Occurrence of ticks on birds banded in the Red Clay Valley

Ian Stewart and Joe Sebastiani
Delaware Nature Society, Hockessin DE, 19807
ian@delnature.org

Introduction

Ticks are external parasites of a range of vertebrates including birds and mammals. Most hard ticks (*e.g.* the Deer Tick, *Ixodes scapularis*[*]) have a complex two-year life cycle during which they parasitize White-tailed Deer but also several species of mice and birds. Adult females attach to a host mammal or bird and feed for several days before dropping off to overwinter in the leaf litter. The following spring they lay hundreds of eggs, which hatch into 6-legged larvae which feed on blood themselves before overwintering. The following spring they develop into nymphs which also feed on blood before developing into adults in late summer and early fall, thus completing the cycle.

Interest in bird ticks has increased rapidly in the last two decades because of intense concerns about tick-borne diseases of humans, primarily Lyme disease. Birds are significant in this regard because many species are short- or long-distance migrants and could thus aid the dispersal of ticks infected with Lyme disease or other serious diseases (Ogden *et al*. 2008). In the first comprehensive survey of its kind, Stafford *et al*. (1995) examined 5,297 passerines banded from spring to early fall in Lyme, Connecticut (where Lyme disease was first diagnosed in 1975) and found *Ixodes scapularis* on 15.2% of birds (803), with no fewer than 36 species harboring ticks. Several other surveys have since confirmed that ticks are routinely found on birds (Kinsey *et al*. 2000, Ogden *et al*. 2008).

We therefore decided to monitor ticks present on passerine birds banded as part of the Delaware Nature Society's bird conservation project in order to test several ecological hypotheses concerning tick distribution within and between species. We hypothesized that tick prevalence is a direct result of exposure, and thus predicted that species which tended to feed and/or nest close to the ground would be most likely to be infected by ticks. We also predicted that females would be more likely to have ticks than males, in the summer time at least, since they spend more time immobile at the nest while incubating eggs or

* Coincidentally, the *Ixodes scapularis* was first described in 1821 by the American naturalist Thomas Say, for whom the Say's Phoebe was named.

brooding nestlings. Finally, we predicted that juvenile birds would be more likely to have ticks than adults because they acquired them in the nest.

Methods

Birds were captured using mist nets at Ashland Nature Center in Hockessin, DE, Coverdale Farm Preserve in Greenville, DE, Middle Run Natural Area in Newark, DE and Bucktoe Creek Preserve near Kennett Square, PA from June 2015 through August 2017, with the exception of December through March. We identified them to species and then sexed them based on their plumage or the presence of a brood patch during the breeding season. We also aged them based on their plumage or other features as adults (*i.e.* hatched in a previous year) or juveniles (*i.e.* hatched in the current year). We briefly inspected their head and face for ticks then took a digital photograph of the right side of the face for later examination. Most ticks were detected using the photographs as these could be magnified on a computer screen then examined more slowly. Data were not available for many of the birds we captured because they were either not examined or photographed due to time constraints, or the photograph was not of sufficient quality to be certain no ticks were present. Ticks were not removed from the birds and we did not attempt to identify them or place them into age categories. Thirteen birds were sampled in more than one year but were retained in the analysis since we considered each bird-year a separate event. Fifteen birds were sampled within the same calendar year but in these cases we scored tick presence or absence from the time the bird was first captured.

Results

A total of 803 birds was inspected to our satisfaction, of which 69 had at least one tick (8.6%). Almost all of these appeared to be hard ticks, likely of the *Ixodes* genus based on published photographs (Wikipedia.org, accessed 10 August 2017). The average number of ticks per infected bird was 1.6 (range 1 to 9) although the majority of infected birds (47/69) had just one tick.

Of the 13 birds sampled in more than one year, 10 had no ticks in either year while 3 were infected in one year but not the other. Of the 15 birds examined in the same year, 12 had no ticks on either occasion while 3 were infected in one survey but not the other.

