Blacklegged Ticks, Climate, and Deer in Maine

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A generalized additive model correlating blacklegged ticks with white-tailed deer density, temperature, and humidity in Maine, USA, 1990–2013 (Elias et al. 2021)

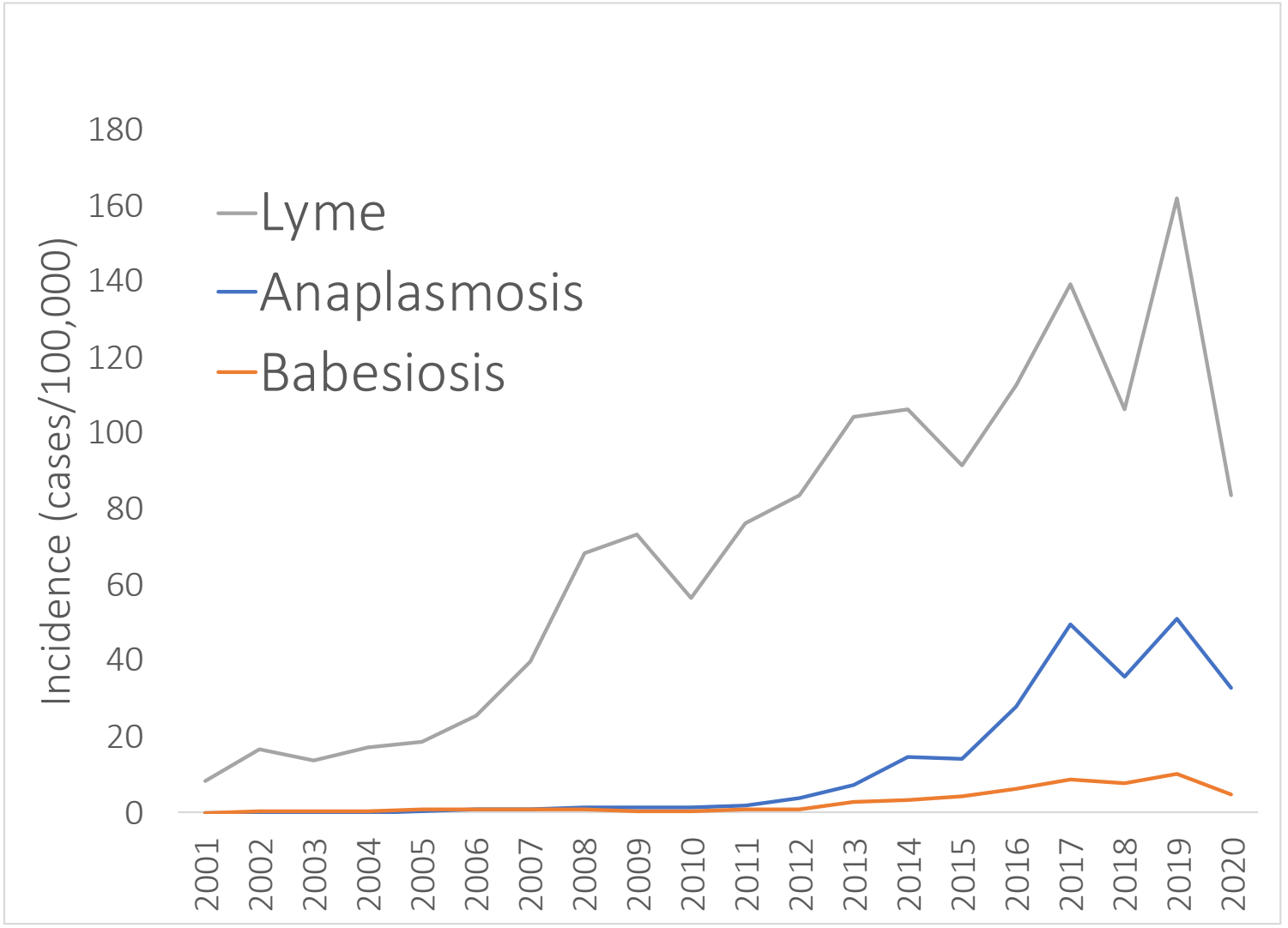
“tick-deer-climate model”

Tick-deer-climate model results

higher nymph abundance was correlated with:

- time
- higher deer density
- seasonal climatology
  - earlier degree-day accumulation
  - warmer winters
  - > relative humidity

