Invasion of the Deer Tick

Holt Research Forest, Maine, USA

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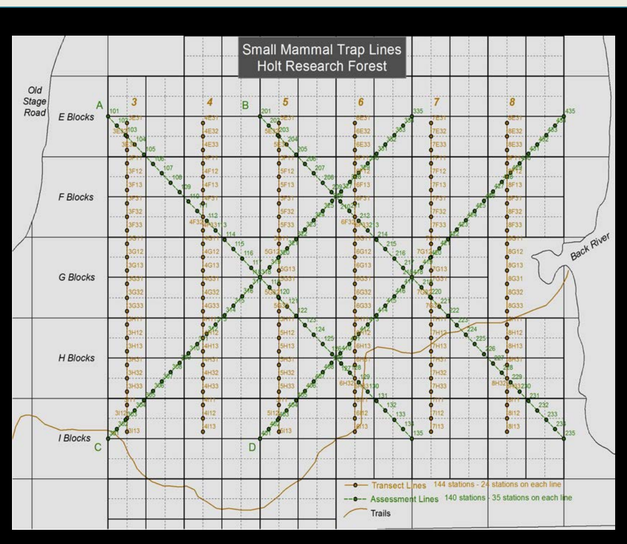
Abstract: In Maine, deer ticks, aka blacklegged ticks (*Ixodes scapularis*), carry the agent of Lyme disease as well as agents causing human Anaplasmosis, Babesiosis, Powassan encephalitis, and relapsing fever. Lyme disease in Maine has followed the increase in deer ticks. A unique long-term dataset of small mammal captures on the Holt Forest suggests that abundance of a lesser known tick, *Ixodes angustus*, has declined as the deer tick has become more abundant. This serves as a reminder that the deer tick is an invasive species.

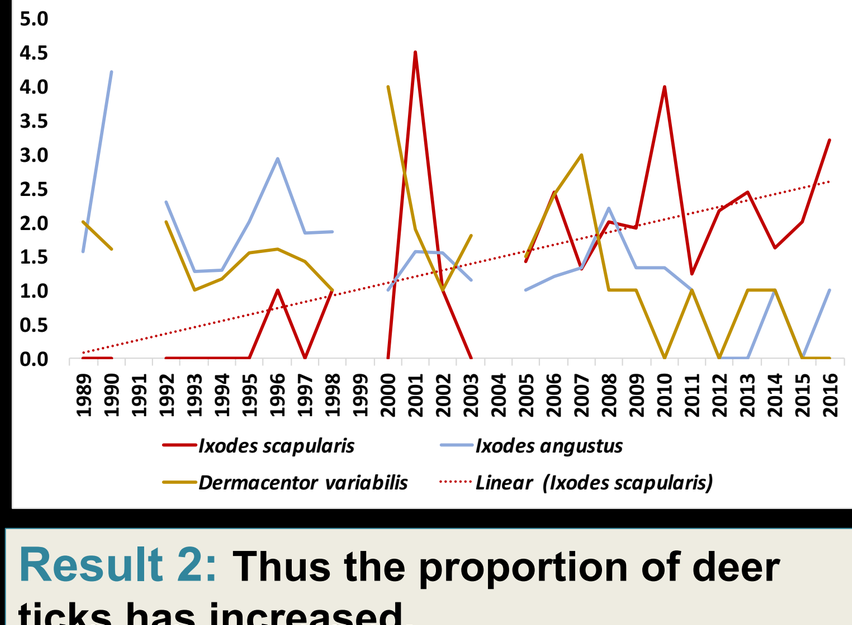


Methods

1. Trapped 1st 2 weeks of August on 24ha; 244 Sherman live traps baited with oats & peanut butter bait plus cotton
2. Ticks seen on animals removed, sent to Maine Medical Center
3. Ticks identified to species and stage (larva, nymph, adult)
4. Subset of ticks tested for *Borrelia burgdoferi*, via DFA (direct fluorescent antibody test)
5. Calculated burdens (ticks per animal) of infested animals by year, mammal species, tick species; infection rates

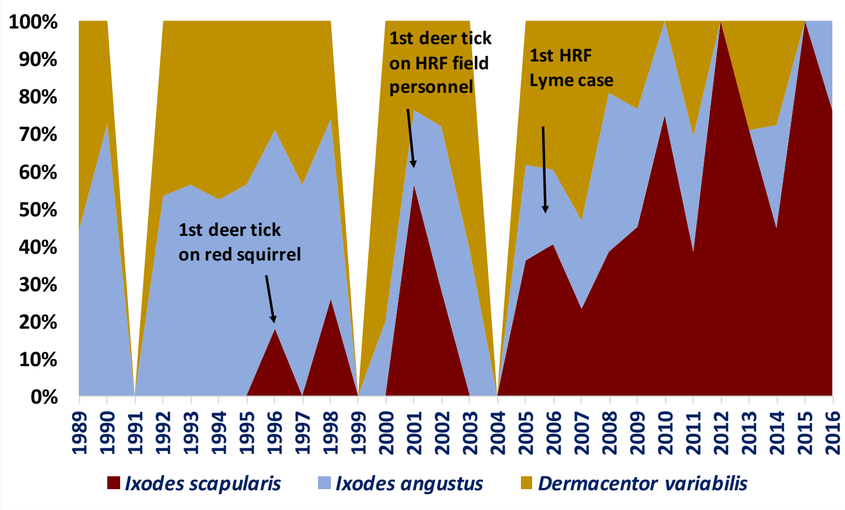
Result 1: The mean burden of deer ticks on all small mammals (mostly white-footed mice) has increased over time, while that of *I. angustus* and dog ticks (*Dermacentor varia*bilis) has decreased

Burdens of deer ticks (*Ixodes scapularis*) on tick-infested small mammals has increased over time,
Holt Research Forest, 1989-2016 (no data for 1991, 1999, 2004).