Ticks were most common around the eye (49/69 birds) although 17 birds had ticks near their mouth (usually the gape flange) and 3 had

ticks in more than one site. The species in which ticks were most often found near the mouth was the Eastern Towhee, with 8 of the 10 infected towhees having ticks in the gape flange.

We calculated tick prevalence (% of birds infected) for each species after first pooling the data from each site and each year. This is unlikely to have affected our results since the proportion of infected birds was not strikingly different between years (2015 = 8.7% (18/207), 2016 = 6.8% (31/462), 2017 = 14.9% (20/134)). We also restricted the analysis to species where we had sampled at least 5 individuals as an arbitrary cut-off point, since prevalence estimates based on sampling a small number of birds are probably unreliable. This excluded 22 species, although interestingly, none of these birds had ticks. These were Acadian Flycatcher (3), Eastern Phoebe (3), Eastern Wood-Peewee (2), Willow Flycatcher (3), American Redstart (4), Black-and-White Warbler (1), Black-throated Blue Warbler (3), Hooded Warbler (1), Magnolia Warbler (1), Northern Waterthrush (3), Northern Parula (1), Prairie Warbler (1), Yellow-breasted Chat (4), Yellow-rumped Warbler (1), Yellow Warbler (1), Blue-gray Gnatcatcher (1), Savannah Sparrow (3), Blue Grosbeak (1), Eastern Bluebird (1), Baltimore Oriole (2), Yellow-shafted Flicker (2), White-eyed Vireo (3) (scientific names are in Appendix 1).

Table 1 shows the tick prevalence per species in descending order. Ticks were most common on Brown Thrashers (3/6), Ovenbirds (5/12), Carolina Wrens (6/16), Eastern Towhees (10/29) and House Wrens (3/12), with at least 25% of birds of these species being infected. By contrast, ticks were entirely absent from several frequently-caught species, with none being found on House Finches (0/44), American Goldfinches (0/29) or Downy Woodpeckers (0/29).

Ticks were present on 15.3% (20/131) of adult males handled during the summer (April through September) and 13.2% (15/114) of adult females. These proportions were not significantly different (Fisher's Exact Test P = 0.72). Ticks were present on 13.5% (39/288) of adult birds handled during the summer but only 9.4% (22/235) of juveniles, although these proportions are not significantly different (Fisher's Exact test = 0.17). The peak of tick prevalence was in May with 17% of birds infected (Figure 1), whereas prevalence was low in April, October and November (<4% of birds infected).

Discussion

We searched for ticks on birds banded in the Red Clay Valley of northern Delaware and south-east Pennsylvania and found that they

Table 1. Prevalence (% infected) of ticks in passerine species banded in the Red Clay Valley area of Delaware and Pennsylvania

Species	# Banded	# With Tick(s)	Prevalence
Brown Thrasher	6	3	50
Ovenbird	12	5	42
Carolina Wren	16	6	38
Eastern Towhee	29	10	34
House Wren	12	3	25
Blue Jay	9	2	22
Hermit Thrush	5	1	20
Palm Warbler	5	1	20
Common Yellowthroat	22	4	18
Wood Thrush	11	2	18
Field Sparrow	7	1	14
Orchard Oriole	7	1	14
Northern Cardinal	61	8	13
American Robin	15	2	13
Swamp Sparrow	9	1	11
Gray Catbird	102	9	9
Song Sparrow	83	7	8
White-throated Sparrow	61	2	3
Tufted Titmouse	34	1	3
House Finch	44	0	0
American Goldfinch	29	0	0
Downy Woodpecker	29	0	0
Slate-colored Junco	28	0	0
White-breasted Nuthatch	20	0	0
Red-winged Blackbird	17	0	0
Carolina Chickadee	14	0	0
Chipping Sparrow	12	0	0
White-crowned Sparrow	10	0	0
Red-bellied Woodpecker	9	0	0
Indigo Bunting	7	0	0
Purple Finch	6	0	0
Red-eyed Vireo	6	0	0
Hairy Woodpecker	5	0	0
Lincoln's Sparrow	5	0	0
Ruby-crowned Kinglet	5	0	0
TOTAL	752	69	9