Problem: rise in tick-borne disease



statewide case data: Maine Center for Disease Control

Points to remember about blacklegged tick ecology

- feed as larvae, nymphs, adults

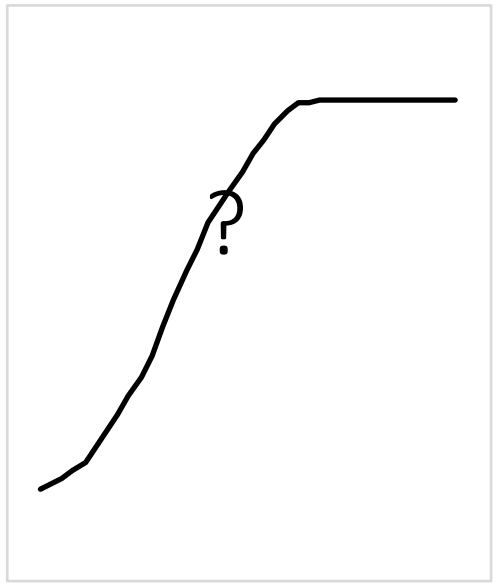
- white-tailed deer: >90% adult blood meals

- climate: 99% time off-host

Prior to Maine tick-deer-climate model

- ticks reduced only if deer lowered below 8–13/deer mi^2 (~3–5/km^2) [1]

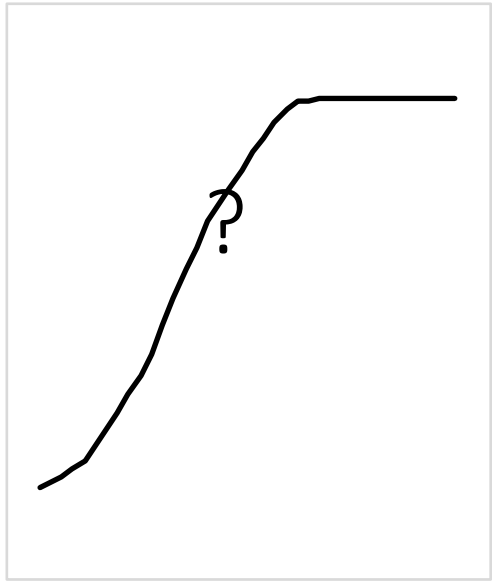
- research needs[2]:
  . quantify ‘saturating’ relationship
  . account for winter cold



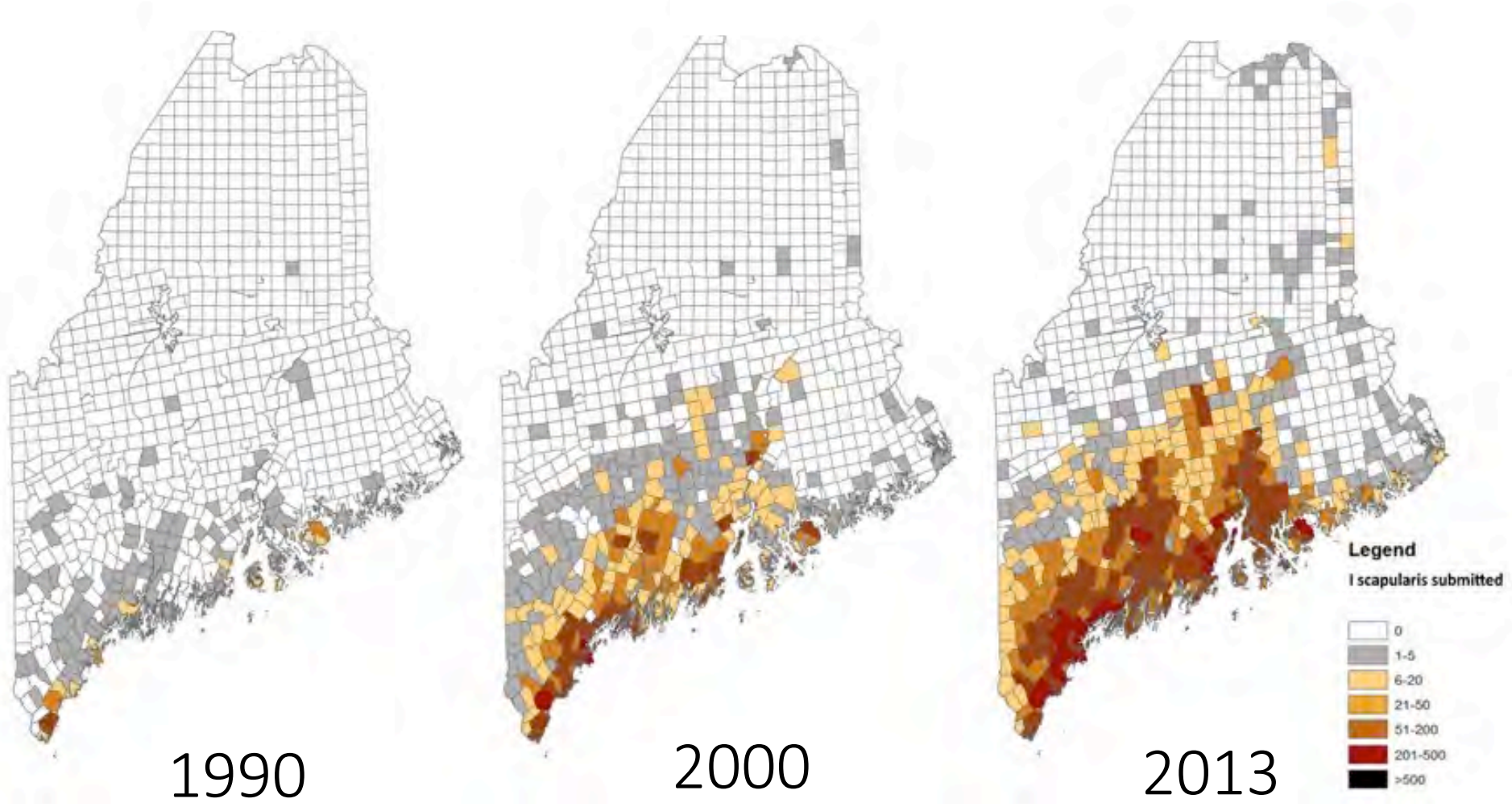
[1]S. Telford 1993, 2002; K. Stafford et al. 2003, 2007; H. Kilpatrick et al. 2014; [2]A. M. Kilpatrick et al. 2017

