Influence of Prescribed Burns on the Abundance of Ticks and Tick-Borne Pathogens in Northeast Missouri

ATSU A.T. Still University
FIRST IN WHOLE PERSON HEALTHCARE

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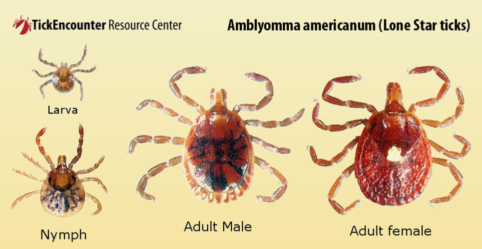
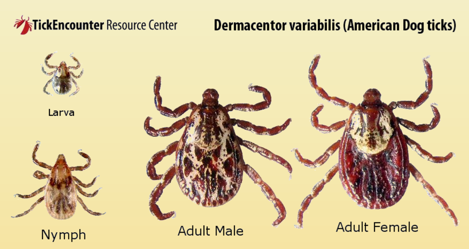
Background

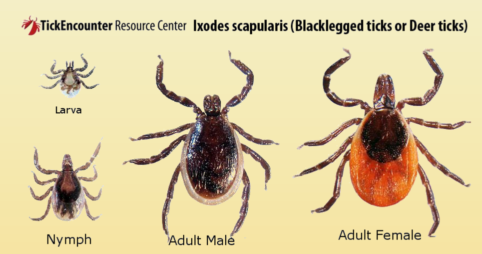
There are three tick species of public health significance in Northeast Missouri: *Amblyomma americanum*, *Dermacentor variabilis*, and *Ixodes scapularis*. Numerous novel tick-borne diseases have emerged in the past several decades, and the incidence of other tick-borne diseases has increased. Controlling tick populations would result in fewer encounters with infected ticks. Prescribed fire is a cost-effective way to treat large landscapes and may reduce tick abundance. We tested the effects of prescribed burning and its impact on tick abundance and disease burden in the remaining or recolonizing ticks.



- Ehrlichiosis
- Tularemia
- Heartland Virus
- STARI
- Bourbon virus



- RMSF
- Tularemia
- Ehrlichiosis



- Lyme disease
- Babesiosis
- Anaplasmosis
- Powassan virus

Methods

We surveyed a 1,500-acre oak-hickory upland woodland divided into twelve management units [FIG1]. Of these twelve units, six were burned before the initiation of this research, three were burned for the first time within this study's time frame, and three were never burned [TABLE1]. Three 100 m transects were randomly selected for each of the twelve units for a total of 36 transects [FIG1]. Tick sampling was performed monthly (April – August) for three consecutive years (2018 – 2020) [FIG2]. DNA was isolated from tick pools and subjected to multiple PCR's for *Borrelia*, *Ehrlichia*, and *Rickettsia* bacterial species. Twelve data loggers, one per unit, collected microclimatic measurements at ground level [FIG3].

