Progress update by the Livestock Arthropod Pests Research Unit

Dr. John Goolsby et al.
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Research Update

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East Foundation, San Antonio, TX
Texas A&M Kingsville- Cesar Kleberg Wildlife Institute, Kingsville, TX
USDA-ARS, College Station, TX & Byron, GA
University of Texas, Rio Grande Valley, Edinburg, TX
Update

• Nilgai home range
• Nilgai lures
• Lab and Barn test of tick nematodes
• Nilgai sprayer
• Nilgai latrine ecology
• Exploration CFT native range for BC agents
Cattle Fever Tick (CFT)  
*Rhipicephalus (=Boophilus) microplus*

- One host tick
- Hosts: Bovidae & Cervidae
- Transmit bovine babesiosis
- Resistant to most acaricides
- Worldwide distribution in tropical, subtropical and warm temperate climates
- Major limitation to cattle & milk production
Cattle Fever Tick Hosts Texas & Mexico

- Acaricides, vaccines
- Medicated corn feeders
- No known methods for treatment
What has changed?

Tick is resistant to most acaricides
Exotic weeds favor survival of tick
A new, highly mobile, host animal of the tick is now widespread
Nilgai Biology

- Members of the Bovidae
- Closely related to cattle
- Native to India
- Cows – 600 lbs. Bulls – 800 lbs.
Nilgai Home Range Study

- Collaborators: Hewitt, Foley, TAMUK; Campbell and Ortega – East Foundation
- Funding: Texas Animal Health Commission
- Location: East Foundation – El Sauz, Willacy Co.
- 30 adult nilgai collared with GPS tracking devices (Lotek) 50/50 bulls/cows
- Data: home range, max distance, effect of helicopters, physical barriers (roads & farmland)

Females have > home range
Young females have largest home range by far!

![Graph showing home range by sex and age with young adult females having the largest range.](image)
NILCAI MOVEMENTS ON EL SAUZ

On one hand, nilgai antelope are a prized trophy for hunters, offering year-round recreational opportunities. On the other hand, nilgai compete for forage with cattle and white-tailed deer, and are a host of cattle fever ticks, thus complicating tick eradication strategies. As such, nilgai are loved by some landowners and loathed by other landowners. Either way, more information is needed to develop effective nilgai management strategies.

Very little is known about the biology of nilgai on rangelands of South Texas, particularly related to their movement rates, patterns, and habits. In a recent publication investigating nilgai movements in South Texas, animals displayed no differences between sexes in home range size and had maximum home range axes between 8 and 10 miles. However, nilgai behavior was highly variable. New GPS collars allow for more detailed characterizations of animal movements.

Together with our partners, we placed 30 state-of-the-art GPS collars on 15 cow nilgai and 15 bull nilgai in early April 2015 on our El Sauz Ranch. GPS locations from only a few months of sampling on the El Sauz Ranch suggest:

- About half of nilgai remained on the Ranch
- About a quarter of nilgai used the Ranch and adjacent properties
- About a quarter of nilgai moved away from the Ranch
- For animals that have moved away from the Ranch, distances were from 1 to 30 miles

Our ultimate goal is to gain understanding of nilgai behavior and determine effective management unit size. This will enable landowners to make informed management decisions related to this non-native animal.

Nilgai Lure Study

- Collaborators: Hewitt, TAMUK; Campbell and Ortega – East Foundation; Singh, Guru Angad Dev Veterinary University
- Nilgai attractants would be useful for developing CFT treatments
- Nilgai form communal latrines
- Nilgai prefer to make latrines on offal
- Testing synthetic offal (Screw worm lure, and bovine volatile fatty acids (VFA))
Nilgai Latrine  Offal – Induces Latrine
Screwworm Lure – Offal Mimic

Nilgai Bull at Lure
Nilgai Lure Study Results

- Offal the most attractive
- Screwworm lure the only other lure that induced latrine formation
- High rates of Screwworm lure being tested at East Foundation, Santa Rosa

Update

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• Nilgai lures
• Lab and Barn test of tick nematodes
• **Nilgai sprayer**
• Thermal UAV density estimates & harvest
• Nilgai latrine ecology
• Exploration CFT native range for BC agents
Attract and Treat at Latrines

• Collaborators: Clint Hoffman, Ag Engineer, USDA-ARS College Station; David Shapiro, Nematologist, USDA-ARS, Byron, GA; Hewitt, TAMUK; Campbell and Ortega – East Foundation; Singh, Guru Angad Dev Veterinary University

• Sensor activated ultra quiet sprayer

• Use nematode, native *Steinernema riobravae* to control CFT, acceptable for USFWS.

