

Texas Center Research Fellows Grant Program 2005-2006

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Research Question: Currently I have two research questions I am working on.

1. What is the current level of tickborne disease in the ticks on the TAMIU campus, and other locations in Webb County?
2. Can we predict microhabitat preference for ticks in South Texas.

What are ticks? Ticks are blood-sucking arachnids commonly found in wooded and grassy areas throughout the United States. They are major vectors of infectious diseases. Ticks have a simple life cycle, hatching from an egg as a larva, grow into a nymph, and finally mature into an adult. At each stage of their life cycle they take a single blood meal. Often during taking the blood meal they acquire a pathogenic organism which they transmit, in their subsequent blood meal to another host. Additionally, some tick-borne diseases are transmitted from the adult female to the eggs that she lays. This means that the newly hatched larva is already carrying and will transmit the pathogen. The larvae are particularly difficult to notice on a human host since they are only slightly larger than the period at that end of this sentence (Figure 1).

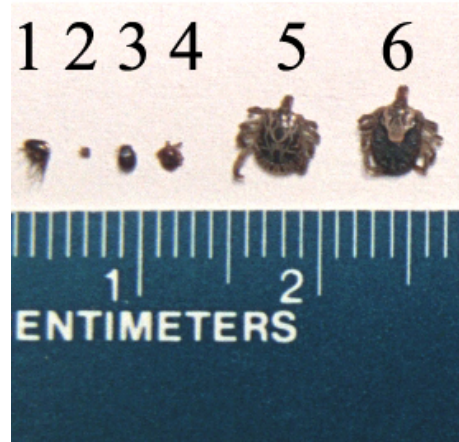


Figure 1: A flea and ticks are shown. 1. A flea; 2. a larval tick; 3. a larval tick after taking a blood meal; 4. a nymph; 5. an adult male; 6. an adult female.

Importance: Why study the occurrence of ticks and tick-borne disease? After mosquitoes, ticks are the second most common vector of infectious diseases. Tick bites often go unnoticed for several days. Ticks are able to bite you without causing noticeable irritation while they feed off of your blood. The long term goal of this project is to complete an analysis of the disease prevalence in ticks isolated from the TAMIU campus and other locations in South Texas. We have field sites currently in Eagle Pass, Zapata, and Webb County.

Regional Significance: There is a very low rate of tick borne disease reported in Webb County. A recent seroprevalence study conducted in Coahuila, Nuevo Leon and Tampaulipas, Mexico demonstrated a 6%, 3.9%, and 14.1% with antibodies against *Borrelia burgdorferi* by western blot. *Borrelia burgdorferi* is the causative agent of Lyme disease (4). This is a very high prevalence rate for a single tick borne disease considering that Lyme disease is rarely diagnosed in Texas with only 639 cases diagnosed between 1986 and 1996 in the entire state (3). This sharp contrast between the number of cases diagnosed in Texas and the high seroprevalence rate across the border from South Texas

demands a careful evaluation of tickborne diseases in South Texas. If we do not know what is going on in South Texas how do we know what our risk is.

What is the current level of tick activity on the TAMIU campus?

From June 2005-July 2006 we collected over 22849 ticks off of the TAMIU campus using CO₂ traps. The vast majority of those ticks collected (98.3 %) were *Amblyomma cajennense* (Table 1). *Amblyomma cajennense* (the Cayenne Tick) is of

Tick Species	# Collected	% of Total
<i>Amblyomma cajennense</i>	22459	98.3%
<i>Amblyomma inornatum</i>	236	1.0%
<i>Amblyomma maculatum</i>	3	0.01%
<i>Dermacentor albipictus</i>	45	0.2%
<i>Dermacentor variabilis</i>	57	0.2%
<i>Haemaphysalis leporispalustris</i>	33	0.1%

serious concern, to quote one researcher, “all stages feed aggressively on people” (2). This tick is extremely common on campus, particularly in the Fall and Spring (See Figure 2) when a single trap can allow for the collection of over 1098 *A. cajennense* ticks. This tick has not been extensively studied in the United States since it is limited to the South Texas region. *A. cajennense* is known to be a vector of rickettsias, including RMSF, Thai tick typhus, and *Rickettsia amblyomii* (5, 6). *Amblyomma americanum* is very closely related to *A. cajennense*. *A. americanum* is known to be a vector of human ehrlichiosis, STARI, RMSF, and Lyme Disease. It is likely that *A. cajennense* is also able to transmit ehrlichiosis, STARI and Lyme Disease although further research needs to be done to demonstrate this. Internationally *A. cajennense* range is very large from South Texas to the northern region of Argentina and thus this tick is of major importance to South Texas, Central America and most of South America. Studies are underway to determine the level of tickborne disease carried by this tick in this region.