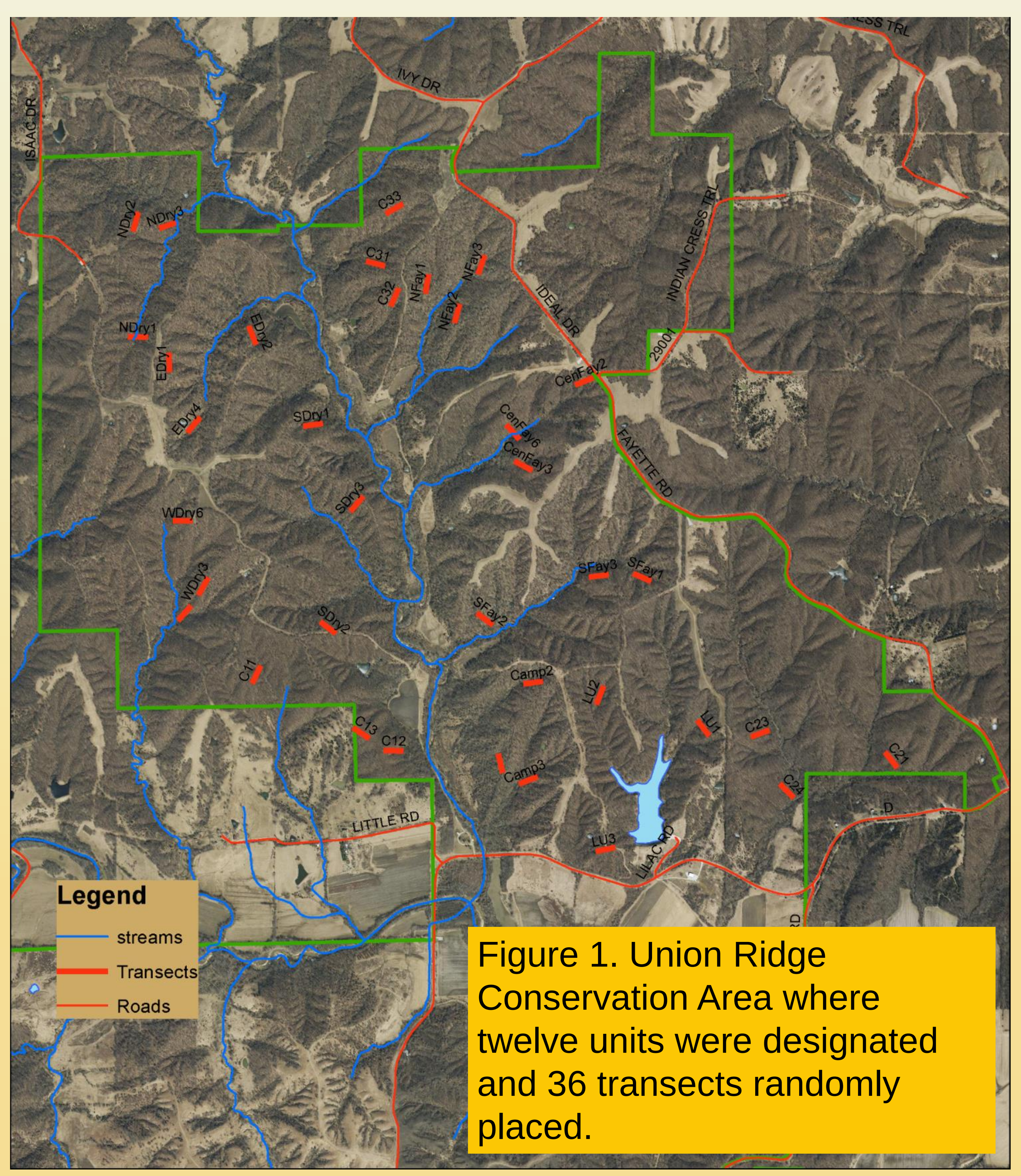


Figure 1. Union Ridge Conservation Area where twelve units were designated and 36 transects randomly placed.

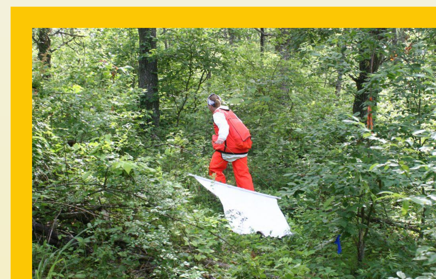


Figure 2. Dragging flannel cloth for tick collections.

Figure 3. Kestrel Drop D2 data logger placed at ground level.

Table 1. Descriptions and burn data for the 12 units sampled during this study.

Site	Hectares	County	Year Burned in March or April	Year Burned in October or November
West Drybranch	81.7	Sullivan	2006, 2009, 2011, 2016	2007
East Drybranch	71.6	Sullivan	2006, 2008, 2014	2009
North Drybranch	64.7	Sullivan	2010, 2015, 2020	n/a
South Drybranch	83.4	Sullivan	2015, 2020	n/a
Lake Unit	85.4	Adair	2016, 2020	n/a
North Fayette	76.5	Sullivan	2016	n/a
Central Fayette	78.1	Sullivan	2020	n/a
South Fayette	88.2	Adair	2018	n/a
Campground	55.4	Sullivan	2018	n/a
Control 1	44.5	Sullivan	n/a	n/a
Control 2	125.9	Adair	n/a	n/a
Control 3	44.1	Sullivan	n/a	n/a

Results

In total, 167,110 ticks were collected. We compared abundance of ticks, by life stage, since year burned [FIG3 (A-C)]. Number of ticks encountered in recently burned units were nearly half the number in control units. The units were combined into control (unburned units n =11), 0-2 years post burn (n = 13), and 3-6 years post burn (n =12) [FIG4 (A-C)]. Tick abundance was significantly reduced for up to three years post-burn for adult ticks (H = 15.61; p<0.001) [FIG4 (A)]. No significant differences were detected between burned and unburned units for nymphs and larvae [FIG4 (B-C)]. Pathogen testing occurred in 710 adult pools, 620 nymph pools, and 548 larval pools. Only *Ehrlichia* bacteria in *A. americanum* were compared between unburned and burned units and no significant differences were detected. The maximum likelihood estimates for *Erhlichia* were 3-15% in adults, 0-4% in nymphs, and 0-1% in larvae. Average temperatures were similar between units but relative humidity was 3% lower for up to three years post-burn.

