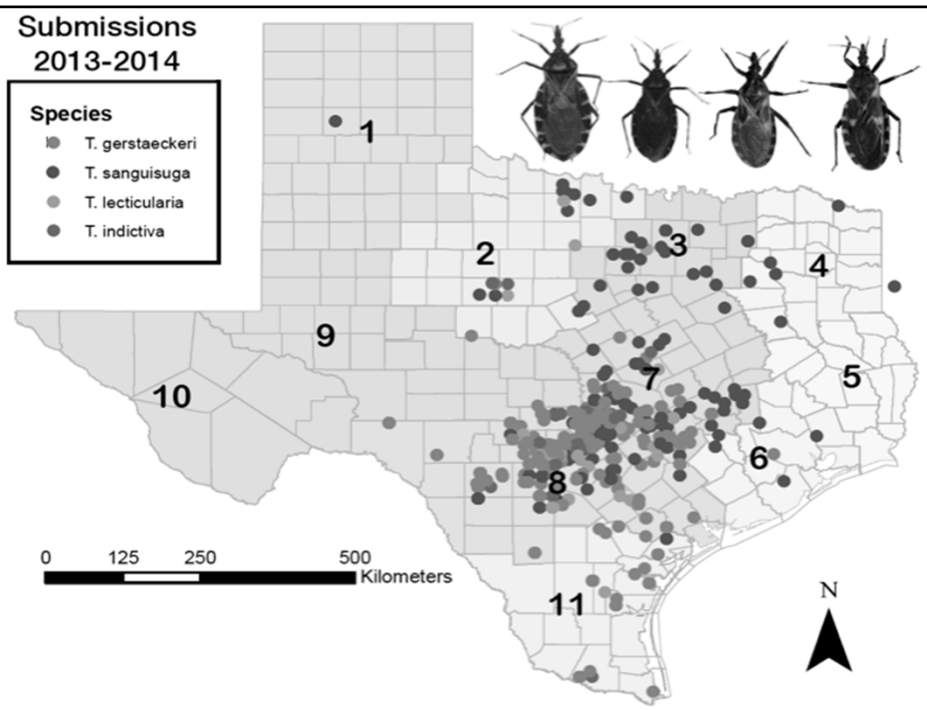
52

Results of Citizen Submissions

These are not kissing bugs!



