# Role of avian hosts in spread and maintenance of *Borrelia burgdorferi* and *Rickettsia* spp. in *Ixodes* spp. collected off birds in southeastern Virginia

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## Background

Most prevalent tick-borne diseases in Virginia:
- Lyme disease
- Spotted fever group rickettsioses

Birds play host to juvenile ticks and can move infected ticks over small and large distances.

## Research Questions

1. What role do birds play in the maintenance and transmission of *Borrelia burgdorferi* in southeastern Virginia?
2. What *Rickettsia* spp. are found in *Ixodes brunneus*, a species that feeds exclusively on birds for all life stages?

## Methodology

**Bird and Tick Collection**
- Mistnetting from 2012-2014 at various sites across southeastern Virginia

**Tick Identification**
- *Ixodes scapularis/Ixodes affinis* real time assay (1)
- 16S and/or 12S (2,3)

***Borrelia* Identification**
- Real time assays: Bb23S, Bb16S, BbSS (4,5)
- Sequencing: *pepX*, IGS, *ospC*, *fla*b (6-9)

***Rickettsia* Identification**
- Real time assays: *Rickettsia* spp. 17Kda, *Rickettsia parkeri ompB* (10)
- Sequencing: *ompA* (11)

## References

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## *Ixodes* spp. Results

288 *Ixodes* spp. collected from birds
- *Ixodes* species: *I. scapularis*, *I. affinis*, *I. brunneus*, and *I. dentatus*
- 6.94% (20/288) *B. burgdorferi* s.s.

Of the 288 *Ixodes* spp., 75 were identified as *I. brunneus*
- *Rickettsia* spp. (59 tested): 49.15%
- 25.33% *R. parkeri* (all 75 tested)

Co-infection
- One *I. brunneus* was positive for both *B. burgdorferi* and *R. parkeri*

## Bird Results

**Table 1. Birds with *B. burgdorferi*-infected *Ixodes* spp.**

| Bird Species | Brown thrasher (*Toxostoma rufum*) | Carolina wren (*Thryothorus ludovicianus*) | Swamp sparrow (*Melospiza georgiana*) |
|---|---|---|---|
| Migratory status | Resident | Resident | Migratory |
| Birds captured | 75 | 186 | 15 |
| Birds with ticks | 27 | 76 | 5 |
| Birds with *Ixodes* ticks | 13 | 34 | 3 |
| Birds with *B. burgdorferi*-infected *Ixodes* ticks | 2 | 9 | 1 |

**Table 2. Birds with *Rickettsia*-infected *Ixodes* spp.**

| Bird Species | Brown thrasher (*Toxostoma rufum*) | Carolina wren (*Thryothorus ludovicianus*) | Swamp sparrow (*Melospiza georgiana*) | Hermit thrush (*Catharus guttatus*) | Dark-eyed junco (*Junco hyemalis*) | White-throated sparrow (*Zonotrichia albicollis*) | Tufted titmouse (*Baeolophus bicolor*) | Northern cardinal (*Cardinalis cardinalis*) |
|---|---|---|---|---|---|---|---|---|
| Migratory status (M=Migratory, R=Resident) | R | R | M | M | M | M | M | R |
| Birds captured | 75 | 186 | 15 | 37 | 21 | 160 | 32 | 302 |
| Birds with ticks | 27 | 76 | 5 | 4 | 6 | 25 | 3 | 16 |
| Birds with *Ixodes* ticks | 13 | 34 | 3 | 4 | 2 | 7 | 2 | 4 |
| Birds with *Rickettsia*-infected *Ixodes* ticks | 2 | 4 | 2 | 1 | 1 | 4 | 1 | 1 |

## *Ixodes* spp. Phenology

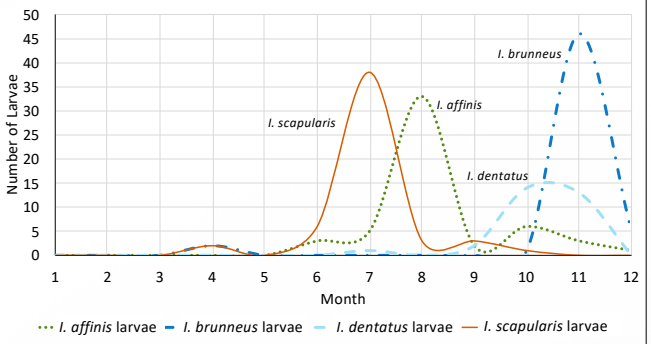


**Figure 1**. Phenology of *Ixodes* spp. larvae collected from birds

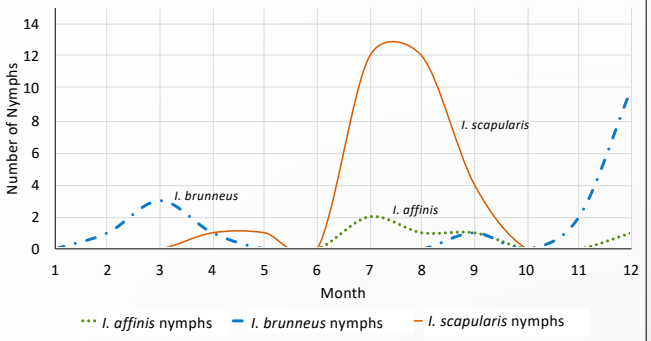


**Figure 2.** Phenology of *Ixodes* spp. nymphs collected from birds

## Discussion

**Role of birds in *B. burgdorferi* maintenance**
-Low prevalence of *B. burgdorferi*-infected *Ixodes* spp. from birds in southeastern Virginia
- Majority of *B. burgdorferi*-infected ticks came from resident bird species

**Role of birds in *Rickettsia* spp. maintenance**
- High prevalence of *I. brunneus* were positive for *Rickettsia* spp.
- Majority of *Rickettsia*-infected ticks came from migratory bird species
- Other ticks on same bird were not positive for *Rickettsia* spp.

**Tick Phenology**
- *Ixodes* spp. larval peak feeding activity occurs during different times of the year; could contribute to maintenance of tick-borne pathogens year-round
- *Ixodes* spp. nymphal peak feeding activity overlaps with larval feeding allowing for co-feeding transmission of pathogens to potentially occur