The other tick species commonly seen on the TAMIU campus were *Amblyomma inornatum*, about which little is known, and *Dermacentor variabilis*, the American Dog Tick. (Note there are two dog ticks – the Brown Dog Tick found on all dogs, and the American Dog Tick found on dogs that visit undeveloped areas such as ranches or forests.) Although *A. inornatum* is present its importance is not clear as it is not known to feed much on humans. *D. variabilis* is well characterized as a vector of disease in humans. *D. variabilis* is known to be a vector of Rocky Mountain Spotted Fever, Ehrlichiosis, Tularemia and tick paralysis. All of these disease are seen in Texas at low rates. They are of particular concern because domestic animals such as dogs, often return home with these ticks. Also hunters are often exposed to these ticks while harvesting wild animals. Recent outbreaks of Tularemia have been observed in wild animals in West Texas (7). In these outbreaks literally hundreds of rabbits are found dead. These outbreaks occur seemingly suddenly for reasons that are not clear. Hunters harvesting these animals immediately before or during these epidemics would be at a high risk for acquiring this highly contagious, and often fatal infection. It is important as a preventative measure, to understand the natural cycles of tularemia in nature.

Seasonal Nature of Tick Isolation

Not surprisingly the isolation of ticks is dependent on the environmental conditions. There are clearly multiple environmental conditions that have an impact on tick collection. Some of these conditions include temperature, wind, rain, humidity, vegetation, animal activity, and animal abundance. To begin to ascertain the critical factors in the South Texas ecosystem on tick activity we have begun a long term study of tick abundance on the TAMIU campus.

Ticks are collected using one of two methods. Tick walks/drags and tick traps. Tick walks/drags involve walking and dragging a cloth through the vegetation. Ticks are found on your clothes and on the large piece of cloth. Tick traps use carbon dioxide to lure ticks onto a piece of cloth. These traps are placed every other week to assess tick activity. In addition various environmental measurements are taken (see below).

Tick activity is seasonal in nature, although this is less apparent in Laredo, Texas due to the mild winters. In general there are less ticks in the hot months (July and August) and cold months (December, January and February) (Figure 2). The seasonal nature is more apparent when one looks at individual stages of the ticks

in their life cycle (Figure 3 – Top). In the United States typically larval ticks will hatch in the spring, with nymphs emerging in late summer. Adults will either emerge in late Fall or the following Spring. In Laredo this seasonality is less apparent. During year 1 (March 2005 – Feb 2006) one significant peak of larva was seen in late Fall (September – October). In year 2 (Mar 2006 – present) larva were seen hatching in March – July with a large peak in July. This was different from the proceeding year. This suggests that other factors are controlling the tick life cycle in this region.

With comparison of this data to local weather data a few trends are observed:

1. Larval ticks were positively correlated with three week average, and total rainfall ($p < 0.05$).
2. Larval ticks were positively correlated with three week average, and daily mean humidity ($p < 0.01$).

Ticks per Trap

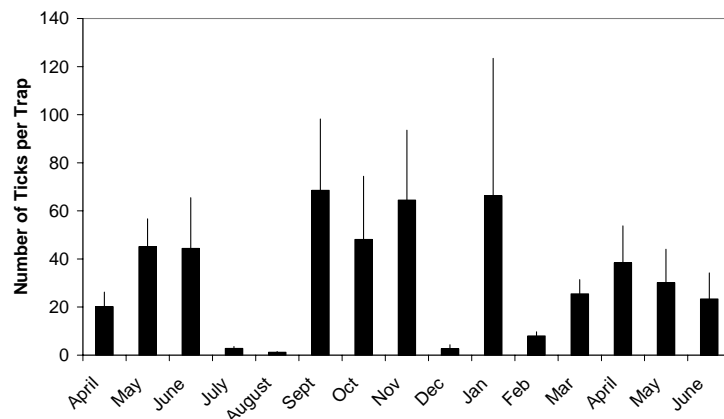


Figure 2: Tick activity peaks in the Spring and the Fall. Number of ticks captured per trap from April 2005 to June 2006.

