A Comparison of Passive and Active Tick Surveillance Data to Assess Sampling Differences in the Tick Inventory via Citizen Science

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Background: Due to ecological, behavioral, and climate factors, tick-borne diseases (TBDs) are increasing across Wisconsin. The Tick Inventory via Citizen Science (TICS) project, launched in 2024, uses ticks submitted by regional residents to assess TBD risk. The TICS surveillance project offers valuable real-world data but could introduce biases related to the passive design, including uneven coverage and limited diversity in species and life stages. Active tick surveillance methods, such as tick dragging, are more systematic but lack the human exposure component and are more labor intensive. To better understand potential biases in TICS, both passive and active tick surveillance methods were compared.

Methods: This analysis used a subset of tick surveillance data from Wisconsin, including adult and nymphal Dermacentor variabilis and Ixodes scapularis (the most common local species for human exposure). Passive TICS data included 5,661 ticks collected in 2024 and 3,965 collected in 2025. This sample was compared to active surveillance data from 1,462 ticks collected from State-provided tick drags in 2024, and 36 ticks collected from drags in summer 2025 from locations that appeared over- or underrepresented in the 2024 TICS submissions. Negative binomial regression was used to assess predictors of tick counts in 2024, with consideration of interactions between surveillance method and species and life stage. The model was validated with 2025 data comparisons to predicted counts.

Results: In 2024, I. scapularis was associated with higher overall counts (IRR=2.88, $p<0.001$), but its interaction with passive surveillance showed a strong reducing effect (IRR=0.26, $p<0.001$), indicating underrepresentation of I. scapularis in the TICS (citizen science) submissions. The TICS surveillance was also associated with somewhat fewer nymphs (IRR=0.73, $p=0.055$). Contrary to the hypothesis that there would be fewer submissions from areas further away from the Marshfield Clinic Research Institute, increased distance was positively associated with passive surveillance (IRR=1.003, $p=0.006$). The model fit the 2024 data moderately well ($R2=0.294$; McFadden's pseudo-$R2=0.334$) but performed poorly for 2025 ($R2=-0.122$).

Conclusions: This study identified some bias in the TICS program. There were fewer than expected nymphal I. scapularis, a primary vector of Lyme disease, collected in the passive TICS surveillance program as compared to the more active tick drag surveillance model used by the State. Combined with the poor predictive power in 2025, this underscores the need for more widely integrated and generalizable tick surveillance methods, including collection of additional ecological and behavioral data, along with active tick drags, to improve TBD risk assessment.