54



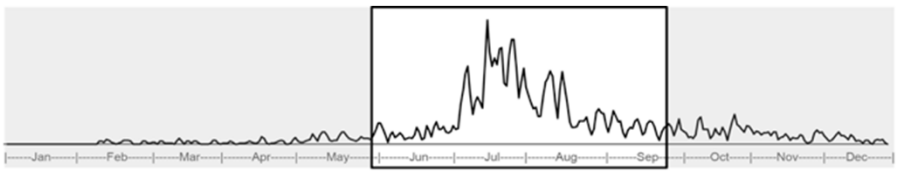
55

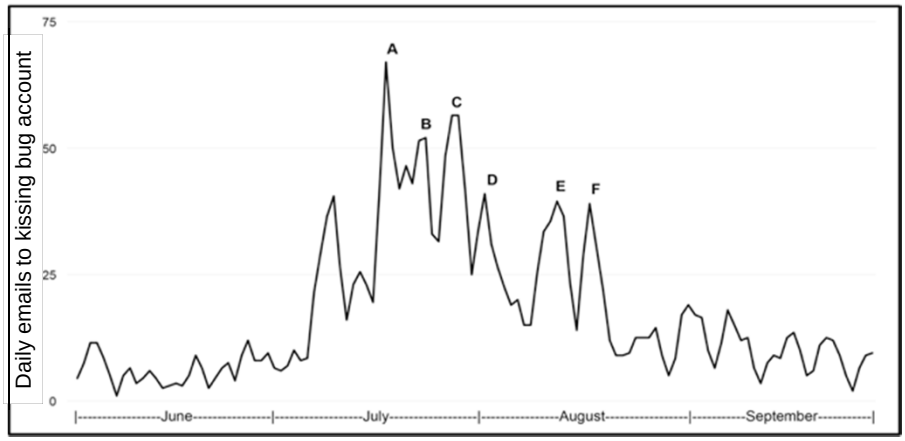
Bloodmeal Analysis

	Bug Species					
Host	***T. gerstaeckeri***	***T. indictiva***	***T. lecticularia***	***T. sanguisuga***	**Nymph**	**Total**
Anabrus simplex (cricket)	0	0	0	1 (16.7)	0	1 (3.2)
Bos taurus (cow)	1 (5.3)	0	0	0	0	1 (3.2)
Canis lupus familiaris (dog)	6 (31.6)	1 (50)	0	1 (16.7)	0	8 (25.8)
Capris hircus (goat)	1 (5.3)	0	0	0	0	1 (3.2)
Didelphis virginiana (Virginia opposum)	0	1 (50)	0	0	0	1 (3.2)
Felis silvestris (cat)	1 (5.3)	0	0	0	0	1 (3.2)
Gallus gallus (chicken)	1 (5.3)	0	1 (100)	0	0	2 (6.5)
Gopherus berlanderi (tortoise)	0	0	0	0	1 (33.3)	1 (3.2)
Homo sapien (human)	2 (10.5)	0	0	2 (33.3)	1 (33.3)	5 (16.1)
Ovis aries (sheep)	3 (15.8)	0	0	0	0	3 (9.7)
Panthera tigris altaica (tiger)	0	0	0	0	1 (33.3)	1 (3.2)
Procyon lotor (raccoon)	1 (5.3)	0	0	1 (16.7)	0	2 (6.5)
Sus scrofa (wild boar)	1 (5.3)	0	0	0	0	1 (3.2)
Mixed	2 (10.5)	0	0	1 (16.7)	0	3 (9.7)
All	19	2	1	6	3	31

56

Public Interest Responds to the Media

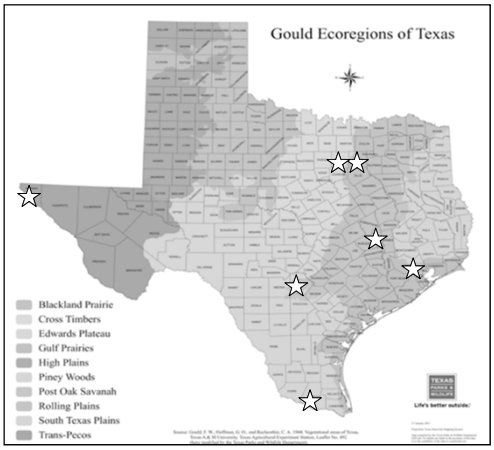




57

Shelter Dogs as Sentinels

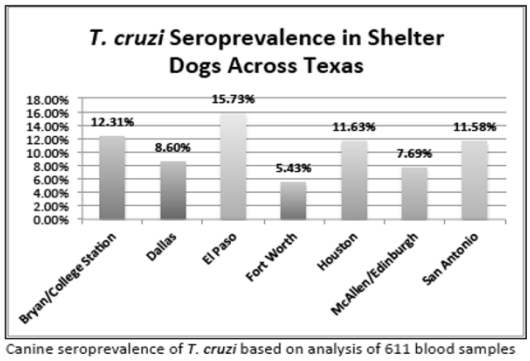
- High risk populations for exposure to vectors
- Longitudinal study at 7 shelters to detect canine exposure to a suite of vector-borne agents



58

Shelter Study Results

- ***T. cruzi* antibody detection**
  - Overall seroprevalence was **10.97%** (67/611)
  - Seropositive dogs found at all shelters
  - Prevalence ranging from 5.4-15.7%



Canine seroprevalence of *T. cruzi* based on analysis of 611 blood samples from dogs.

