

The effectiveness of the 4-Poster tick management system in controlling three tick species at Brookhaven National Laboratory

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ABSTRACT

In 2013, Brookhaven National Laboratory (BNL) set out fourteen “4-Poster” deer treatment devices within its campus to manage blacklegged ticks (*Ixodes scapularis*), lone star ticks (*Amblyomma americanum*), and American dog ticks (*Dermacentor variabilis*). Four additional devices were added in 2014. Each station, equipped with four rollers treated with 12% Permethrin solution were applied to feeding white-tailed deer (*Odocoileus virginianus*), primary hosts of ticks, to reduce tick populations; thus diminishing the risk of tick-borne disease. Flagging to define tick populations at each of the 4-Poster devices occurred during the month of July, 2013 and in June and July, 2014. A 26 by 40 inch flag was dragged for one minute 30 times at each 4-Poster station; ticks located on the substrate were counted and recorded. A comparison of samples between July 2013 and July 2014 showed a decrease of 52%, 37%, and 68% in *A. americanum* males, females, and nymphs, respectively; as well as a 24% reduction in *I. scapularis* densities. Previous studies revealing significant reductions of >90% in tick densities were detected only three to five years after deployment, suggesting the study must continue in order to show effectiveness (1, 4, 7).

INTRODUCTION

Lyme disease is a life-threatening tick-borne disease that has become an epidemic in the Northeastern and mid-Atlantic United States. Other tick-borne diseases that pose a threat to humans include human anaplasmosis, babesiosis, human ehrlichiosis, Powassan (POW) virus, Rocky Mountain spotted fever (RMSF), and southern tick-associated rash illness (STARI) (2). The three tick species established on Long Island are blacklegged ticks (*Ixodes scapularis*), lone star ticks (*Amblyomma americanum*), and American dog ticks (*Dermacentor variabilis*) (5).

The 4-Poster system was patented by the Agricultural Research Service in 1994 as a way to diminish tick populations in an area by targeting a common mobile host: white-tailed deer (6). It is designed to dispense corn into two depressions on either side of the 4-Poster device. Two Permethrin treated rollers surround each cavity to disperse the solution topically onto the head and ears, an area of high tick abundance, of white-tailed deer as they consume the corn.

This research study aimed to :

- Reduce tick populations and the human-wildlife associated risks of tick-borne disease
- Compare tick densities over two years to determine effectiveness of the 4-Poster system
- Analyze tick densities during the month of June and July to determine changes throughout their peak season.

MATERIALS AND METHODS

- Eighteen 4-Poster devices were set up within the BNL property
- A 0.25 ml Permethrin treatment was applied to each roller per 1.5 lb corn added to the 4-Poster device
- Sampling was performed a 26 x 40 inch white corduroy flag
- The drag sampling method consists of pulling a cloth flag throughout vegetation and leaf litter to capture ticks
- Thirty one-minute drag samples were taken ≈200 m within the area surrounding each 4-Poster device.
- Identifications were recorded as male, female, nymph, or larvae of species *A. americanum*, *I. scapularis*, or *D. variabilis*.
- Each station was sampled July 2013, June 2014, and July 2014.



Figure 3. White-tailed deer feeding at 4-Poster station 10.