Prior to Maine tick-deer-climate model

- Maine has it all
  . long-term data (ticks, deer, weather)
  . low deer densities
  . 4.5° latitude S to N
  . warming winters, esp. N

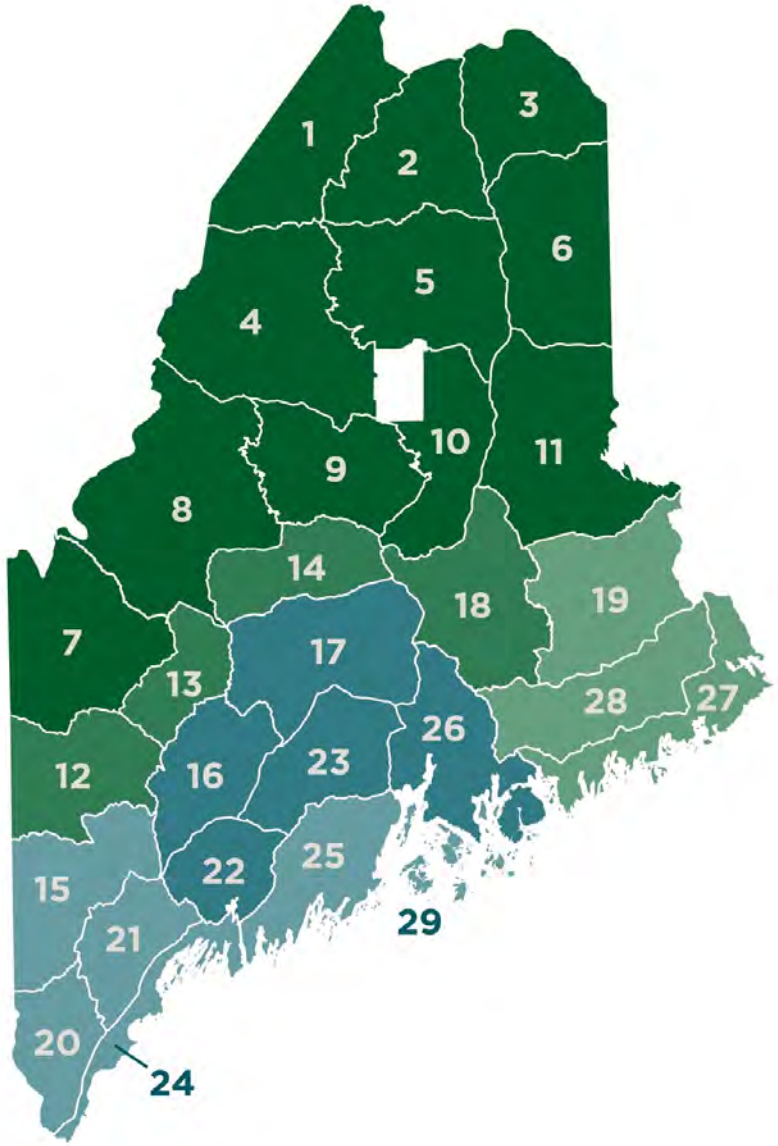


Tick data



data: Maine Medical Center Research Institute statewide passive surveillance program