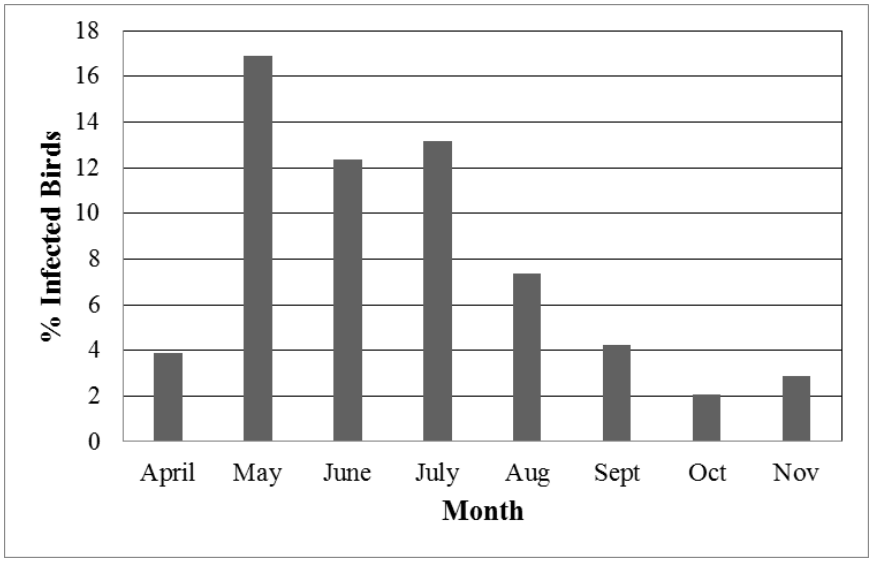

Figure 1. Monthly prevalence of ticks on passerine birds banded in the Red Clay Valley Area, 2015-2017.

were surprisingly common, with almost 9% of birds having at least one tick. Though our sample sizes are small for some species, our main hypothesis was supported since ticks were most common on birds that either nest or feed on or close to the ground. Ticks were especially common on Brown Thrashers, Ovenbirds and Eastern Towhees, all of which regularly feed on the ground, and in the case of the Ovenbird, also nest on the ground. Brown Thrashers were also the most commonly infected bird in a large survey of spring migrants undertaken in eastern Canada (Ogden *et al.* 2008) with 11% having at least one tick. Tick prevalence is clearly not an automatic cost of ground-feeding however. American Robins commonly feed on the ground and yet few had ticks (2/15), and none of 12 Chipping Sparrows had ticks even though these are also ground-feeders. Song Sparrows often feed on the ground and also nest either low to the ground or on it and yet tick prevalence was modest (7/83).

Ground-feeding is also not the only way birds can acquire ticks, since they were fairly common on both Carolina and House Wrens, neither of which routinely feed on the ground. Carolina Wrens do feed close to the ground however and sometimes nest low in the undergrowth, which presumably represents a significant exposure to ticks. Stafford *et al.* (1995) mist-netted birds during the fall in Lyme, Con-

Figure 2. Ovenbird with ticks above eye.

necticut and found that deer ticks were most common on Carolina Wrens, with 51% of birds being infected, and were also prevalent on Common Yellowthroats (27%), which also do not nest directly on the ground but do feed and nest low in the undergrowth.

As further support for our hypothesis, no ticks were found on birds which are rarely seen on the ground (*e.g.* American Goldfinches, House Finches, Downy Woodpeckers or White-breasted Nuthatches).

We tested whether adult females were more likely to have ticks than adult males during the summer months, based on the assumption that ticks are more likely to find them because they spend significantly more time sitting in the nest incubating eggs or brooding young. However, we found no difference in prevalence between the sexes, suggesting that either ticks do not commonly infect birds at the nest, or that males suffer additional exposure, perhaps because they travel through the undergrowth more extensively while patrolling their territory or searching for additional females to copulate with. We also tested whether juvenile birds were more likely to have ticks than adults because they spend one or more weeks immobile in the nest during which time they are emitting heat or chemical cues that attract ticks. However, we found no difference in prevalence between the two age classes. It is possible that ticks do not regularly climb up to nests and juveniles do not acquire them until after they fledge. A study of European Blackbirds, which have a very similar nesting ecology to American Robins, found that

Figure 3. Eastern Towhee with ticks on gape flange.

