Amblyomma dissimile Koch (Acari: Ixodidae) parasitizes bird captured in Canada

Authors: Scott, John D., and Durden, Lance A.

Source: Systematic and Applied Acarology, 20(8) : 854-860

Published By: Systematic and Applied Acarology Society

URL: https://doi.org/10.11158/saa.20.8.2

Systematic & Applied Acarology 20(8): 854–860 (2015) ISSN 1362-1971 (print)
http://dx.doi.org/10.11158/saa.20.8.2 ISSN 2056-6069 (online)

Article http://zoobank.org/urn:lsid:zoobank.org:pub:3D7EF8E4-1E17-4EC9-BF48-8071C0A7FCAC

Amblyomma dissimile Koch (Acari: Ixodidae) parasitizes bird captured in Canada

JOHN D. SCOTT[1] & LANCE A. DURDEN[2]

[1]*Research Division, Lyme Ontario, 365 St. David Street South, Fergus, Ontario, Canada N1M 2L7 (jkscott@bserv.com)*
[2]*Department of Biology, Georgia Southern University, 4324 Old Register Road, Statesboro, Georgia 30458, U.S.A. (ldurden@georgiasouthern.edu)*

Abstract

We document *Amblyomma dissimile* Koch (Acari: Ixodidae) parasitizing a bird in Canada. A partially engorged *A. dissimile* nymph was collected from a Veery, *Catharus fuscescens* (Stephens) (Passeriformes: Turdidae), in Toronto, Ontario during spring migration. This constitutes the first authentic host record of *A. dissimile* on a bird in North America and, likewise, on a Veery, plus a new distributional record in Canada. Veeries could theoretically transport *A. dissimile* from as far south as southeastern Brazil, a distance of over 7,500 km. Experimentally, *A. dissimile* can transmit *Ehrlichia ruminantium* (Ricksettiales), which causes heartwater, a severe disease of cattle and other ungulates. Since a fully engorged *A. dissimile* nymph could likely molt during the summer in northern latitudes, this tick species could potentially parasitize local reptiles, people or ungulates, and cause autochtonous disease. Because *A. dissimile* is known to harbor rickettsiae in South America and is a laboratory vector of *E. ruminantium*, the medical and veterinary profession must be vigilant that *A. dissimile* may pose a health risk.

Key words: *Amblyomma dissimile*, bird, avian host, bird parasitism, Canada, North America

Introduction

Amblyomma dissimile Koch is a hard-bodied tick (Acari: Ixodida: Ixodidae) that feeds primarily on toads (Anura), turtles (Testudines), and lizards (Squamata) but is also known to parasitize mammals belonging to at least 10 families (Guglielmone & Nava 2010). Notably, *A. dissimile* has been reported on cattle, goats, sheep (Bovidae), rabbits (Lagomorpha), rodents (Rodentia), and humans (Guglielmone & Nava 2010). This tick species also has a host-parasite relationship with crocodiles (Crocodilia). The commonest hosts harboring all parasitic stages (larvae, nymphs, adults) of *A. dissimile* are: cane toad, *Rhinella marina* (Linnaeus) (formerly *Bufo marinus*); *Boa constrictor* Linnaeus, and *Iguana iguana* (Linnaeus) (Guglielmone & Nava 2010). The focal host range for *A. dissimile* is in the Neotropics where all three of these vertebrate hosts are indigenous. Biogeographically, *A. dissimile* has a natural host range that extends from northern Argentina to southern Mexico, the Caribbean Islands, and southern Florida (Jones *et al.* 1972, Nava *et al.* 2007). This obligate, hematophagous ectoparasite is now established throughout much of the Neotropics, and also the southernmost fringe of the Nearctic Region.

Ticks are vectors of many infectious agents of human and other animal diseases (Nicholson *et al*. 2009). Under experimental conditions *A. dissimile* is an efficient vector between goats of *Ehrlichia ruminantium* Dumler (Rickettsiales) (formerly *Cowdria ruminantium*), which causes fatal heartwater in cattle, goats, sheep and other ungulates (Jongejan 1992).