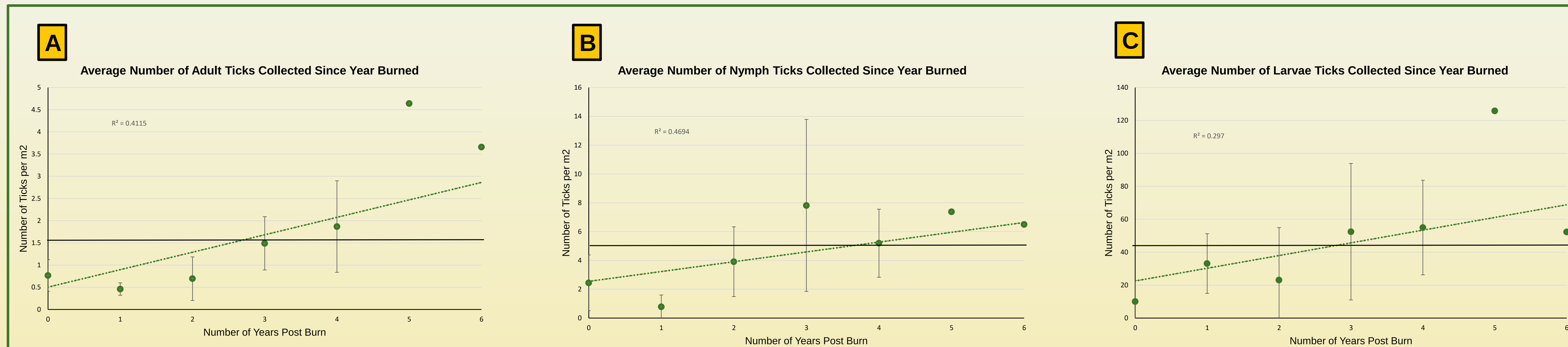


Figure 3. Average number of ticks by life stage adult (A),nymph (B), and larvae (C) were compared since year the unit was burned. The dark line going across each graph represents the average number from the control (unburned units).

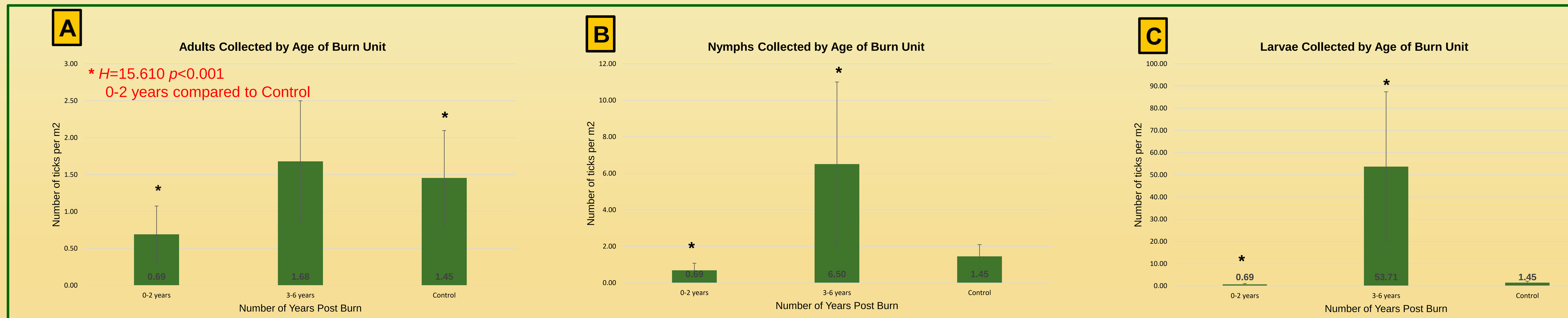


Figure 4. Tick abundance by life stage adult (A), nymph (B), and larvae (C) were compared by categories of years since burn. Adults were significantly different than the control group (H=15.61; p<0.001) however nymphs (H=10.22; p=0.006) and larvae (F=6.203; p=0.005) did not differ from control group but did significantly differ between years since burn.

Conclusions

Prescribed burns effectively reduce tick populations for up to three years post-burn. Although prescribed burns did not impact pathogen prevalence, the risk of pathogen transmission is lower at sites subjected to burns due to lower encounter rates. We hypothesize that the reduction of detritus post-burn inhibits larval and nymph survival due to desiccation. After three years, layers of leaves, twigs, and other detritus accumulate to provide a moist favorable substrate for ticks once again. White-tailed deer are known to frequent burned plots for up to three years post-burn to forage. Intensive use of post-burn sites by white-tailed deer may increase the abundance of *A. americanum* to levels greater than occurs in sites that remain unburned. The increase of nymphs and larvae in units three to six years post burn is most likely from the white-tailed deer acting as a source of ticks being reintroduced, *A. americanum* generally complete their life cycles in a minimum of two years, and eventually, enough structure on the forest floor would allow for overwinter survival for nymphs and adults.

Acknowledgements

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