FIRE & TICKS: THE IMPACTS OF LONG-TERM PRESCRIBED FIRE ON TICK POPULATIONS & TICK-BORNE DISEASE RISK

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North Atlantic Fire Science Exchange
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**Ticks & Tick-borne Pathogens of the Eastern United States**

- **Amblyomma americanum**
  - AKA lone star tick
  - Associated Diseases:
    - Human monocytic ehrlichiosis (HME)
    - Ehrlichiosis ewingii
    - Southern tick associated rash illness (STARI)

- **A. maculatum**
  - AKA Gulf Coast tick
  - Associated Diseases:
    - *Rickettsia parkeri* rickettsiosis

- **Dermacentor variabilis**
  - AKA American dog tick
  - Associated Diseases:
    - Rocky Mountain spotted fever (RMSF)

- **Ixodes spp.**
  - **I. scapularis**
  - **I. minor**
  - **I. affinis**
  - Associated Diseases:
    - Lyme disease
    - Human granulocytic anaplasmosis (HGA)
    - Babesiosis
Tick-borne Disease Incidence & Emergence are on the Rise

- Land Modification
- Increase in host abundance
- Climate change → Vector expansion

![Annual Cases of Lyme Disease in the US](chart)
Tick-borne Disease Incidence & Emergence are on the Rise

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CDC 2013
Ticks & Fire

• Tick populations reduced *immediately* after fire.

• Tick populations steadily recover over-time

• Dispute over *long-term* effects of fire on tick abundance
  • Increase or decrease in tick population &/or pathogen prevalence??

• Previous studies fail to account for variables affecting tick populations and/or do not simulate “real-world” management practices
Objectives

In southwest Georgia, determine:

1) Tick abundance & seasonality

2) Tick-borne pathogen prevalence

3) Determine the effects of long-term prescribed burning on the above
Study Design

• 21 Total Sites
  - 8 burned sites, surrounded by burned areas (BB)
  - 5 burned sites, surrounded by portions of unburned areas (BUB)
  - 5 unburned sites, surrounded by burned areas (UBB)
  - 3 control sites → unburned, surrounded by unburned (UBUB)
Methods

- Tick surveys
  - Monthly flagging

- Microclimate & Weather

- Quarterly vegetation & host surveys
Prescribed Burns

- Burns performed as dictated by land managers
  - All dormant season burns
  - Ichauway: 2 year burns
  - WMA’s: 2-4 year burns
    - All WMA’s burned during study period
Ticks Captured

- >47,000 ticks collected!!

- **Lone star tick** by far most abundant
- **Black-legged tick** second most common
- **Gulf coast tick** surprisingly abundant; third most common
- **American dog tick** fourth most common
Impact of Long-term Prescribed Burning on Tick Abundance

Average Total Ticks per Hour*

Month

2010

2011

*One clutch of larvae was counted as a single tick.
Other Variables’ Impacts on Ticks

• Total tick counts
  – Interaction between burning & season
  – >95% litter cover \(\rightarrow\) 2x more ticks
  – High tree densities \(\rightarrow\) 6x more ticks

• Black-legged ticks
  – Burning \(\rightarrow\) 78% reduction
  – High tree densities \(\rightarrow\) 17x more ticks
  – Recent precipitation \(\rightarrow\) 2x more ticks
What is Driving This?
- Red imported fire ants (RIFA) strongly prefer disturbed habitats

\[ \text{Burning} = \text{disturbance} = \text{presence of fire ants} \]
RIFA predation on *Amblyomma americanum* (lone star tick) observed
- No data on other tick species in SE US

Correlary and observational studies

Few experimental studies
## Study Design

<table>
<thead>
<tr>
<th></th>
<th>Burned</th>
<th>Unburned</th>
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<tbody>
<tr>
<td>RIFA</td>
<td>✔</td>
<td>❌</td>
</tr>
<tr>
<td>No RIFA</td>
<td>✔</td>
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- 3 treatments
- Lack of ticks confirmed
- 10 tick enclosures per treatment
Engorged lone star (n=19) and Gulf coast tick (n=17) nymphs “stocked” into each tick enclosure
- Released during months previously determined to be naturally active

RIFA actively monitored and managed during study

Adults collected & survival determined
• No sig. effect of RIFA on either tick spp. (F = 1.32; df = 1, 35; p = 0.2586).

• Gulf coast ticks survived significantly better in the burned habitats than lone stars (p <0.0001).

• Lone stars survived significantly better in the unburned habitat versus the burned habitat (p = 0.0144).
Gulf coast ticks better adapted to burned habitats
  - Higher temperatures, lower humidities

OVERALL: The forest structure is driving tick reductions
  ➔ Harsher microclimates in burned sites
Pathogen Results

- Pathogen prevalence similar to past studies
  - No *B. burgdorferi* in black-legged ticks → No Lyme disease

- No significant differences in pathogen prevalence + Decrease in ticks = Lower disease risk!
  - 0.02 infected ticks/hour in all burn treatments
  - 0.70 infected ticks/hr in UBUB
Long-term prescribed fire reduces tick populations

- ~98% reduction in ticks!!

WHY?
- Change in vegetation structure → hotter, drier environment

Major reduction in disease risk for humans:
- 0.02 infected ticks/hour in all burn treatments
- 0.70 infected ticks/hr in UBUB
Future Work...
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Questions?

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