Several *Amblyomma* species from the Neotropics and southern United States have been reported on songbirds (Passeriformes) in Canada during northward spring migration. These *Amblyomma* spp. include: *A. americanum* (Linnaeus) (Scott *et al.* 2001, 2010), *A. humerale* Koch (Morshed *et al.* 2005), *A. inornatum* (Banks) (Ogden *et al.* 2008a), *A. longirostre* (Koch) (Scott *et al.* 2001, 2010, 2012), *A. maculatum* Koch (Scott *et al.* 2001, 2010, 2012; Ogden *et al.* 2008a), *A. rotundatum* Koch (Scott & Durden 2015a), and *A. sabanerae* Stoll (Scott *et al.* 2001, 2010, 2012; Scott & Durden 2015b). Within the Great Lakes region, Hamer *et al.* (2012) also reported *A. nodosum* Neumann, a neotropical tick from Brazil, collected from a migratory songbird at the southern end of Lake Michigan. In Louisiana, Mukherjee *et al.* (2014) recorded *A. longirostre, A. nodosum A. maculatum* and *A. calcaratum* Neumann from northward migrating songbirds. Additionally, *Ixodes* ticks, such as *I. affinis* Neumann and *I. minor* Neumann, which are indigenous to the southeastern United States and Central America, have been reported on Neotropical songbirds in Canada during spring migration (Scott *et al.* 2012, Scott & Durden 2015c).

Fairchild *et al.* (1966) reported an *A. dissimile* male on a Boat-billed Heron, *Cochlearius cochlearius* Linnaeus, in Panama. Scofield *et al.* (2011) documented a partially engorged nymph from a Blue-winged Macaw, *Primolius marcana* Vieillot, in the State of Pará, Brazil.

Migratory Neotropical songbirds have an inherent capacity of flying long distances in a short period of time, and reaching Canada (Scott *et al.* 2012, Scott & Durden 2015a, Scott & Durden 2015b, Scott & Durden 2015c). This capability allows them to transmit ixodid ticks long distances while the attached ticks are taking a blood meal. Subsequently, these engorged ticks are imported and released in Canada during northward spring migration.

Our objective was to continue to monitor tick species that are coming into Canada via Neotropical and southern temperate songbirds and to determine what pathogens these attached ticks may be carrying.

Materials and methods

Bird banders collected a partially engorged nymphal tick from a wild-caught Veery, *Catharus fuscescens* (Stephens) on 24 May 2015 at Toronto, Ontario, Canada (43.6178˚ N, 79.3425˚ W). After measurements and physical examination of this bird, the banders employed super-fine, stainless steel tweezers to remove the tick. The tick was inserted in a 8.5 mL polypropylene tube (15.7 X 75 mm) with a label listing collection and background information. A 7-mm hole in the polyethylene push-cap (15.7 mm diameter) provided ventilation for the tick. Tulle netting covered the inside of the push-cap to prevent the tick from escaping. This tube was placed in a self-sealing, double-zippered plastic bag with slightly moistened paper towel, and sent by regular mail to the lab (JDS). Taxonomic identification keys for *Amblyomma* spp. nymphs were used for morphological identification (Keirans & Durden 1998, Martins *et al.* 2010). After preliminary identification (JDS), the live, nymphal tick was sent via overnight courier to LAD for confirmation of identification. In order to slow down the movement of the tick, it was held on a cold plate for physical examination.
The *Amblyomma* sp. nymph (15-5A48) was kept alive in high relative humidity (90–95%) for 37 d to see if it would molt to an adult. Since this partially engorged nymph would not molt, it was put in 94% ethyl alcohol. Dorsal and ventral close-up photographs of the *A. dissimile* nymph were taken using a Nikon Multizoom AZ100M steroscopic microscope with a Nikon DS-Fi1 camera.

Because of the special significance of this nymph, we did not test it for tick-borne pathogens and, instead, have kept it intact as a voucher specimen. The nymphal tick has been deposited in the Biodiversity Institute of Ontario (University of Guelph, Ontario, Canada) with accession number BIO-15-092.