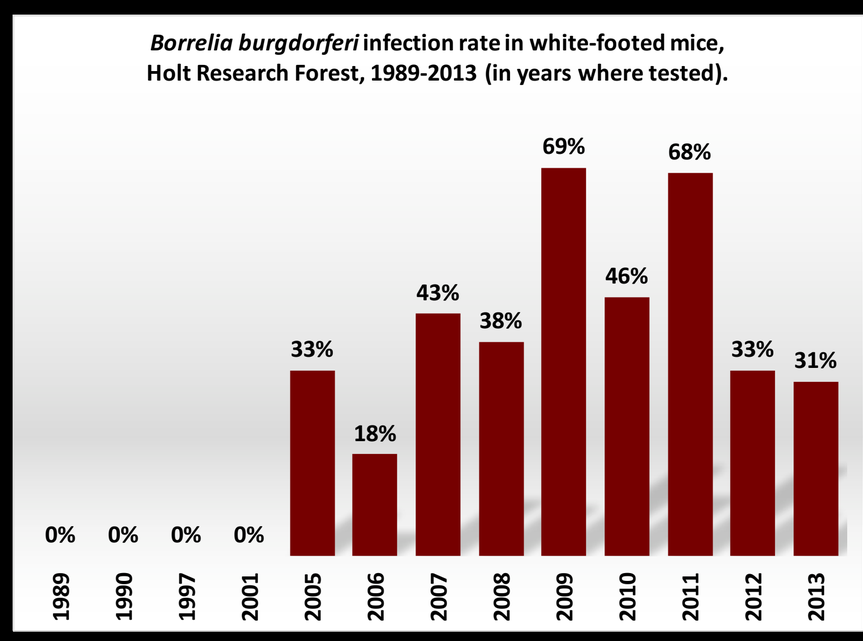
Result 2: Thus the proportion of deer ticks has increased.

The proportion of deer ticks (*Ixodes scapularis*) on tick-infested small mammals has increased over time,
Holt Research Forest, 1989-2016 (no data for 1991, 1999, 2004).



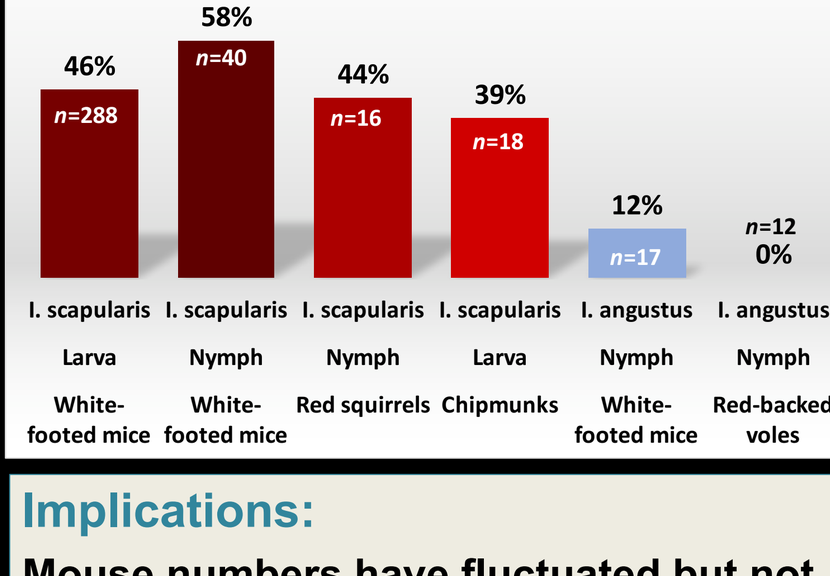
Result 3: *Borrelia burgdorferi* first appeared in deer ticks and some *I. angustus* in 2005.

Borrelia burgdorferi infection rate in white-footed mice,
Holt Research Forest, 1989-2013 (in years where tested).



Result 4: *B. burgdoferi* infection rate was greatest in deer tick larvae and nymphs feeding on mice. Note low infection rates of *I. angustus* (comparable to 12% seen in a lab study[1])

Borrelia burgdorferi infection rates or deer ticks and *I. angustus* ticks feeding on small mammals,
Holt Research Forest, 1989-2013. First postive deer ticks detected in 2005.



Implications:

Mouse numbers have fluctuated but not increased on the Holt Forest[2,3] so an increase in mice does not explain the increase in deer ticks. Deer ticks outcompeted *I. angustus* for some other reason.

Questions:

What competitive advantage does the deer tick have over *I. angustus*? Earlier feeding? Climate change? Deer population increase? Why are deer ticks more suitable for Bb?

Next steps:

Calculate infestation rate by population (minimum number alive) so can compare with estimates from other studies.

Corroborate with small mammal data from elsewhere, e.g., the island of Vinalhaven.

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[1]Peavey CA, RS Lane, T Damrow. Vector competence of *Ixodes angustus* (Acari: Ixodidae) for *Borrelia burgdorferi* sensu stricto. Exp Appl Acarol. 2000;24:77-84

[2]Elias, SP, JW Witham, and ML Hunter, Jr. 2004. *Peromyscus leucopus* abundance and acorn mast: population fluctuations over 20 years. J. Mammalogy 2004;85:743-747

[3]Wang G, JO Wolff, SH Vessey, NH Slade, JW Witham, JF Merritt, ML Hunter Jr, SP Elias. Comparative population dynamics of *Peromyscus leucopus* in North America: influences of climate, food, and density dependence. Population ecology 2009;51:133-142