Deer data

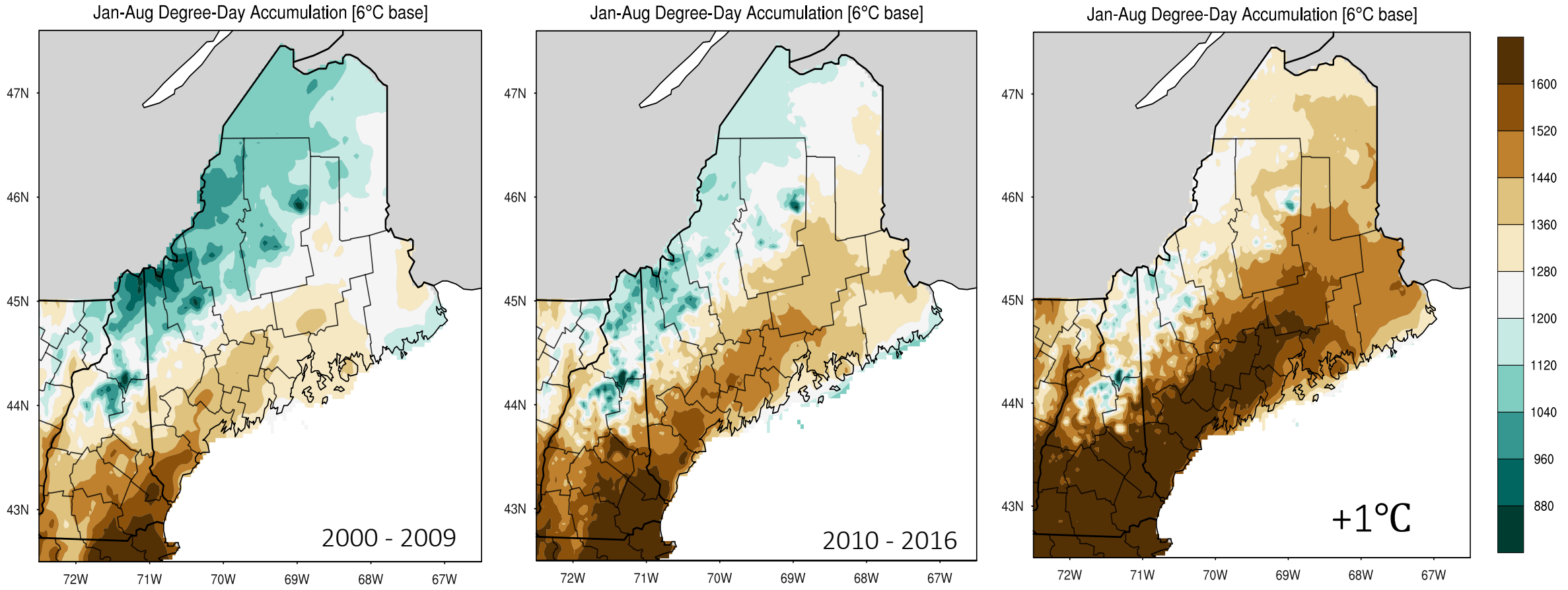


Northern Tier — Goal 10/mi2, actual ~6/mi2

Southern Tier — Goal 15-20/mi2, actual 15/mi2

29 Wildlife Management Districts: Maine Dept. of Inland Fisheries and Wildlife