Results

The nymph (Figure 1) exhibited the following physical characteristics: coxa I with 2 spurs, coxa II with only 1 spur, cornua absent, auriculae absent, hypostome dentition 2.5/2.5, dorsum of body lacking dense pilosity, and scutum sparsely punctated. Based on these distinctive physical characteristics, the ixodid nymph was confirmed as *A. dissimile*.

FIGURE 1. *Amblyomma dissimile* nymph: A) dorsal view, scutum; bar, 1 mm. B) ventral view, coxae I–IV; bar, 1 mm. Photo credits: Kellyn Hawley.

Discussion

We provide a novel discovery of bird parasitism which illustrates that certain migratory songbirds can transport *A. dissimile* to Canada during northward spring migration. Our findings underscore the fact that passerine migrants transport ticks much farther than previously hypothesized by some researchers. At the same time, we show that *A. dissimile* has a northward extralimital range within the Western Hemisphere into Canada.

Neotropical passerines can transport ticks hundreds of kilometers during migration from wintering grounds to breeding grounds. Ogden *et al.* (2008b) postulated that songbirds can fly a maximum distance of 425 km during a 5-day engorgement period. In contrast, other researchers have documented Neotropical and southern temperate passerines transporting ixodid ticks much greater distances (Scott *et al.* 2001, Morshed *et al.* 2005, Scott *et al.* 2010, Hamer *et al.* 2012, Scott & Durden 2015a, Scott & Durden 2015b, Scott & Durden 2015c, Scott 2015). Leberman & Browne (1976) documented a Red-eyed Vireo, *Vireo olivaceus* (L.) flying 483 km from Pennsylvania to North Carolina on an overnight flight. As well, Brewer *et al.* (2000) reported a White-throated Sparrow, *Zonotrichia albicollis* (Gmelin), flying 681 km from Bradley, Ontario (in Chatham-Kent) to Lakeview Heights, Ontario in a single day. From the northern edge of the range of *A. dissimile*, the distance is approximately 1990 km from southern Florida (Miami) to Toronto, Ontario. Since the wintering range of Veeries is in southeastern Brazil, and the geographic range of *A. dissimile* extends as far south as northern Argentina, the Veery could have transported this tick as far as 7500 km during its migratory flight. Neotropical and southern temperate passerines are clearly capable of transporting slow-feeding *Amblyomma* ticks much greater distances than previously surmised.

In addition, Stutchbury *et al.* (2009) used light-sensitive geolocators (nano-tags) to track the daily flight path of migratory passerines, and found that certain Neotropical songbirds have a flight pace of 750 km/d or more, and followed a doglegged pattern during northward spring migration. Using geolocators, DeLuca *et al.* (2015) tracked Blackpoll Warblers, *Setophaga striata* (Forster), during fall migration flying an average of 62 h for an average distance of 2540 km (923 km/day) on their non-stop flight over the Atlantic Ocean. These passerine migrants depart from the northeastern United States and Maritime Provinces and fly directly to Hispaniola or Puerto Rico and, potentially, directly to their wintering range in the northern part of South America. When a passerine migrant has plentiful energy reserves before and during the migratory flight, it can fly more than 10 times the distance conjectured by some researchers. South winds, warm temperatures, body condition, and bird species can greatly enhance rapid movement while en route to their breeding range and nesting grounds. The presence of the *A. dissimile* nymph on the Veery at Toronto during spring migration underscores a much greater flight pace and distance than some researchers have speculated.

