## 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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## Ixodes spp. Results Ixodes spp. Phenology Background Most prevalent tick-borne diseases in Virginia: 288 Ixodes spp. collected from birds 50 Lyme disease - Ixodes species: I. scapularis. I. affinis. I. brunneus. and I. dentatus 45 I. brunneus Spotted fever group rickettsioses - 6.94% (20/288) B. burgdorferi s.s. 40 Of the 288 Ixodes spp., 75 were identified as I. brunneus e 35 - Rickettsia spp. (59 tested): 49.15% 03 ل<sup>م</sup> Birds play host to juvenile ticks and can move infected ticks over small and affini I. scapular °5 <sub>25</sub> large distances. - 25.33% R. parkeri (all 75 tested) ية 20 Co-infection 4 20 M 15 dentatus - One I. brunneus was positive for both B. burgdorferi and R. parkeri **Research Questions** 10 **Bird Results** 5 0 1. What role do birds play in the maintenance and Table 1. Birds with B. burgdorferi-infected Ixodes spp 2 3 5 6 7 8 9 10 11 transmission of Borrelia burgdorferi in southeastern Month Virginia? **Brown thrasher** Carolina wren Swamp sparrow •••• I. affinis larvae – I. brunneus larvae – I. dentatus larvae – I. scapularis larvae (Toxostoma (Thryothorus (Melospiza Figure 1. Phenology of *Ixodes* spp. larvae collected from birds rufum) ludovicianus) georgiana) **Bird Species** 2. What Rickettsia spp. are found in Ixodes brunneus, a species that feeds exclusively on birds for all life **Migratory status** Resident Resident Migratory stages? 14 12 Birds captured 75 186 15 rd 10 N Jo Methodology Birds with ticks 27 76 5 . scapulari Number Bird and Tick Collection - Mistnetting from 2012-2014 at various sites across southeastern Virginia Birds with Ixodes ticks 13 34 3 4 Tick Identification I. brunneus . affinis 2 Ixodes scapularis/Ixodes affinis real time assay (1) 16S and/or 12S (2.3) Birds with **Borrelia** Identification 10 11 B. burgdorferi-infected 2 9 1 6 7 8 ۵ 12 Ixodes ticks Real time assays: Bb23S, Bb16S, BbSS (4,5) Month Sequencing: pepX, IGS, ospC, flab (6-9) - I. scapularis nymphs ···· I. affinis nymphs – I. brunneus nymphs **Rickettsia** Identification Figure 2. Phenology of Ixodes spp. nymphs collected from birds Real time assays: Rickettsia spp. 17Kda, Rickettsia parkeri ompB (10) Sequencing: ompA (11) Discussion Role of birds in B. burgdorferi maintenance References -Low prevalence of *B. burgdorferi*-infected *Ixodes* spp. from birds in . Wright et al. 2014. Ticks and Tick-borne Diseases. 6. Margos et al. 2008. Proceedings of National Academy of Sciences. southeastern Virginia Nadolny et al. 2011. Journal of Vector Ecology. 7. Bunikis et al. 2004. Microbiology. 8. Williamson et al. 2012. Emerging Infectious Diseases. 8. Tsao et al. 2013. Applied and Environmental Microbiology. - Majority of *B. burgdorferi*-infected ticks came from resident bird species Courtney et al. 2004. Journal of Clinical Microbiology. 9. Johnson et al. 1992. American Journal of Tropical and Medical Hygiene Role of birds in *Rickettsia* spp. maintenance . Graham et al 2018. Ticks and Tick-borne Diseases 10. Jiang et al. 2012. Vector-borne and Zoonotic Diseases 11. Paddock et al. 2004. Clinical Infectious Diseases. - High prevalence of *I. brunneus* were positive for *Rickettsia* spp. - Majority of *Rickettsia*-infected ticks came from migratory bird species Acknowledgements Other ticks on same bird were not positive for *Rickettsia* spp. Tick Phenology ODU Tick Team and the Avian Ecology Lab at ODU - Ixodes spp. larval peak feeding activity occurs during different times of the

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TICK RESEARCH TEAN

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| Table 2. Birds with <i>Rickettsia</i> -infected <i>Ixodes</i> spp. |   |  |   |   |  |  |   |   |
|--|---|--|---|---|--|--|---|---|
| Bird Species   | Brown thrasher<br>(Toxostoma<br>rufum)  | Carolina wren<br>(Thryothorus<br>Iudovicianus)   | Swamp<br>sparrow<br>(Melospiza<br>georgiana)  | Hermit thrush<br>(Catharus<br>gutta tus)  | Dark-eyed<br>junco<br>( <i>Junco</i><br>hyemalis)  | White -thro ated<br>sparrow<br>(Zon otrichia<br>albicollis)  | Tufted titmouse<br>(Baeolophus<br>bicolor)  | cardinal<br>(Cardina lis<br>cardinalis)   |
| Migratory status<br>(M=Migratory,<br>R=Resident)                   | R   | R  | м   | м   | м  | м  | м   | R   |
| Birds captured   | 75  | 186  | 15  | 37  | 21   | 160  | 32  | 302   |
| Birds with ticks   | 27  | 76   | 5   | 4   | 6  | 25   | 3   | 16  |
| Birds<br>with <i>Ixodes</i> ticks                                  | 13  | 34   | 3   | 4   | 2  | 7  | 2   | 4   |
| Birds with<br>Rickettsia-infected<br>Ixodes ticks                  | 2   | 4  | 2   | 1   | 1  | 4  | 1   | 1   |
|  | Bird Species<br>Migratory status<br>(M=Migratory,<br>R=Resident)<br>Birds captured<br>Birds with ticks<br>Birds with <i>ixodes</i> ticks<br>Birds with<br><i>ixodes</i> ticks | Bird SpeciesDispeciesMigratory status<br>(M=Migratory status<br>(M=Migratory status)RBirds captured75Birds with ticks27Birds with ticks133Birds with<br>kodes ticks2 | Bird SpeciesBord SpeciesBord SpeciesMigratory statusRRBirds captured751860Birds with ticks27760with koodes ticks13340Birds with24 | Bird SpeciesItem of the second se | Bird SpeciesBookBookBookBookBookBookMigratory statusRRMMBirds captured7518661537Birds captured2776554Birds with ticks233434Birds with koodes ticks133421 | Bird SpeciesBird SpeciesRRMHermit HumberHyme BirdMigratory, StarseRRMMBirds captured751861553721Birds captured2776055446with Ixodes ticks13343342Birds with<br>kxodes ticks24211 | Bird SpeciesNoneRMMMMBird Species00 | Bird SpeciesBird SpeciesCC< |



vear: 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