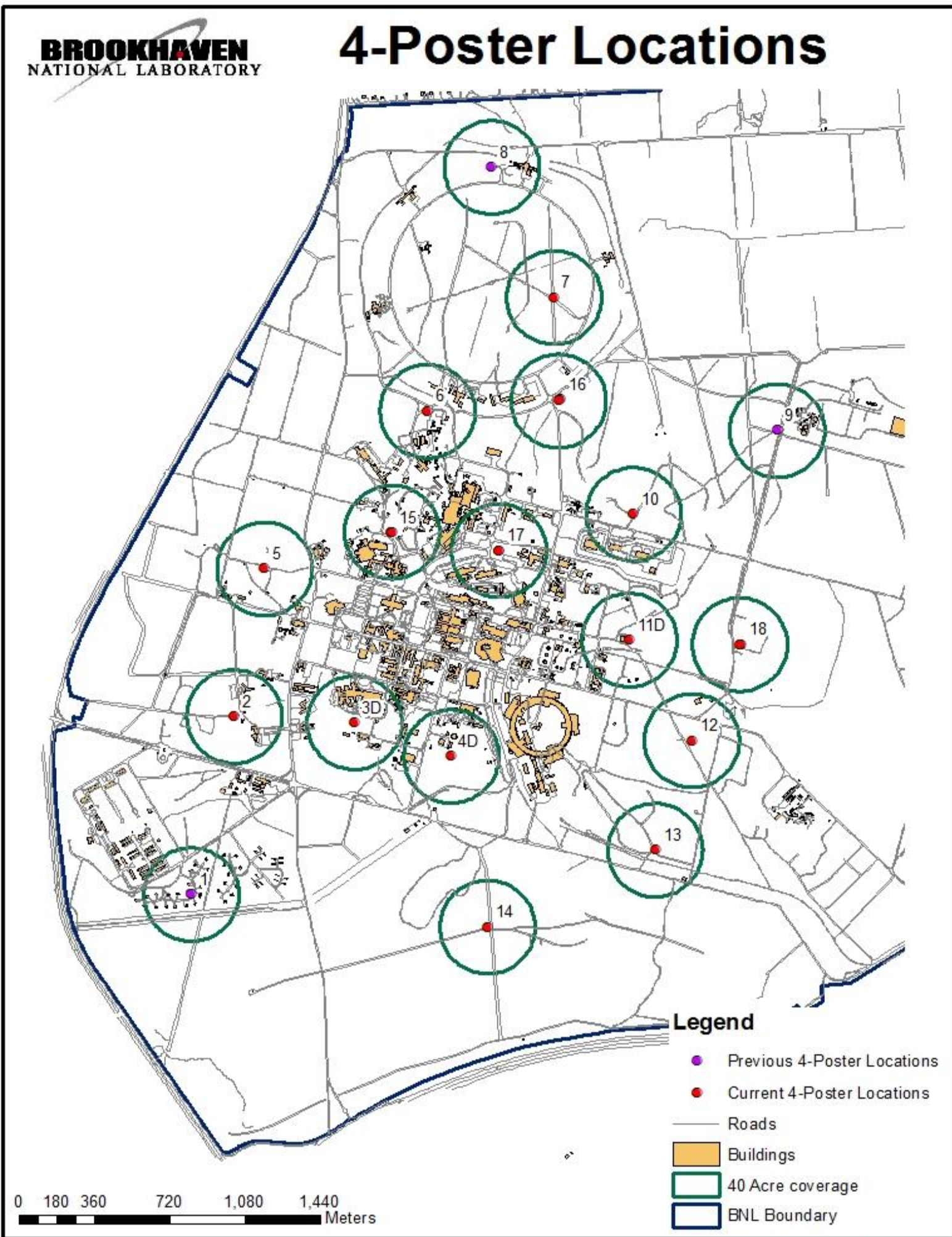


Figure 1. 4-Poster locations at Brookhaven National Laboratory.