Tenney et al. 2014. Emerging Infectious Diseases

59

Key Question:

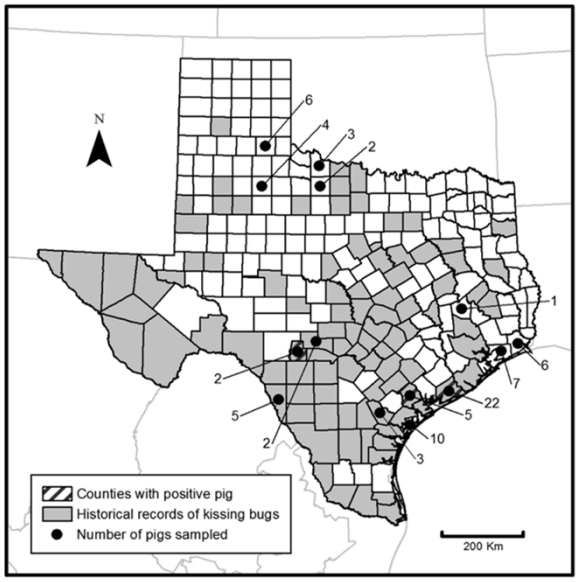
- What are the public health implications of owning a positive dog?
  - Positive dogs are typically indicative of a landscape conducive to transmission

60

Feral Hogs as Reservoirs?

61

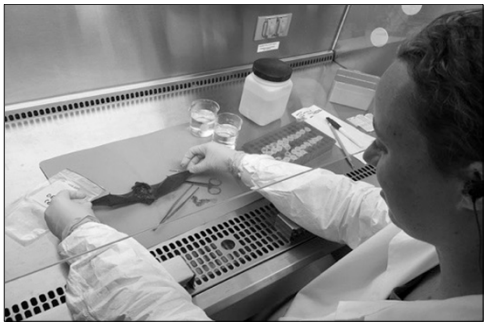
Low prevalence in feral hogs (3/54)



62

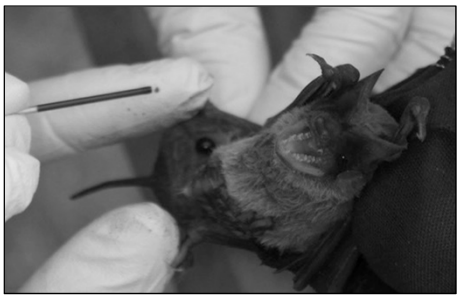
Migratory Bats as Reservoirs?

Epidemiologically-relevant dead bats across TX



Partnership with TDSHS

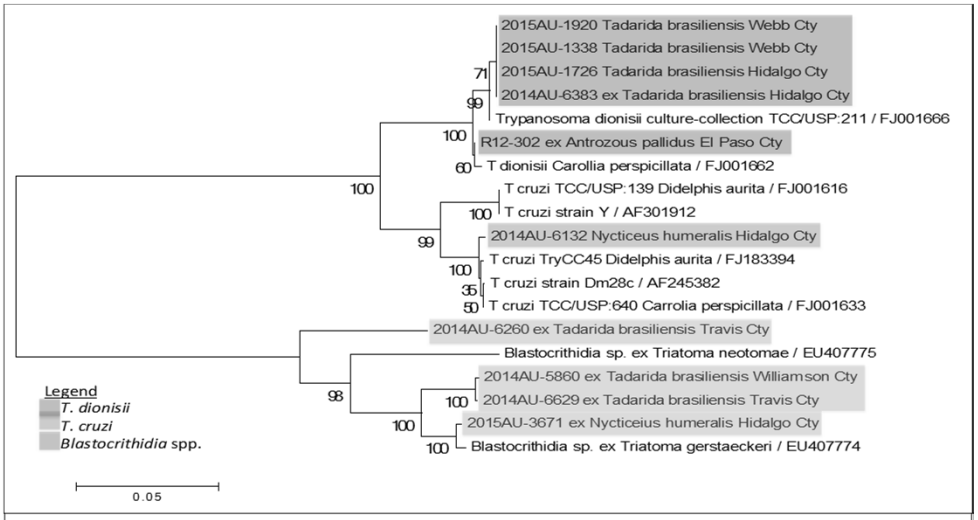
Wild bats from Chagas hotspots in south TX



Mist nets at private ranches and caves

63

Low Prevalence in Bats (1/593)