• Funding USDA-APHIS-VS Microgrant Program
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Lab and barn test of tick nematodes

- *Heterorhabditia floridensis* & *Steinernema riobravae* highly effective in lab assays
- Whole animal treatment study at 1X completed with moderate efficacy. Plan to repeat at 10X
- *Steinernema riobravae* native to South Texas and Northeastern Mexico and has high heat tolerance
- *S. riobravae* is commercially available from BASF Company
Nematode Infection of CFT

- Normal cattle fever tick

1 day after nematode application

7 days after nematode application

control
Effect of various nematode infective juveniles (IJs) on reproductive parameters of *Rhipicephalus (Boophilus) microplus* engorged females following 72 h exposure on filter paper

<table>
<thead>
<tr>
<th>Nematode</th>
<th>Nematode concentration (IJs/dish)</th>
<th>Av. tick wt. ± SE (mg)</th>
<th>Av. egg mass wt. ± SE (mg)</th>
<th>RI ± SE</th>
<th>%IO ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Steinernema riobrave</em></td>
<td>1250</td>
<td>293.9 ± 12.5</td>
<td>100.8 ± 11.5</td>
<td>0.34 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37.27 ± 6.94</td>
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<td></td>
<td>2500</td>
<td>354.8 ± 11.3</td>
<td>12.3 ± 6.5</td>
<td>0.04 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>93.03 ± 3.93</td>
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<tr>
<td></td>
<td>5000</td>
<td>352.3 ± 6.8</td>
<td>0 ± 0</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>100 ± 0</td>
</tr>
<tr>
<td><em>S. carpocapsae</em></td>
<td>1250</td>
<td>334.1 ± 14.7</td>
<td>129.2 ± 11.4</td>
<td>0.37 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>31.11 ± 5.7</td>
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<td></td>
<td>2500</td>
<td>348.9 ± 12.8</td>
<td>26.1 ± 10.0</td>
<td>0.07 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>86.49 ± 5.23</td>
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<td>5000</td>
<td>379.5 ± 11.7</td>
<td>16.2 ± 12.3</td>
<td>0.04 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
<td>93.47 ± 4.76</td>
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<td><em>S. feltiae</em></td>
<td>1250</td>
<td>333.8 ± 17.5</td>
<td>142.2 ± 12.0</td>
<td>0.43 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.56 ± 6.11</td>
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<td>2500</td>
<td>346.7 ± 10.1</td>
<td>165.2 ± 11.8</td>
<td>0.48 ± 0.03</td>
<td>12.61 ± 5.89</td>
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<td>5000</td>
<td>352.7 ± 8.9</td>
<td>160.5 ± 14.6</td>
<td>0.45 ± 0.04</td>
<td>17.47 ± 7.30</td>
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<td><em>Heterorhabditis</em></td>
<td>1250</td>
<td>342.6 ± 17.5</td>
<td>82.3 ± 13.9</td>
<td>0.23 ± 0.04&lt;sup&gt;b&lt;/sup&gt;</td>
<td>57.19 ± 7.57</td>
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<td>bacteriophora</td>
<td>2500</td>
<td>333.2 ± 13.8</td>
<td>15.7 ± 6.3</td>
<td>0.06 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>5000</td>
<td>359.2 ± 8.0</td>
<td>2.9 ± 2.0</td>
<td>0.008 ± 0.005&lt;sup&gt;b&lt;/sup&gt;</td>
<td>98.53 ± 1.02</td>
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<td><em>H. indica</em></td>
<td>1250</td>
<td>318.3 ± 14.4</td>
<td>117.5 ± 17.5</td>
<td>0.36 ± 0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>34.47 ± 9.36</td>
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<tr>
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<td>2500</td>
<td>349.9 ± 13.8</td>
<td>21.4 ± 10.1</td>
<td>0.06 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>88.33 ± 5.94</td>
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<td>5000</td>
<td>378.0 ± 10.4</td>
<td>1.0 ± 1.0</td>
<td>0.002 ± 0.002&lt;sup&gt;b&lt;/sup&gt;</td>
<td>99.57 ± 0.42</td>
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<td><em>H. floridensis</em></td>
<td>1250</td>
<td>321.7 ± 16.7</td>
<td>1.45 ± 1.45</td>
<td>0.003 ± 0.003&lt;sup&gt;b&lt;/sup&gt;</td>
<td>99.40 ± 0.59</td>
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<tr>
<td></td>
<td>2500</td>
<td>350.5 ± 9.2</td>
<td>0 ± 0</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>100 ± 0</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>354.1 ± 12.0</td>
<td>0 ± 0</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>100 ± 0</td>
</tr>
<tr>
<td>Control</td>
<td>-</td>
<td>312.3 ± 13.7</td>
<td>172.2 ± 12.8</td>
<td>0.55 ± 0.03</td>
<td>0.0</td>
</tr>
</tbody>
</table>

RI- Reproductive index; % IO- Percentage inhibition of oviposition; <sup>a</sup>(P < 0.05); <sup>b</sup>(P < 0.01)
Dose mortality curve of *R. microplus* against nematode species on 72 h exposure.
Effect of *Steinernema* & *Heterorhabditis* IJs against *Rhipicephalus microplus*

- In filter paper test exposure tests, 72 hours *H. floridensis* caused 100% at 2500 IJ/ml, followed by *S. riobravae* 100% at 5000 IJ/ml.