74% of adults in rural sites were infected with ticks and yet none of the nestlings were (Faivre *et al.* 2002).

Most ticks were found close to the eye, presumably because birds would be reluctant to try to remove them from this sensitive area by scratching (Figure 2). Eastern Towhees were notable for having ticks in their gape flange, perhaps because this is unusually large and fleshy in this species (Figure 3).

We also detected a marked seasonal distribution in tick prevalence, with most infected birds being seen during May, which is significant as this is the month migrating birds pass through the region. We found ticks on a White-throated Sparrow on 10 April and a Swamp Sparrow on 26 April, neither of which breed at their capture site (Bucktoe Creek). These species have a wide breeding range that extends into northern Canada and could thus transport infected ticks for several hundred miles. Ogden *et al.* (2008) surveyed ticks on northward migrants captured at banding stations in eastern Canada and estimated that 0.4% of them had ticks (mostly nymphs), although a sub-sample examined by tick specialists found 2.2% were infected. The second most common tick species identified (263/897 ticks) was *Ixodes scapularis*, which is the deer tick and primary vector for Lyme disease. Fifteen percent of these ticks tested positive for the Lyme disease virus, *Borrelia burgdorferi*, and could have infected new birds had they reached their breeding

grounds.

Relatively few birds had ticks during late fall, probably because the ticks have dropped off in order to overwinter in the vegetation. This was quite surprising as Kinsey *et al.* (2000) examined passerines banded during fall migration (September and October) at coastal sites in Georgia and Alabama and found 14.7% and 13.3% of birds were infected with ticks (n = 423 and 165 birds respectively). We did find ticks on a Hermit Thrush on 6 October, a Palm Warbler on 7 October, and a White-throated Sparrow on 23 November, and it is possible that some of the infected Gray Catbirds we captured during fall were in the process of migrating from further north.

In sum, we examined birds banded in the Red Clay Valley area through spring and late fall and found that a significant number (9%) had at least one tick. Although our study was limited by small sample sizes for some species and the possibility that some ticks went undetected one clear pattern emerged: ticks were most prevalent in species that fed or nested on or close to the ground. Moreover, we found ticks on a small number of both northward and southward migrants, suggesting that birds could theoretically transport ticks long distances. This study emphasizes the need for further studies on the role of bird ticks in spreading diseases such as Lyme disease, especially in the event of continued global warming. A model generated by Brownstein *et al.* (2005) suggests that if temperatures continue to rise Lyme disease will spread northward since milder winters would mean greater overwinter survival of infected ticks. Moreover, changes in bird distribution could also mean infected birds could spread disease into new breeding areas.

Acknowledgments

We thank Jeff Chambers, Steve Cottrell, Lauren Morgens, Carol Spease, Zoe Yost and Tim Zador for their indispensable help with banding, several anonymous donors for funding, and Brian Winslow of DNS for facilitating the bird banding project. All banding was conducted under Federal and State permits and with the permission of the landowners or managers.

Literature Cited

Brownstein, J.S., T.R. Holford, and D. Fish. 2005. Effect of climate change on Lyme disease risk in North America. *Ecohealth* 2:38 – 46.

Gregoire A., B. Faivre, P. Heeb, and F. Cezilly. 2002. A comparison of infestation patterns by *Ixodes* ticks in urban and rural populations of the Common Blackbird *Turdus merula*. *Ibis* 144:640 – 645.

Hamer, S.A., T.L. Goldberg, U.D. Kitron, J.D. Brawn, T.K. Anderson, S.R. Loss, E.D. Walker, and G.L. Hamer. 2012. Wild birds and urban ecology of ticks and tick-borne pathogens, Chicago, Illinois, USA, 2005 – 2010. *Emerging Infectious Diseases* 18:1589 – 1595.