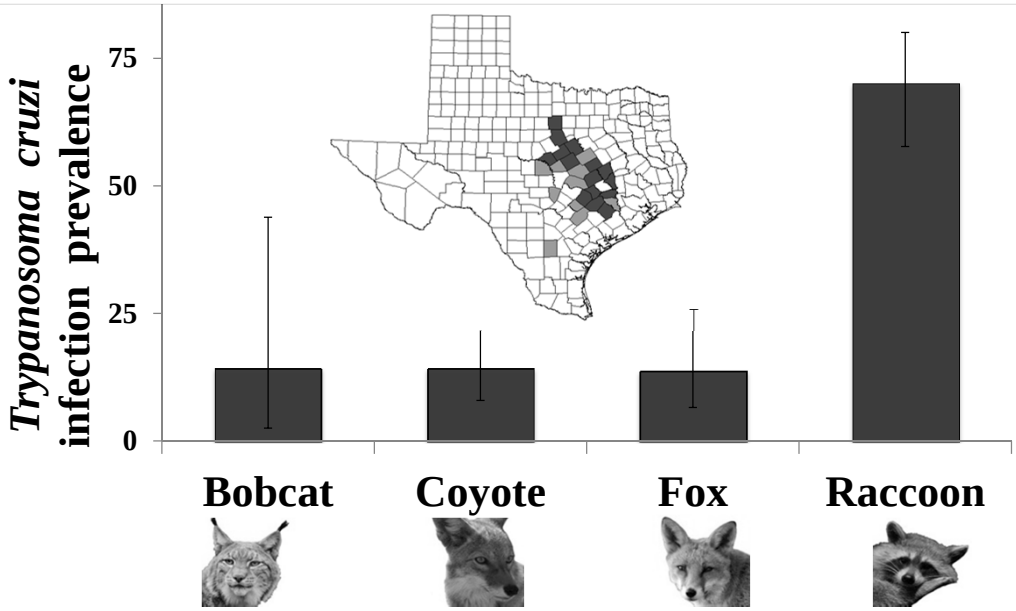
Phylogenetic tree based on the 632bp region of the 18S rRNA gene illustrating the relationships between the sequences obtained in this study (highlighted) and selected reference sequences. Created using the Neighbor-Joining method in MEGA6.

64

Mesopredators as Reservoirs?

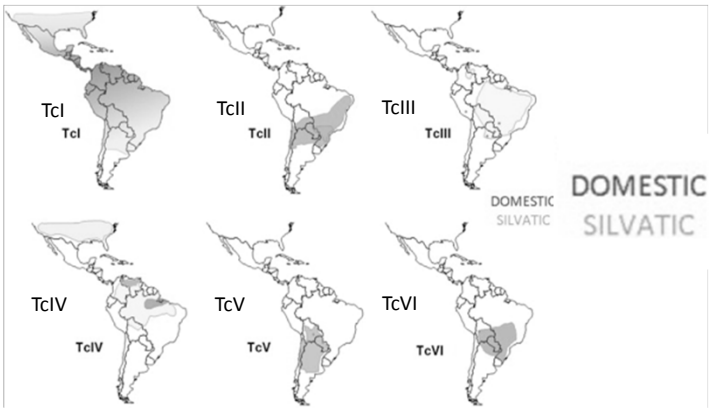
65

Raccoons Are Highly Infected (n=226)



66

Trypanosoma cruzi Strains

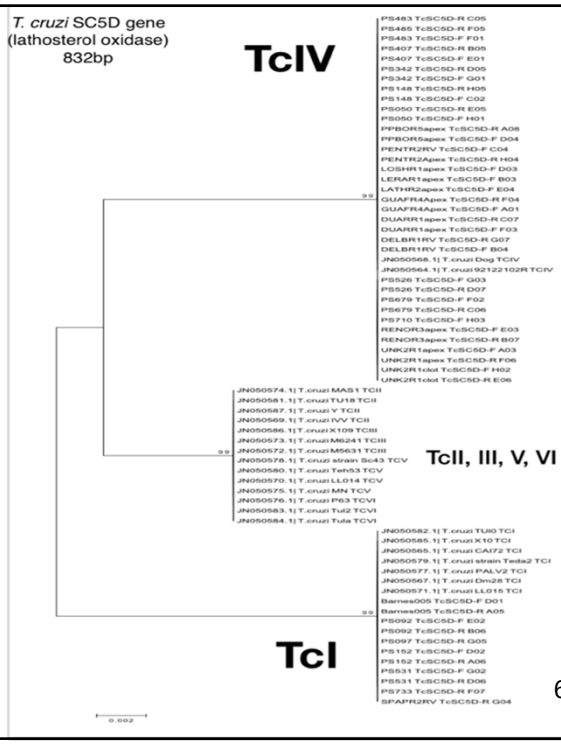


Presently known geographic distribution of *Trypanosoma cruzi* strains in the tropical and subtropical regions of the New World. Figure adopted from Zingales, *et al*. 2012. *Infection, Genetics and Evolution* 12:240-253.