Climatology data, e.g., degree-day accumulation



maps: Sean Birkel, CCI, University of Maine

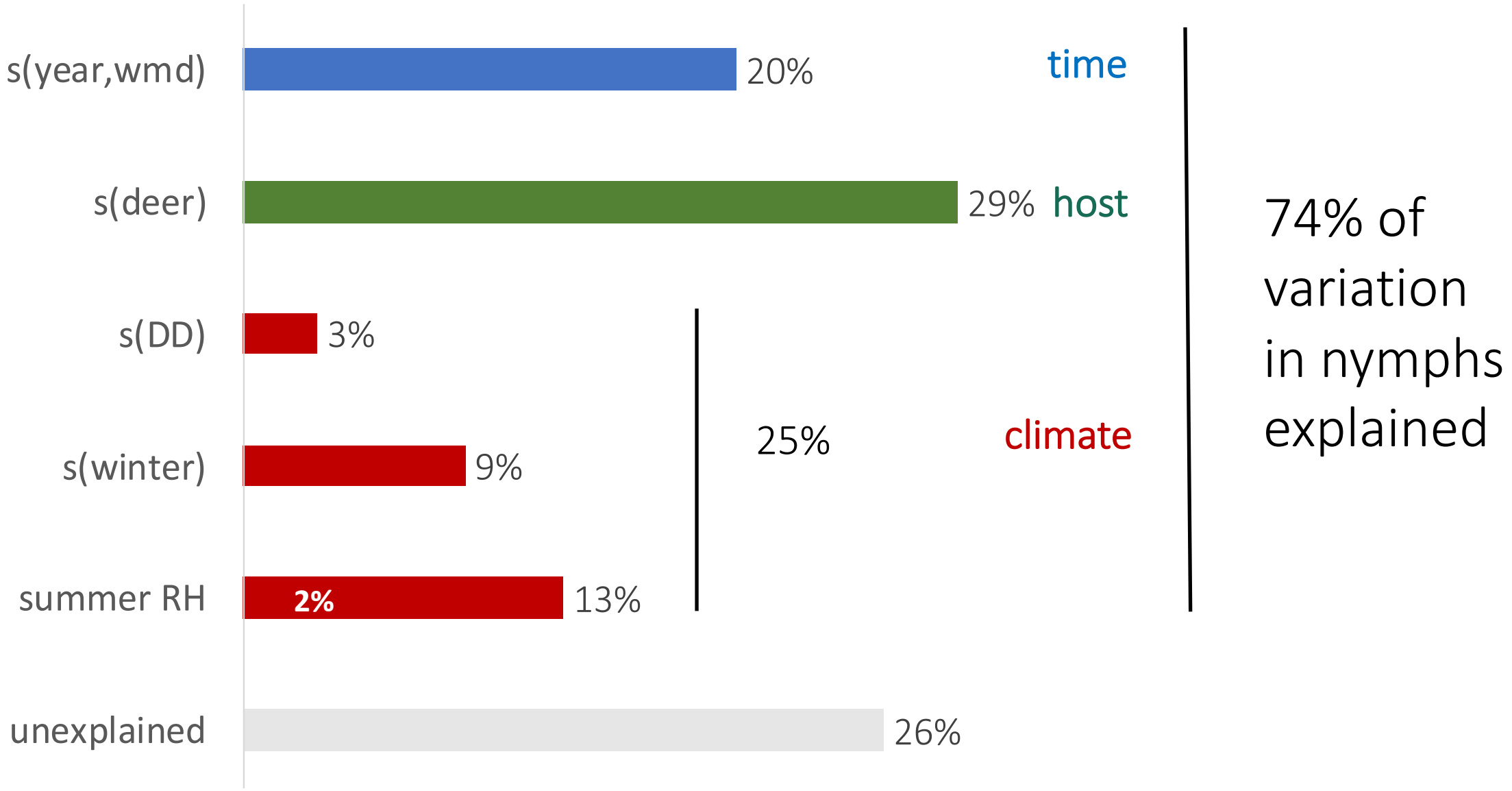
Tick-deer-climate model methods

- data: sum for *each* WMD (*n* = 29) by year, 1990 – 2012 (*n* = 23)