3. Nymphal ticks like warm, but not hot temperatures. When the 3 week mean temperature was 75-84°F an average of 7.9 nymphs were collected per trap, whereas at 85-94°F an average of only 1.75 ticks were collected per trap (Figure 4).
4. Adult ticks were positively correlated with increased temperature ($p < 0.05$).

Based on these observations the following hypothesis can be proposed:
 Larval ticks hatch in Laredo, TX based on the humidity and precipitation at permissible temperatures. The viability of nymphal ticks is impacted at high temperatures, whereas the viability of adults is not as severely affected.

It will take several years of observation to prove the first part of the hypothesis. The second hypothesis is supported by experimental data looking at tick viability under harsh conditions (8).

The timing of the hatching of larva is of concern. Larval ticks become infected when they feed on animals on which infected nymph or adult ticks have recently fed. When larval ticks hatch in the Spring/Fall at cool

temperatures there are less adults feeding at that time. However, if the larval ticks hatch during a warm months such as May through September then they are much more likely to feed on the same host as an adult. This would result in a higher incidence of disease burden in the ticks in the following season/year. One might predict that in 2007 there would be a higher disease burden in the ticks due to the hatching of larva in late Spring and July of 2006. At this time there is not sufficient data to address this question. With continued research it will be possible to begin to predict the likelihood of tick borne disease outbreaks.

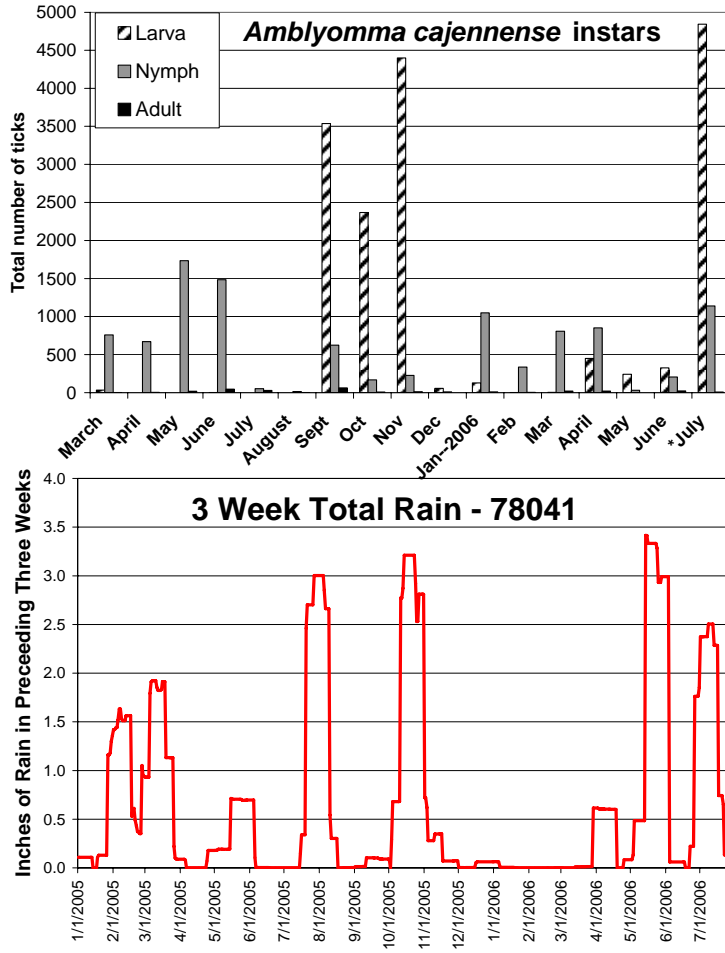


Figure 3: (Top) Tick activity for larva, nymph and adult ticks in 2005 and 2006. (Bottom) The total rainfall for the preceding 3 weeks in Laredo, TX (78041).

Can we identify habitat preference for tick endemic to South Texas?

This project was commenced in November 2005. This is an ongoing long term project to determine the microhabitat preference of ticks. The idea is to determine why ticks are abundant under one tree, and not abundant under another tree. This information then will allow for predicting the behavior of ticks, and can be used for selective treatment of tick populations. For instance no one has a scientific explanation for this simple question: Where do mother ticks go to lay their eggs?