67

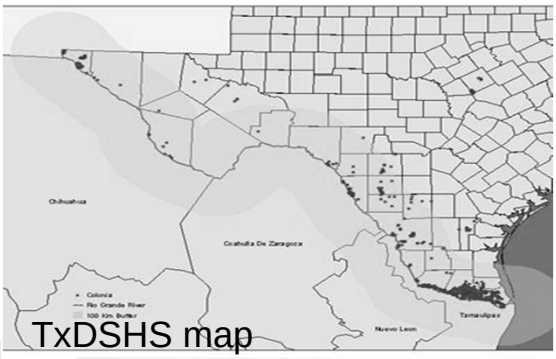
Trypanosoma cruzi strain variation

- **Triatomine bugs (n=30)**
  - 56% TcI
  - 44% TcIV
- **Raccoons (n=12)**
  - 8% TcI
  - 92% TcIV



68

Colonias - High Risk Populations?



69

- Testing dogs
- Testing people
- Housing survey
- Demographic information

70

Community Recruitment

¿Ha visto este bicho peligroso?

Si lo ha visto, por favor llame
(956) 373-5172 o (956) 358-2295
para más información

TEXAS A&M UNIVERSITY

71

Human Results

Site	No. tested	No. screened positive	Prevalence
SH	16	2	12.5%
CA	30	1	3.3%
LP	46	0	0%
BT	56	1	1.8%
AN	13	0	0%
All	**161**	**4**	**2.5%**

Human ID	H16	H54	H03	H29
StatPAK	POS	POS	POS	POS
Chagas Detect	POS	NEG	POS	POS
Mayo IFA	NEG	NEG	POS	N/A

72

Canine Results

Site	No. tested	No. screened positive	Prevalence
CA	14	3	21.4%
LP	23	5	21.7%
BT	54	10	18.4%
AN	22	6	27.3%
All	113	24	21.2%

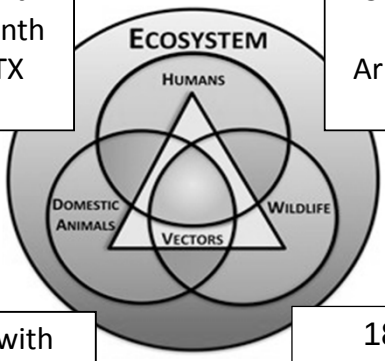
- 4/110 (3.6%) have parasite DNA in blood
- One seropositive dog in same household as seropositive human

73

Is Chagas Disease Emerging?

1955: First human diagnosed with Chagas disease in the US, 6 month old baby girl, Corpus Christi, TX
Woody and Woody, 1955

1942: Wildlife species found to be infected in TX: Armadillo, Woodrat, Opossum
Packchanian, 1942



1975: First dog diagnosed with Chagas disease in TX (TAMU)
Williams, et al. 1977

1859: First kissing bug described in TX: *Triatoma gerstaeckeri*
Stal, 1859

74

Questions and Answers

Linda Gaul, PhD
State Epidemiologist,
Texas Department of
State Health Services

Remote sites can send in questions by typing in the *GoToWebinar* chat box or email GrandRounds@dshs.state.tx.us.

For those in the auditorium, please come to the microphone to ask your question.

75

April 13

Case Studies Examining the Impact of Community Health Workers/Promotores

Presenters: Oscar J. Muñoz, Dir., Colonias Program, Texas A&M University; Monica Garcia, CHW, CHWI, Supervisor, Larry Combest Community Health & Wellness Center, Texas Tech University Health Sciences Center; Rosamaria Murillo, PhD, Dir., Office of Border Affairs, TX HHSC; Evelyn Delgado, Assistant Commissioner at Texas Department of State Health Services