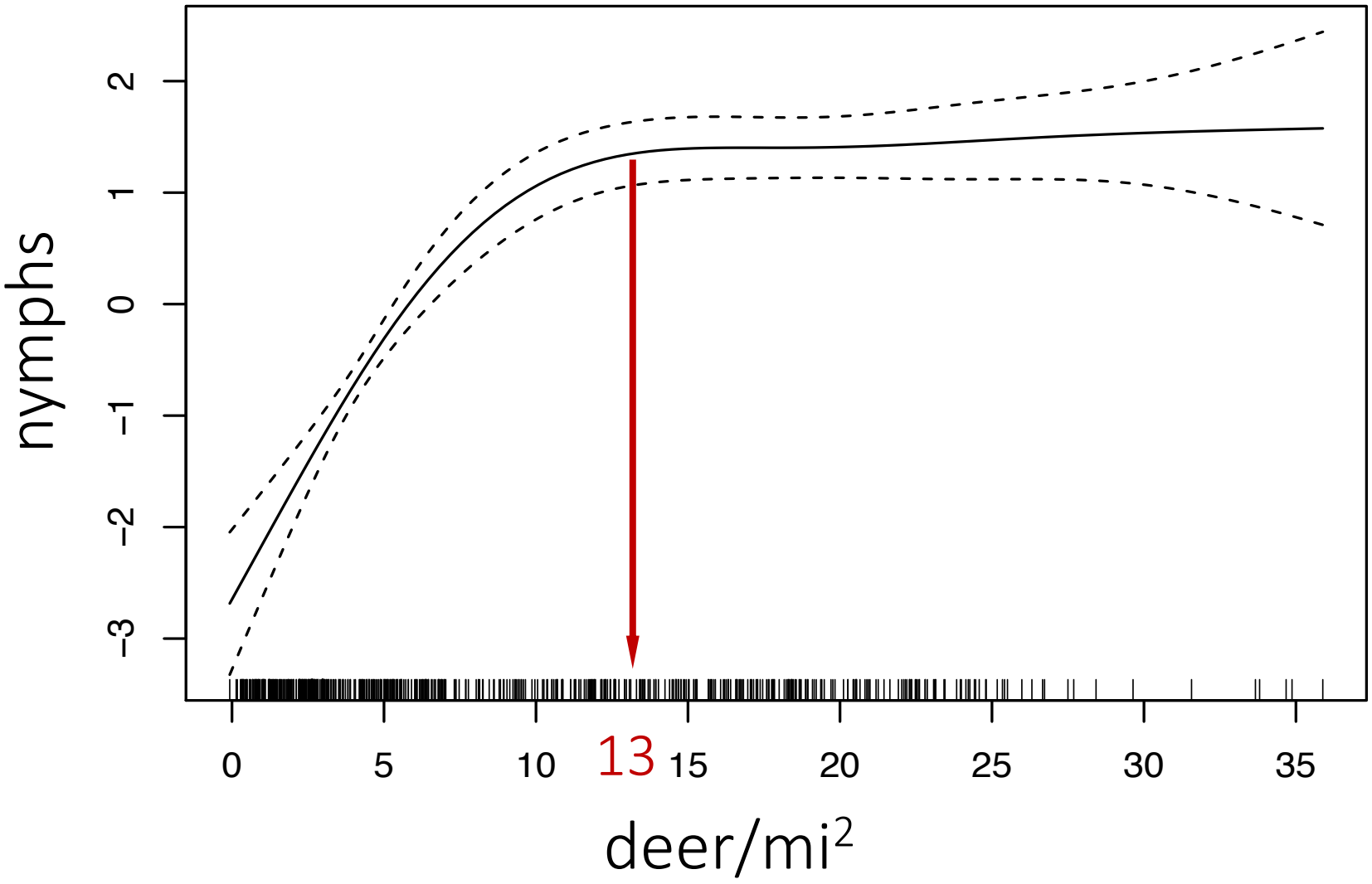
- nymphs
- deer
- seasonal climatology
  - winter/spring/fall avg. min temp
  - summer avg. max temp & relative humidity,
  - annual degree-day accumulation

- model: generalized additive model (nonlinear/smooth, visual)