Corn *et al.* (2011) suggested that *A. dissimile* was imported into Florida from the Neotropical region on reptiles. However, we suggest that *A. dissimile* could have been introduced into southern Florida from the Caribbean Islands, Central America or South America via migratory passerines. In southern Florida, *A. dissimile* is sympatric with *A. rotundatum* (Oliver *et al.* 1993); both tick species are amphibian- and reptile-feeding ticks in the southern maritime Nearctic Region. It seems feasible that a fully engorged *A. dissimile*, which has a similar home range as *A. rotundatum*, could molt to an adult in northern latitudes, because an *A. rotundatum* nymph has previously molted to a female in Canada (Scott & Durden 2015a). Furthermore, a heavily infested, ground-foraging passerine has the potential to aid in the establishment of new foci of ticks and associated pathogens at stopover sites or nesting grounds, especially when suitable hosts are present in these localities (Anderson *et al.* 1990, Scott *et al.* 2014).

Adult *A. dissimile* are primarily found on snakes (Jones *et al.* 1972, Guglielmone & Nava 2010, Verbel-Vergara *et al.* 2015), but they are also reported on lizards, iguana and toads. The commonest hosts of all three parasitic life stages of *A. dissimile* in the Neotropics are the cane toad (*Rhinella marina*), *Boa constrictor*, and *Iguana iguana* (Guglielmone & Nava 2010).

As an ectoparasite, *A. dissimile* has the potential to transport ricksettsiae to mammalian hosts, including people. Although primarily a reptile-associated parasite, this tick species is also reported to parasitize cattle, goats, sheep, rabbits, rodents, and humans (Guglielmone & Nava 2010). Based on experimental studies with *A. dissimile*, Jongejan *et al.* (1992) found that *A. dissimile* is a competent vector of *E. ruminantium*, the causative agent of cowdriosis or heartwater, a severe rickettsial disease of ruminants in sub-Saharan Africa and the Caribbean. According to these findings, *A. dissimile* could play an important role in the maintenance of rickettsiae among certain amphibian, reptilian, and mammalian hosts. Moreover, *Candidatus* Rickettsia columbianensi, a rickettsial bacterium of unknown pathogenicity that is associated with *A. dissimile*, was recently reported from Colombia (Miranda *et al*. 2012). After feeding as a larva or nymph, and subsequently molting to the next life stage, an infected *A. dissimile* nymph or female could bite, and potentially transmit *E. ruminantium* or other rickettsiae to a suitable vertebrate host. In essence, the wide diversity of vertebrate hosts for *A. dissimile* provides greater opportunity of this tick species to acquire rickettsiae from infected hosts, and transmit them to other hosts.

The ability of Neotropical *Amblyomma* spp. ticks attached to northward migrating songbirds to introduce spotted fever group (SFG) rickettsiae into North America was recently demonstrated by Mukherjee *et al.* (2014) who recorded six distinct SFG rickettsiae in four species of *Amblyomma* ticks collected from songbirds in Louisiana. Additionally, Andoh et al. (2015) molecularly detected several different *Rickettsia* and *Ehrlichia* strains, some of which were very similar to known human pathogens, in exotic ticks (*Amblyomma* spp. and *Hyalomma* spp.) collected from exotic amphibians and reptiles that had been brought into Japan for the pet trade. Andoh *et al.* (2015) emphasized the potential for these pathogens to be transferred from non-native ticks to humans in Japan. Of course, the same would be true for North America whether the ticks were purposely imported for the pet trade or introduced naturally on migrating birds.

It is highly unlikely that *A. dissimile* would become established in Canada. *Amblyomma* spp. larvae, in particular, succumb to frigid Canadian winters. However, whenever a rickettsiae-infected *A. dissimile* is imported into Canada via a passerine migrant during spring migration, it could molt to the next life stage during the warm summer. It could then feed on and infect a local reptile (e.g., American five-lined skink, *Pleistiodon fasciatus* (Linnaeus)), which is found across southern Ontario. Such a reptilian host could in theory serve as an enzootic reservoir for rickettsiae. Subsequently, a larval or nymphal *Ixodes scapularis* Say could potentially act as a bridge vector to other vertebrate hosts, including ungulates or humans.