- In immersion tests, *H. floridensis* caused 100% mortality at 5000 IJ/ml with an immersion for above 30 sec period. However, other EPN did not cause high mortality in any immersion time (max. of 40% for *H. indica* for 30 min immersion).

- A significant effect on the reproductive parameters of *R. microplus* female ticks was recorded for all EPNs.

- Hatchability percent of 60-70 was recorded in *S. riobrave* exposed groups whereas, no effect was seen in eggs of other groups.
Update

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• Nilgai latrine ecology
• Exploration CFT native range for BC agents
Thermal UAV

- Can detect nilgai under dense brush canopy
- 1km meandering transects surveys in Cameron Co. = 1: 88
- How does density compare to 1: 44 ratio at East Foundation?

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Latrine Ecology

• Study with CKWRI, M.S. student
• Funded by Las Huellas wildlife organization
• How many latrines per acre
• How many nilgai visit each latrine (molecular analysis of dung)
• Tie-in to nilgai sprayer
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Biological control of cattle fever ticks

A. Racelis = native range
R. hookeri = introduced range

The southern cattle fever tick, Rhipicephalus microplus, has several important hosts including domestic cattle, whitetailed deer and Indian nilgai antelope. Biological control could potentially reduce populations of tick in Mexico and reduce the risk of invasion into the U.S. along the Rio Grande. Biological control could be integrated with current cattle fever tick eradication programs.

Wildlife Hosts of CFT

White-tailed Deer
Exotic Indian Nilgai

These pictures show the tick parasitoid Arachnocoris neokori, a parasitoid of the tick Ixodes acapari. We hypothesize that a similar specialist parasitoid occurs in the native range of cattle fever tick. On right is Ixodiphagous aethes, a newly described species from India. Its tick host is unknown.

Cattle Fever Ticks

Potential Biocontrol Agents

Exploration in Native Range

Tick Exposures to Collect Parasitoids

Predation Questing Larvae

Soil-Dwelling Predators

Fig. 1. Native and introduced ranges of cattle fever ticks (Rhipicephalus spp.). Red = introduced range of R. microplus, Pink = R. microplus eradicated, Blue = native range of R. annulatus, Purple = introduced range, Green = native range of R. microplus, Yellow = native range of R. australensis. Stars = search locations for biocontrol agents.


The southern cattle fever tick, *Rhipicephalus microplus* has several important hosts including domestic cattle, whitetail deer and Indian nilgai antelope. Biological control could potentially reduce populations of tick in Mexico and reduce the risk of invasion into the U.S. along the Rio Grande. Biological control could be integrated with current cattle fever tick eradication programs.

**Fig. 1.** Native and introduced ranges of cattle fever ticks (*Rhipicephalus* spp.) **Red** = introduced range of *R. microplus*, **Pink** = *R. microplus* eradicated, **Blue** = native range of *R. annulatus*, **Purple** = introduced range, **Green** = native range of *R. microplus*, **Yellow** = native range of *R. australensis*. **Stars** = search locations for biocontrol agents.
Wasp inserts egg tick nymph

Egg hatches and wasp larvae begins feeding

Wasp larvae completes development

Tick mummifies and next generation of wasps emerge

Multiple wasps emerge from dead tick

Adult wasps search for ticks

Life cycle of the tick parasitoid *Ixodiphagus hookeri* on *Ixodes ricinus* tick
Biopesticides in Native Range

We hypothesize that a similar specialist parasitoid nematode which can be used as a tick biocides. Other CFT with spider in background.

These pictures show the predator mites Anystis aethes, a newly described species from India. Its tick host is unknown. These pictures show the tick parasitoid Steinernemidae specialists may occur in the native range.

Currently, no treatment is available for CFT on nilgai. Ticks beyond the border with Mexico and within temporary quarantine zones in Texas.

White-tailed Deer and other exotic wildlife can be hosts of CFT and treatment of tick infestation programs.

White-tailed Deer and other exotic wildlife can be hosts of CFT and treatment of tick infestation programs.
Summary

- Develop method to treat CFT on nilgai to aid in eradication of CFT from Cameron and Willacy Counties.

- Develop biocontrol methods to reduce CFT populations in Mexico along border.