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First record of *Amblyomma rotundatum* tick (Acari: Ixodidae) parasitizing a bird collected in Canada

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Abstract

Migratory birds disperse engorged ticks across Canada during northward spring migration. During our tick-host study, we collected a nymphal *Amblyomma rotundatum* Koch, from a Veery, *Catharus fuscescens* (Stephens) (Passeriformes: Turdidae), at Long Point, Ontario, Canada. In the laboratory, this nymph molted to a female in 44 d. The infestation of *A. rotundatum* on a Veery constitutes a first tick-host record, and a new distributional record in Canada. Notably, this novel collection is the northernmost record of *A. rotundatum* and the first record of this species on a bird anywhere. We provide formidable evidence that migratory songbirds can carry *A. rotundatum* thousands of kilometers during northward spring migration. From an epidemiological perspective, *A. rotundatum* is known to harbor bacteria that are pathogenic to humans. Health-care providers should take note that migratory songbirds can transport *A. rotundatum* into Canada, and be alert that this tick species signifies an unforeseen public health risk to humans.

Key words: tick, *Amblyomma rotundatum*, songbird, Veery, bird migration, new distribution record

Introduction

Ticks are vectors of many human and other animal disease agents (Nicholson *et al.* 2009). *Amblyomma rotundatum* Koch, 1844 is a hard-bodied tick (Acari: Ixodida: Ixodidae) that is typically found on amphibians and reptiles. This parthenogenetic tick has a biogeographical range from Argentina to Mexico, including the Caribbean Islands (Jones *et al.* 1972, Guglielmone *et al.* 2003, Nava *et al.* 2007, Voltzit 2007, Guzman-Corejo *et al.* 2011) and southern part of Florida (Oliver *et al.* 1993, Corn *et al.* 2011). Zoogeographically, *A. rotundatum* is now established in localized areas within the southernmost fringe of the Nearctic Region. In South America, this obligate, hematophagous ectoparasite is also known to feed on certain mammals, including humans (Guglielmone & Nava 2010). Of note, severe parasitic infestations of *A. rotundatum* on amphibians and reptiles can cause exsanguination and death (Keirans & Durden 1998).

Some other Neotropical and southern Nearctic *Amblyomma* species have been previously reported during spring migration on songbirds (Passeriformes) in Canada. These songbird-carried *Amblyomma* ticks 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; Ogden *et al.* 2008a), *A. maculatum* Koch (Scott *et al.* 2001, 2010, 2012), and *A. sabanarae* Stoll (Scott *et al.* 2001, 2010, 2012). In addition, *Ixodes* ticks, such as *I. affinis* and *I. minor*, are transported from the southeastern United States and the Neotropics by passerines (Scott *et al.* 2012, Scott & Durden 2014).

Extralimital transport of ticks between continents by wild birds can occur, during hemispheric and intercontinental flight (Hoogstraal & Kaiser 1961, Olsen *et al.* 1995, Bjoersdorff *et al.* 2001). Other Neotropical ticks, such as *Amblyomma nodosum* Neumann, an extralimital tick in the Nearctic Region, have been collected from passerine migrants in the Great Lakes Region (Hamer *et al.* 2012).

We present a novel phenomenon of bird parasitism showing that Neotropical passerines can transport *A. rotundatum* ticks to Canada during northward spring migration, and substantiate long-distance transit of bird-feeding ticks within the Western Hemisphere.

Materials and methods

A fully engorged nymphal tick was collected from a wild-caught Veery, *Catharus fuscescens* (Stephens) (Passeriformes: Turdidae), band number 2681-88949, on 26 May 2014 at the Tip (42.55ºN, 80.05ºW) of Long Point, Ontario, Canada, which juts out into Lake Erie. The live nymphal tick was placed in a 4-dram (12 mL) polystyrene vial with a vented cap made of tulle netting. In order to facilitate receiving live ticks in the laboratory, one drop of water was added to the paper towel inside the vial. Next, the vial was inserted into a self-sealing plastic bag with slightly moistened paper towel to retain high humidity. Taxonomic keys for *Amblyomma* nymphs and females respectively by Keirans & Durden (1998), Martins *et al.* (2010) and Jones *et al.* (1972) were used.