In conclusion, we document the first authentic report of *A. dissimile* parasitizing a bird in North America. Likewise, we provide the first host record of this tick on a bird in Canada. The presence of a nymphal *A. dissimile* on a Veery collected in southern Canada extends both the known northward extralimital range of this tick species and underscores the rapid, long-distance flight of migratory passerines during the tick engorgement period. With the presence of a partially engorged *A. dissimile* on a Veery, 23 species of ticks have now been recorded to parasitize birds in Canada. The medical and veterinary profession must be vigilant that migratory songbirds may be able to transport rickettsiae-infected *A. dissimile* as far north as Canada, and potentially cause serious illness.

Acknowledgments

We thank Charlotte England and Nigel Shaw for collecting the engorged *Amblyomma dissimile* tick from the Veery. We gratefully acknowledge the expertise of Kellyn Hawley in taking the photographs of the *A. dissimile* nymph. This research was supported by Lyme Ontario.

References

Anderson, J.F., Magnarelli, L.A. & Stafford, K.C., III. (1990) Bird-feeding ticks transstadially transmit *Borrelia burgdorferi* that infect Syrian hamsters. *Journal of Wildlife Diseases*, 26, 1–10.

Andoh, M., Sakata, A., Takano, A., Kawabata, H., Fujita, H., Une, Y., Goka, K., Kishimoto, T., & Ando, S. (2015) Detection of *Rickettsia* and *Ehrlichia* spp. in ticks associated with exotic reptiles and amphibians imported into Japan. *PLoS ONE*, 10(7), e0133700. http://dx.doi.org/10.1371/journal.pone.0133700

Brewer, D., Diamond, A., Woodsworth, E.J., Collins, B.T., & Dunn, E.H. (2000) Canadian atlas of bird banding, vol. 1. Doves, cuckoos, and hummingbirds through passerines, 1921–1995. Canadian Wildlife Service, Environment Canada, Hull, QC.

Corn, J.L., Mertins, J.W., Hanson, B. & Snow, S. (2011) First reports of ectoparasites collected from wild-caught exotic reptiles in Florida. *Journal of Medical Entomology*, 48, 94–100. http://dx.doi.org/10.1603/ME10065

DeLuca, W.V., Woodworth, B.K., Rimmer, C.C., Marra, P.P., Taylor, P.D., McFarland, K.P., Mackenzie, S.A., & Norris, D.R. (2015) Transoceanic migration by a 12 g songbird. *Biology Letters*, 11, 20141045. http://dx.doi.org/10.1098/rsbl.2014.1045

Fairchild, G.B., Kohls, G.M. & Tipton, V. (1966) The ticks of Panama, p. 167–219. *In*: Wenzel, R.L., Tipton, V.J. (Eds). Ectoparasites of Panama. Field Museum Nature History, Chicago, IL, pp. 861.

Guglielmone, A.A. & Nava, S. (2010) Hosts of *Amblyomma dissimile* Koch, 1844 and *Amblyomma rotundatum* Koch, 1844 (Acari: Ixodidae). *Zootaxa*, 2541, 27–49.

Hamer, S.A., Goldberg, T.L., Kitron, U.D. Brawn, J.D., Anderson, T.K., Loss, S.R., Walker, E.D., & Hamer, G.L. (2012) Wild birds and urban ecology of ticks and tick-borne pathogens, Chicago, Illinois, USA, 2005–2010. *Emerging Infectious Diseases*, 18, 1589–1595. http://dx.doi.org/10.3201/eid1810.120511

Jones, E.K., Clifford, C.M., Keirans, J.E., & Kohls, G.M. (1972) Ticks of Venezuela (Acarina: Ixodoidea) with a key to the species of *Amblyomma* in the Western Hemisphere. Brigham Young University Science Bulletin, Biological Series, Vol. VXII, No. 4, 1–40.