Kinsey, A.A., L.A. Durden, and J.H. Oliver. 2000. Tick infestations of birds in coastal Georgia and Alabama. *Journal of Parasitology* 86:251 – 254.

Ogden, N.H., L.R. Lindsay, K. Hanincova, I.K. Barker, M. Bigras-Poulin, D.F. Charron, A. Heagy, C.M. Francis, C.J. O'Callaghan, I. Schwartz, and R.A. Thompson. 2008. Role of migratory birds in the introduction and range expansion of *Ixodes scapularis* ticks and of *Borrelia burgdorferi* and *Anaplasma phagocytophilum* in Canada. *Applied and Environmental Microbiology* 74:1780 – 1790.

Stafford, K.C., V.C. Bladen, and L.A. Magnarelli. 1995. Ticks (Acari: Ixodidae) infesting wild birds (Aves) and white-footed mice in Lyme, CT. *Journal of Medical Entomology* 32:453 – 466.

Appendix 1. Scientific names of bird species referenced in this article.

Species	Scientific Name
Acadian Flycatcher	*Empidonax virescens*
American Goldfinch	*Carduelis tristis*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
Baltimore Oriole	*Icterus galbula*
Black-and-White Warbler	*Mniotilta varia*
Black-throated Blue Warbler	*Dendroica caerulescens*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Blue Grosbeak	*Guiraca caerulea*
Blue Jay	*Cyanocitta cristata*
Brown Thrasher	*Toxostoma rufum*
Brown-headed Cowbird	*Molothrus ater*
Carolina Chickadee	*Poecile carolinensis*
Carolina Wren	*Thyrothorus ludovicianus*
Chipping Sparrow	*Spizella passerina*
Common Yellowthroat	*Geothlypis trichas*
Downy Woodpecker	*Picoides pubescens*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Phoebe	*Sayornis phoebe*
Eastern Towhee	*Pipilo erythrophthalmus*
Eastern Wood-Peewee	*Contopus virens*
Field Sparrow	*Spizella pusilla*
Gray Catbird	*Dumatella carolinensis*
Hairy Woodpecker	*Picoides villosus*
Hermit Thrush	*Catharus guttatus*
Hooded Warbler	*Wilsonia citrina*
House Finch	*Carpodacus mexicanus*
House Wren	*Troglodytes aedon*
Indigo Bunting	*Passerina cyanea*
Lincoln's Sparrow	*Melospiza lincolnii*
Magnolia Warbler	*Dendroica magnolia*

Appendix 1 (cont.). Scientific names of bird species referenced in this article.

Species	Scientific Name
Lincoln's Sparrow	*Melospiza lincolnii*
Magnolia Warbler	*Dendroica magnolia*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*
Northern Parula	*Parula americana*
Northern Waterthrush	*Seiurus noveboracensis*
Orchard Oriole	*Icterus spurius*
Ovenbird	*Seiurus aurocapillus*
Palm Warbler	*Dendroica palmarum*
Prairie Warbler	*Dendroica discolor*
Purple Finch	*Carpodacus purpureus*
Red-eyed Vireo	*Vireo olivaceus*
Red-winged Blackbird	*Agelaius phoeniceus*
Ruby-crowned Kinglet	*Regulus calendula*
Savannah Sparrow	*Passerculus sandwichensis*
Slate-colored Junco	*Junco hyemalis*
Song Sparrow	*Melospiza melodia*
Swamp Sparrow	*Melospiza georgiana*
Tufted Titmouse	*Baeolophus bicolor*
Veery	*Catharus fuscescens*
White-breasted Nuthatch	*Sitta carolinensis*
White-crowned Sparrow	*Zonotrichia leucophrys*
White-throated Sparrow	*Zonotrichia albicollis*
Willow Flycatcher	*Empidonax traillii*
Wood Thrush	*Hylocichla mustelina*
Yellow-breasted Chat	*Icteria virens*
Yellow-rumped Warbler	*Dendroica coronata*
Yellow Warbler	*Dendroica discolor*