In order to allow the nymphal tick to molt to an adult, the specimen was held between 18–22ºC and relative humidity of 90–95% with a photoperiod of 16:8 (L:D). These climatic settings reflect field conditions in tick habitats during late May to early July in southeastern Canada. The fully engorged nymph was checked weekly to ensure that the humidity was optimal, that it was not spoiled by deleterious microorganisms or invasive endoparasites, and the molt was in progress. At molt, the exoskeleton was stored in a 2 mL micro tube containing 94% ethyl alcohol. The *Amblyomma* sp. nymph was compared to the scanning electron micrographs and the redescription of *Amblyomma* by Keirans & Oliver (1993). After the nymph-adult molt, the female was kept alive for 2 mo to ensure it was fully mature and sclerotized before confirming the identification. The *Amblyomma* sp. female was compared to the line drawings of Robinson (1926) and Boero (1957). The live *Amblyomma* female was sent by overnight courier to LAD for further examination. The female was assessed morphologically, and compared with similar *Amblyomma* females in the U.S. National Tick Collection.

Because of the special significance of this bird-parasitizing, Neotropical *Amblyomma* tick, we did not test it for pathogens, and have kept it intact as a voucher specimen. This tick, reference number14-5A71, has been deposited in the Biodiversity Institute of Ontario (University of Guelph, Guelph, Ontario, Canada) with accession number, BIO-14-120.

Results

After collection from the Veery, the fully engorged *A. rotundatum* nymph molted to a female in 44 d. When the female matured, and was fully sclerotized (Fig. 1), it was stored in 94% ethyl alcohol. Upon preservation, tunnelling by an endoparasite was evident in the right, latero-posterior section of the idiosoma; its presence did not impede the completion of the tick molt. The mature *Amblyomma* female displayed two short, rounded spurs on coxae I–IV. The presence of 2 spurs on all coxae is characteristic of *Amblyomma* species associated with reptiles and/or amphibians, including *A. argentinae*, *A. dissimile*, and *A. rotundatum*, each of which parasitizes both reptiles and amphibians. The hypostome has 3/3 dentition and the tip is very slightly truncated. Although scutal punctations

are slightly more numerous and evenly distributed than in most reference specimens in the U.S. National Tick Collection, the mature female was confirmed as *A. rotundatum* (Fig. 1).

FIGURE 1. *Amblyomma rotundatum*, unfed female, dorsal view live, legs recoiled in a defensive stance. This Neotropical tick was originally collected as an attached nymph from a Veery, *Catharus fuscescens*, and held to molt to a female. The beige colored area in the right latero-posterior area of the idiosoma suggests activity of an endoparasite. Photo credit: Alan Bibby

Discussion

We provide the first documentation of *A. rotundatum* on a bird, and the first record of this tick species in Canada. We conducted a thorough examination of the literature, and have not found any reference to this species on an avian host. Labruna *et al.* (2007) reported immature stages of *A. longirostre* Koch, *Amblyomma calcaratum* Newmann, *A. nodosum*, and *Amblyomma cajennense* (F.) on birds in Brazil. Moreover, Ogrzewalska *et al.* (2009) reported immatures of *Amblyomma coelebs* Neumann, *Amblyomma ovale* Koch, and *Amblyomma naponense* (Packard) on birds in Brazil. In addition to these *Amblyomma* ticks, Keirans and Durden (1998) reported immatures of *A. americanum*, *Amblyomma imitator* Kohls, *A. inornatum*, *A. maculatum* and *Amblyomma tuberculatum* Marx on birds in the United States.