Jongejan, F. (1992) Experimental transmission of *Cowdria ruminantium* (Rickettsiales) by the American reptile tick *Amblyomma dissimile* Koch, 1844. *Experimental and Applied Acarology*, 15, 117–121. http://dx.doi.org/10.1007/BF01275522

Keirans, J.E. & Durden, L.A. (1998) Illustrated key to nymphs of the tick genus *Amblyomma* (Acari: Ixodidae) found in the United States. *Journal of Medical Entomology*, 35, 489–495. http://dx.doi.org/10.1093/jmedent/35.4.489

Leberman, R.C. & Browne, M.M. (1976) A direct line recovery of a red-eyed vireo. *Bird-banding*, 47, 366–367. http://dx.doi.org/10.2307/4512274

Martins, T.F., Onofrio, V.C., Barros-Battesti, D.M., & Labruna, M.B. (2010) Nymphs of the genus *Amblyomma* (Acari: Ixodidae) of Brazil: descriptions, redescriptions, and identification key. *Ticks and Tick-borne Diseases*, 1, 75–99. http://dx.doi.org/10.1016/j.ttbdis.2010.03.002

Miranda, J., Portillo, A., Oteo, J.A., & Mattar, S. (2012) *Rickettsia* sp. strain *colombianensi* (Rickettsiales: Rickettsiaceae): a new proposed *Rickettsia* detected in *Amblyomma dissimile* (Acari: Ixodidae) from iguanas and free-living larvae ticks from vegetation. *Journal of Medical Entomology*, 49, 960–965. http://dx.doi.org/10.1603/ME11195

Morshed, M.G., Scott, J.D., Fernando, K., Beati, L., Mazerolle, D.F., Geddes, G. & Durden, L.A. (2005) Migratory songbirds disperse ticks across Canada, and first isolation of Lyme disease spirochete, *Borrelia burgdorferi*, from the avian tick, *Ixodes auritulus*. *Journal of Parasitology,* 9, 780–790. http://dx.doi.org/10.1645/GE-3437.1

Mukherjee, N., Beati, L., Sellers, M., Burton, L., Adamson, S., Robbins, R.G., Moore, F. & Karim, S. (2014) Importation of exotic ticks and tick-borne spotted fever group rickettsiae into the United States by migrating songbirds. *Ticks and Tick Borne Diseases*, 5, 127–134. http://dx.doi.org/10.1016/j.ttbdis.2013.09.009

Nava, S., Lareschi, M., Rebollo, C., Usher, B., Beati, L., Robbins, R.G., Durden, L.A., Mangold, A.J., & Guglielmone, A.A. (2007) The ticks (Acari: Ixodida: Argasidae, Ixodidae) of Paraquay. *Annals of Tropical Medicine & Parasitology,* 101, 255–270. http://dx.doi.org/10.1179/136485907X176319

Nicholson, W.L., Sonenshine, D.E., Lane, R.S. & Uilenberg, G. (2009) Ticks (Ixodoidea). *In*: Mullen, G.R. & Durden, L.A. (Eds), *Medical and Veterinary Entomology*, 2nd ed. Elsevier, Inc. Amsterdam, pp. 493–542.

Odgen, N.H., Lindsay, L.R., Hanincová, K. Barker, I.K., Bigras-Poulin, M., Charron, D.F., Heagy, A., Francis, C.M., O'Callaghan, C.J., Schwartz, I. & Thompson, R.A. (2008a) Role of migratory birds in introduction and range expansion of *Ixodes scapularis* ticks and of *Borrelia burgdorferi* and *Anaplasma phagocytophilum* in Canada. *Applied and Environmental Microbiology*, 74, 1780–1790. http://dx.doi.org/10.1128/AEM.00857-08

Ogden, N.H., St-Onge, L., Barker, I.K., Brazeau, S., Bigras-Poulin, M., Charron, D.F., Francis, C.M., Heagy, A., Lindsay, L.R., Maarouf, A., Michel, P., Milord, F., O'Callaghan, C.J., Trudel, L. & Thompson, A. (2008b) Risk maps for range expansion of the Lyme disease vector, *Ixodes scapularis*, in Canada now and with climate change. *International Journal of Health Geographics*, 7, 24. http://dx.doi.org/10.1186/1476-072X-7-24

Oliver, J.H., Jr., Hayes, M.P., Keirans, J.E. & Lavender, D.R. (1993) Establishment of the foreign parthenogenetic tick *Amblyomma rotundatum* (Acari: Ixodidae) in Florida. *Journal of Parasitology*, 79, 786–790. http://dx.doi.org/10.2307/3283624