Tick-deer-climate model results

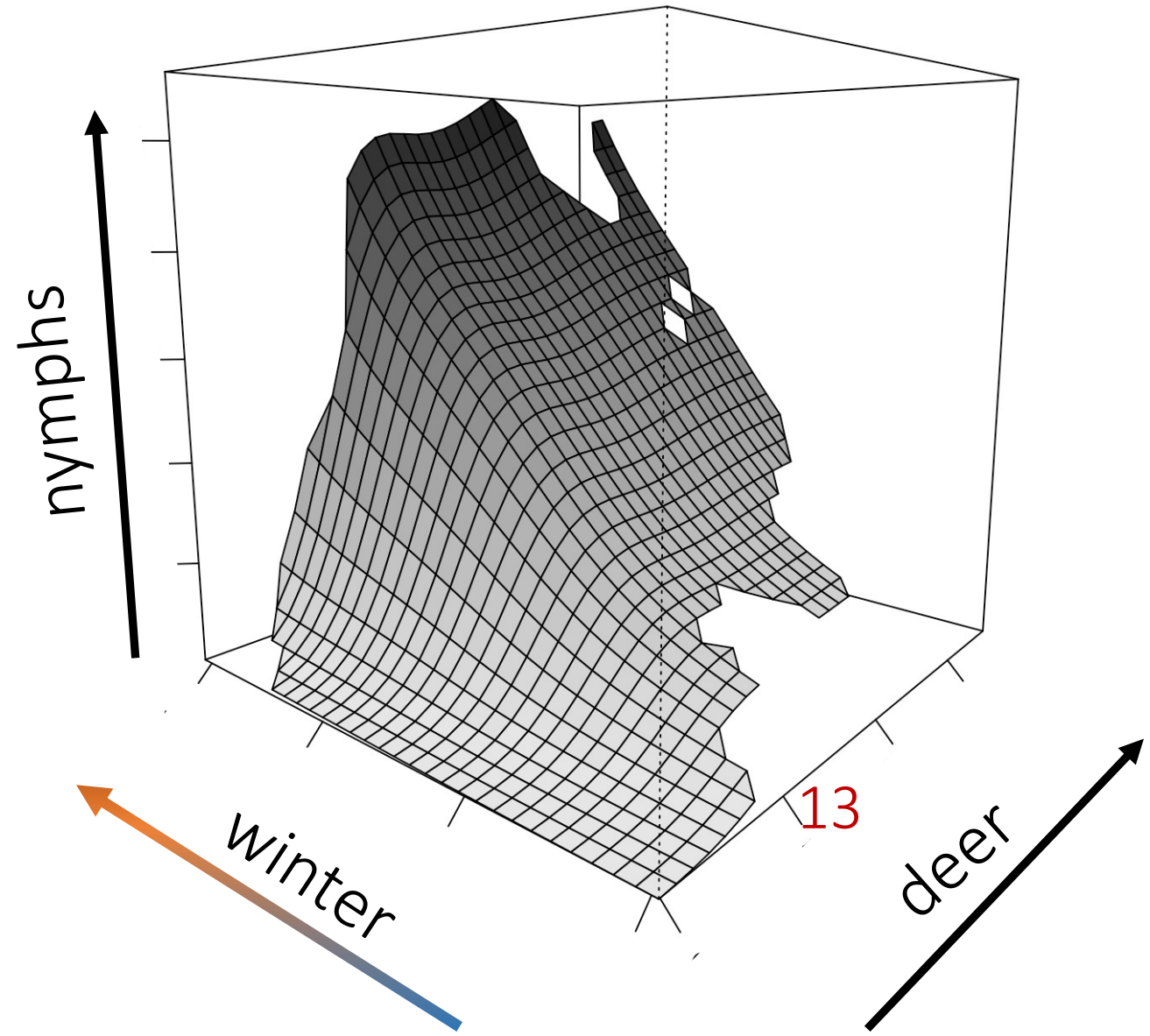


nymphs ~ *s*(deer)



nymphs ~ *s*(deer) + *s*(winter temp)

Quantify the ‘saturating’ relationship while accounting for winter cold



History of deer herd reduction for tick control on Maine's offshore islands (Elias et al. 2021)

- 13 of 14 had deer, Monhegan removed, 9 of 14 culled (reduced) at least once 1992-2019

- culls motivated by Lyme but also by damage to vehicles, gardens, forests

- 15-60/mi^2 where problems persist

- no ITM (Integrated Tick Management)