For this project we are collecting ticks every two weeks on TAMIU campus, and at other field sites as time permits. We are collecting many microenvironment

variables such as: humidity, air temperature, soil temperature, soil hardness, ground cover, plant density, light intensity, and other factors. For this project we have so far set about 235 traps. We originally estimated that we would need to set at least 300 traps for the data to develop a sufficient power for accurate interpretation. It is now clear that it will likely take another 250 traps (total of 500 traps) to develop statistically valid interpretations. From the data we have collected so far we can make a number of observations about the habitat preference of the dominant tick in South Texas (called *Amblyomma cajennense*):

1. It prefers more heavily shaded environments with dense shrubs.
2. It prefers shallower leaf litter spread over most of the ground as opposed to deeper leaf litter with only a small part of the ground covered. In these areas during peak tick activity it was possible sometimes to observe the ticks directly on the ground (Figure 5).
3. We observed that the ticks were in areas where there was less soil moisture. This is surprising, but may reflect that if the soil is too moist that there is risk of fungal disease for the ticks.
4. We found that with increased animal activity there was an increased level of tick activity. However the presence of a medium/large animal den usually results in fewer ticks collected. Our attractant may not be sufficient to attract the ticks away from the animal den, or than animal may have removed the ticks from the area by being bitten.

How can we protect ourselves from ticks?

Ticks are present in the environment. We like to enter that environment for recreational and work purposes. From the studies here a couple of recommendations can be made:

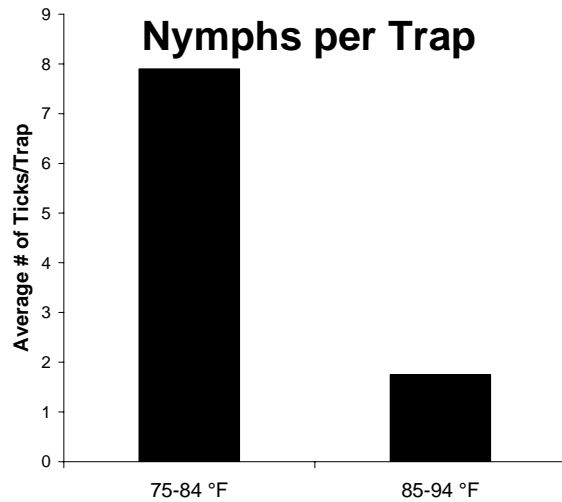


Figure 4: At high temperatures there is less activity of nymphal ticks. Shown is the number of ticks per trap compared to the 3 week mean temperature.

1. Avoid regions of heavy brush, especially if that brush has abundant leaf litter. It is not enough to just avoid the most dense areas of the brush as we have noticed heavy tick activity at times in areas near to the dense brush. We have only rarely observed heavy tick activity in areas quite distant from heavy brush.



Figure 5: This picture shows one of the preferred habitats of the tick. The leaves here are about the size of the last digit of your fingers. There is abundant leaf litter, although it is not very deep as the ground can be seen below the litter.

2. If the weather in the past month has been unusually wet/humid more care should be taken to avoid these areas. If it is necessary to work in heavy brush it is best to plan this work after a month of dry conditions. Or ideally

during cold weather as the tick activity is low during the coldest weeks. Given the highly variable nature of weather it is not possible in this region to say that January will be a cold month, and thus represent a good time to work in heavy brush. There is no substitute for common sense in this case. If it has been a warm week, the tick activity will be higher.

As far as personal and private yard protection the standard recommendations are:

1. Keep the lawn mowed and clear of dense brush. Light brush is not a problem.
2. If going into areas that have unknown numbers of ticks it is best to tuck your pant legs into your socks. This will keep from crawling up you pant legs. Then check for ticks when you leave the area. If you are in the area for a long time it is best to inspect your clothing for ticks from time to time.

What should we do if we find a tick on our body?

Of concern is the response of the public to ticks found on their body. Tick borne diseases can be transmitted quickly, although most transmit slowly. Thus prompt removal of the tick will avoid most disease transmission. This is often not done. It is common to hear of people crushing ticks, smashing them, etc. This practice is actually very unsafe as it releases the infectious agent onto the persons hands, or environment. This will allow for potential disease transmission.

Best Approach: Gently remove the tick from the skin using a pair of forceps. Do not squeeze the body of the tick, but grab it right where it is attached to the skin. It may take many gentle tugs to successfully remove the tick. The tick can then be placed in any

convenient sealable container like a Zip-Loc bag. Do not crush the tick. Importantly, wash your hands as they sometimes become contaminated with blood during the removal process. The tick bite should be reported to your doctor and the tick sent to the state lab for pathogen detection.

References

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