Scofield, A., Bahia, M., Martins, A.L., Góes-Cavalcante, G., Martins, T.F. & Labruna, M.B. (2011) *Amblyomma dissimile* Koch (Acari: Ixodidae) attacking *Primolius maracana* Vieillot (Psittaciformes: Psittacidae) in the Amazon region, state of Pará, Brazil. *Neotropical Entomology*, 40. http://dx.doi.org/10.1590/S1519-566X2011000400017

Scott, J.D. (2015) Birds widely disperse pathogen-infected ticks. *In*: Mahala G. (Ed). *Seabirds and Songbirds: Habitat Preferences, Conservation and Migratory Behaviour.* Nova Science Publishers, Inc., New York (NY), pp. 1–22.

Scott, J.D., Anderson, J.F. & Durden, L.A. (2012) Widespread dispersal of *Borrelia burgdorferi*-infected ticks collected from songbirds across Canada. *Journal of Parasitology*, 98, 49–59. http://dx.doi.org/10.1645/GE-2874.1

Scott, J.D. & Durden, L.A. (2015a) First record of *Amblyomma rotundatum* tick (Acari: Ixodidae) parasitizing a bird collected in Canada. *Systematic & Applied Acarology*, 20, 155–161. http://dx.doi.org/10.11158/saa.20.2.1

Scott, J.D. & Durden, L.A. (2015b) New records of Lyme disease bacterium in ticks collected from songbirds in central and eastern Canada. *International Journal of Acarology*, 41, 241–249. http://dx.doi.org/10.1080/01647954.2015.1038301

Scott, J.D. & Durden, L.A. (2015c) Songbird-transported tick *Ixodes minor* (Ixodida: Ixodidae) discovered in Canada. *The Canadian Entomologist*, 147, 46–50. http://dx.doi.org/10.4039/tce.2014.34

Scott, J.D., Fernando, K., Banerjee, S.N., Durden, L.A., Byrne, S.K., Banerjee, M., Mann, R.B. & Morshed, M.G. (2001) Birds disperse ixodid (Acari: Ixodidae) and *Borrelia burgdorferi*-infected ticks in Canada. *Journal of Medical Entomology*, 38, 498–500. http://dx.doi.org/10.1603/0022-2585-38.4.493

Scott, J.D., Lee, M.-K., Fernando, K., Durden, L.A., Jorgensen, D.R., Mak, S. & Morshed, M.G. (2010) Detection of Lyme disease spirochete, *Borrelia burgdorferi* sensu lato, including three novel genotypes in ticks (Acari: Ixodidae) collected from songbirds (Passeriformes) across Canada. *Journal of Vector Ecology*, 35, 124–139. http://dx.doi.org/10.1111/j.1948-7134.2010.00068.x

Scott, J.D., Scott, C.M., & Anderson, J.F. (2014) The establishment of a blacklegged tick population by migratory songbirds in Ontario, Canada. *Journal of Veterinary Science & Medicine*, 2, 5. http://dx.doi.org/10.13188/2325-4645.1000005

Stutchbury, B.J.M., Taraf, S.A., Done, T., Gow, E., Kramer, P.M., Tautin, J., Fox, J.W. & Afanasyev, V. (2009) Tracking long-distance songbird migration by using geolocators. *Science*, 323, 896. http://dx.doi.org/10.1126/science.1166664

Verbel-Vergara, D.E., Bejarano, E.E. & Paternina, L.E. (2015) First report of *Amblyomma dissimile* (Acari: Ixodidae) on *Spilotes pullatus* (Squamata: Colubridae) from Colombia. *Revista de Investigaciones en Medicina Tropical*, 1, 23–25. http://dx.doi.org/10.13140/RG.2.1.3441.9925

Submitted: 4 Aug. 2015; accepted by Trevor Petney. 26 Oct. 2015; published: 30 Nov. 2015