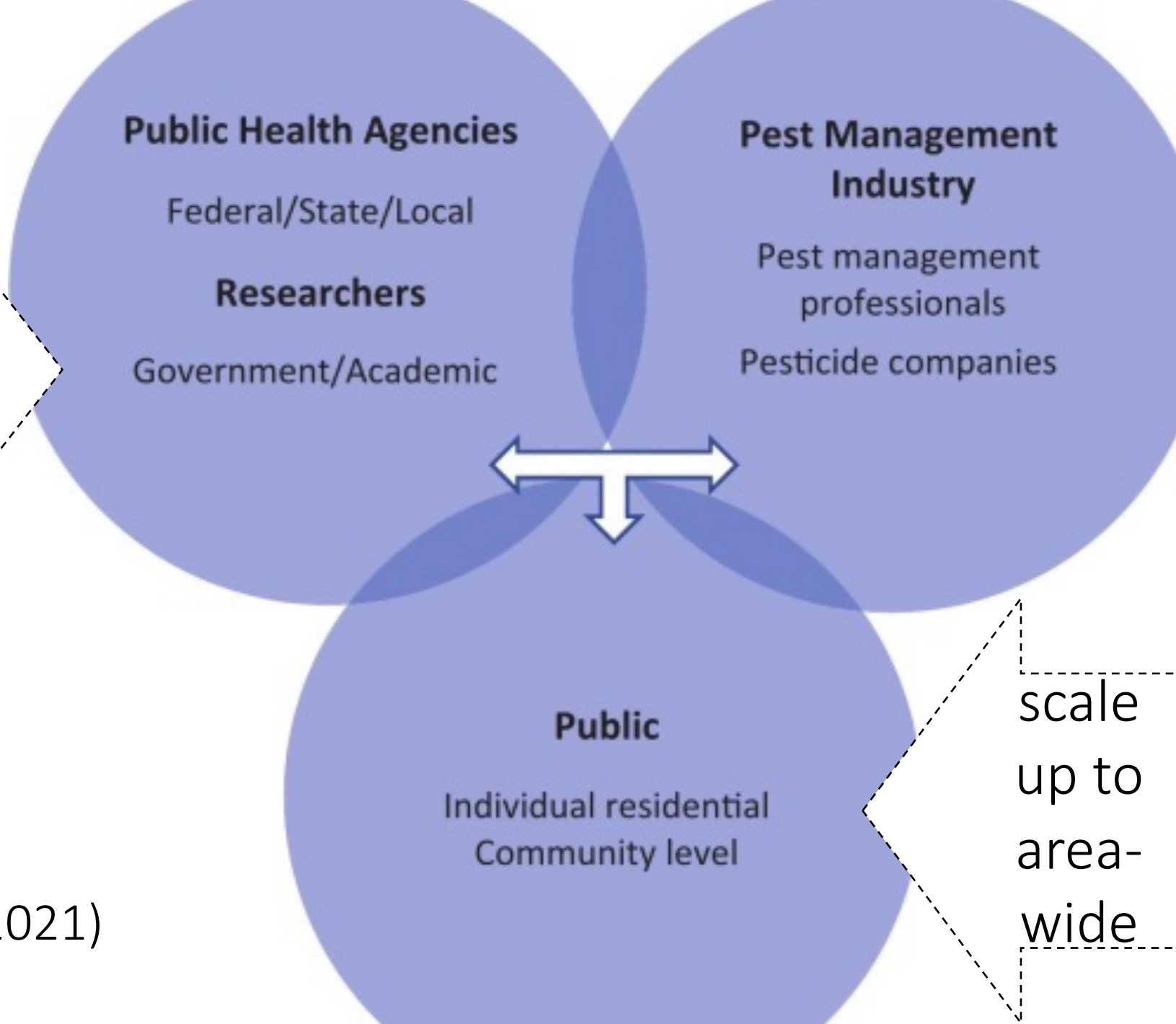
ITM toolbox, e.g., Stafford et al. 2017

target	methods
landscape/vegetation	hardscaping, brush/leaf litter removal
host-seeking ticks	reduce rodent harborage, acaricides (synthetic, botanical, biological)
rodents	topical acaricide, vaccine, antibiotics
deer	reduction, fencing, topical/systemic acaricide

combine short- and long-term strategies for sustained control (Telford 2017)

What's next?

Vector control districts w/ professionally staffed ITM programs



scale up to area-wide

ITM Triad (Eisen & Stafford 2021)

Collaborators & Support

Maine Center for Disease Control and Prevention
An Office of the Department of Health and Human Services

MAINE DEPT. OF INLAND FISHERIES AND WILDLIFE

Maine Islands Coalition

ISLAND INSTITUTE

1865 THE UNIVERSITY OF MAINE

THE UNIVERSITY OF MAINE
CLIMATE CHANGE INSTITUTE

NSF

A2C2 IGERT
adaptation to abrupt climate change

Maine Medical Center Research Institute

Blacklegged Ticks versus Climate and Deer in Maine

Questions?

Support for deer herd reduction on offshore islands of Maine, U.S.A. (Elias et al. 2021)

- 2016 survey of island residents, 793 respondents, 84% agreed LD a problem, 61% supported deer herd reduction

- support greater if bitten or sick

- tick problem not just about deer

- responsibility on town/state, < individuals