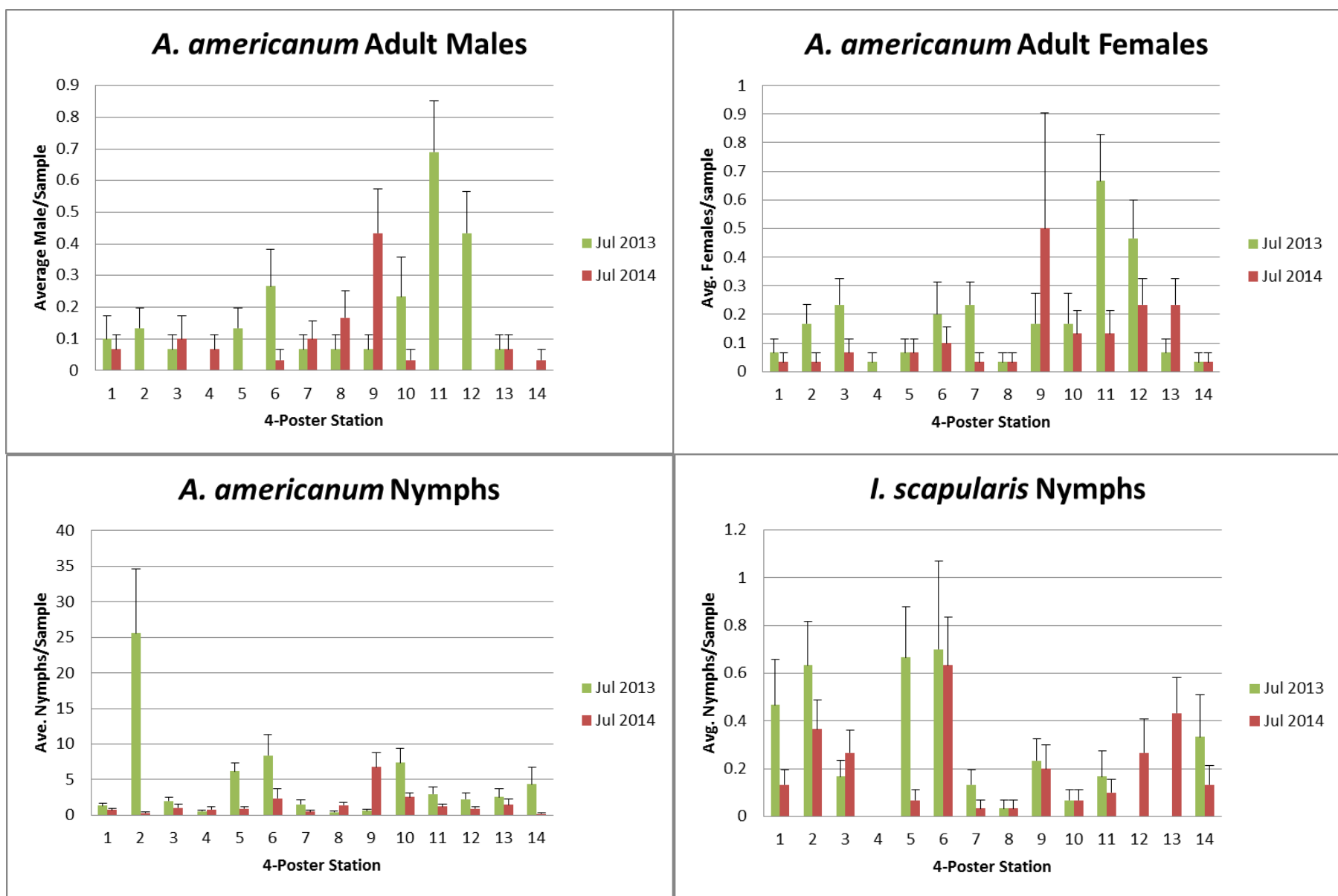


Figure 2. Average individual per flagging for July 2013- July 2014 samples at each 4-Poster station (1-14).

	Lone Star		Blacklegged	
	Adult Male	Adult Female	Nymph	Nymph
4P-1	-33.3%	-50.0%	-46.3%	-71.4%
4P-2	-100.0%	-80.0%	-98.7%	-42.1%
4P-3	50.0%	-71.4%	-48.3%	60.0%
4P-4	+	-100.0%	47.1%	0.0%
4P-5	-100.0%	0.0%	-85.4%	-90.0%
4P-6	-87.5%	-50.0%	-71.8%	-9.5%
4P-7	50.0%	-85.7%	-65.2%	-75.0%
4P-8	150.0%	0.0%	223.1%	0.0%
4P-9	550.0%	200.0%	1033.3%	-14.3%
4P-10	-85.7%	-20.0%	-65.3%	0.0%
4P-11	-100.0%	-80.0%	-59.6%	-40.0%
4P-12	-100.0%	-50.0%	-58.2%	+
4P-13	0.0%	250.0%	-42.9%	+
4P-14	+	0.0%	-95.4%	-60.0%
Total	-52.20%	-37.18%	-67.82%	-24.07%

Table 1. Percent difference between July 2013 and July 2014 samples for *A. americanum* adult males, adult females, nymphs, and *I. scapularis* nymphs for 4-Poster locations 1-14. + indicates an unquantifiable increase from 0. .

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RESULTS

- Percent differences between July 2013 and July 2014 stations 1-14 samples for *A. americanum* adult males, adult females, and nymphs were -52.17% (P-0.002), -37.18% (P-0.002), and -67.82% (P-0.000), respectively. Percent difference for *I. scapularis* nymphs was -24.07% (P-0.478).
- Adding 4-Poster stations 15-18 that existed in July 2014 into the comparison with the July 2013 data yielded percent differences for *A. americanum* adult males, adult females, and nymphs of -49.37% (P-0.004), -33.31% (P-0.004), and -37.45% (P-0.000), respectively. Percent difference for *I. scapularis* nymphs was -36.02% (P-0.093).
- Percent differences between June 2014 and July 2014 samples for *A. americanum* adult males and adult females were -88.26% (P-0.000) and -72.97% (P-0.000), respectively.
- During the course of the study no *I. scapularis* males, *D. variabilis* nymphs, or *D. variabilis* larvae were found.



Figures 4 & 5. Flagging at 4-Poster station 11. Lone star tick larvae removed from a flag sample.

DISCUSSION

The most significant data collected was of *A. americanum* adult males, adult females, nymphs, and of *I. scapularis* nymphs. A comparison of samples from 4-Poster stations 1-14 from July 2013 to July 2014 determined that there was an overall decrease in significant species over time (Table 1). When the sampling data from stations 15-18 were added into comparison, percent difference between 2013 and 2014 was less than that of only stations 1-14. 4-Poster's 15-18 were recently added prior to 2014 samplings and had not been in effect for long; thus, added data from untreated areas had a negative effect on the declining trend in tick densities. Few *I. scapularis* adult females and few *D. variabilis* adult males and females were discovered during the course of this study; thus these species were not focused on. Sampling data for larvae was trivial because according to a tick's life cycle stage, larvae will not reach considerable abundance until August (3).

A comparison of sampling from June 2014 and July 2014 showed a prominent decrease in *A. americanum* adult males and adult females, as expected. This is agreement with the life cycle stages of ticks, when adults will release eggs and adults begin to decline (3).

The overall decrease in tick densities shows the 4-Poster system has been effective, but not to the desired extent. Previous studies revealing significant reductions of >90% in tick densities were detected only three to five years after deployment, suggesting the management action must continue in order to show greater effectiveness (1, 4, 7).

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