Bird parasitism and long-distance migration is a subtle dispersal mechanism for certain species of extralimital ticks and their associated pathogens. Our study highlights the introduction of *A. rotundatum* into southern Canada by a Veery during northward spring migration. In Brazil, this tick

species is known to harbour *Rickettsia bellii*, which can cause spotted fever Rickettsiosis in humans (Labruna *et al.* 2004). Also, *Rickettsia amblyommii*, a putative human pathogen, has been detected in *Amblyomma* in South America. Additionally, *Rickettsia parkeri* has been detected in *Amblyomma* species ticks collected in Brazil, and is known to cause human spotted fever (Medeiros *et al.* 2011). Likewise, *R. parkeri* is associated with *A. maculatum* (Parker 1940, Paddock *et al.* 2004), which is indigenous in areas bordering the Gulf of Mexico (Sumner *et al.* 2007); immature stages of this tick species are transported into Canada on passerine migrants (Scott *et al.* 2001, 2010, 2012). Migratory songbirds clearly have great potential to widely disperse immature stages of *Amblyomma* ticks within the Western Hemisphere and, after molting, these ticks could parasitize various vertebrate hosts, including humans, and transmit zoonotic pathogens. These findings may have epidemiological significance in Canada.

The distance that songbirds transport ticks has been in dispute. Ogden *et al.* (2008b) conjectured that the maximum distance which a songbird can carry immature *Ixodes scapularis* Say during a 5-day blood meal, is 425 km. In contrast, multiple researchers have documented that Neotropical and southern temperate songbirds can transport ixodid ectoparasites much greater distances (Scott *et al.* 2001, 2010, 2012; Morshed *et al.* 2005, Hamer *et al.* 2012, Scott & Durden 2014). Stutchbury *et al.* (2009) used light-sensitive geolocators (nano-tags) to track the daily movement patterns and the flight path of passerine migrants, and found that some Neotropical songbirds can have a flight pace of 750 km/day or more, and follow a doglegged pattern during northward spring migration. Passerines can fly as much as 950 km/day during migratory flight (Smith *et al.* 1996) and, when heavily infested, can initiate new foci of ticks (Anderson & Magnarelli 1984, Scott *et al.* 2014). Rapid northward migration is aided by southerly winds, warm temperature, body condition, in addition to bird species. At the northern fringe of the *A. rotundatum* range, in Florida, the direct flight path is approximately 1800 km from southern Florida (Miami) to Long Point, Ontario. Neotropical and southern temperate passerine migrants are clearly capable of transporting slow-feeding immature stages of *Amblyomma* ticks much greater distances than previously claimed.

Veeries have a wintering range in southeastern South America, principally in southern Brazil. This bioregion also encompasses the indigenous range of *A. rotundatum*. The initial tick infestation could have originated in this Brazilian region. The fully engorged nymph could have attached to the Veery for 10–12 days during its migratory flight to its breeding grounds in southern Canada. The flight distance from southeastern Brazil to Long Point, Ontario for this bird parasitism may have been as far as 7500 km.

Notably, an attached female *A. rotundatum* has been recorded to cause tick paralysis in a snake; namely, a Southern Black Racer, *Coluber constrictor priapus* Dunn & Wood, in southern Florida (Hanson *et al.* 2007). Removal of this tick restored the snake to full mobility within 18 h. This specific example *A. rotundatum* parasitism is noteworthy because it shows the potential lethal nature of this tick species to cause tick paralysis.

Since passerines can be parasitized by *A. rotundatum* immatures, we now have substantive evidence to show that Neotropical migrants may have been the means by which this tick species became established in Florida. In the springtime, passerine migrants could easily transport immature *A. rotundatum* northward from avian wintering grounds in Central and South America, or the Caribbean Islands. If a passerine migrant was heavily infested with *A. rotundatum* immatures, and released them in one tick-conducive, maritime-like environment with suitable hosts, it could certainly start a new tick population. Even though it was supposed that *A. rotundatum* was imported on the cane toad, *Rhinella marina* (Linnaeus), formerly *Bufo marinus*, as an integrated pest management agent to control pest beetles between 1955 to 1964 (Oliver *et al.* 1993), we suggest migratory passerines as an alternative means of tick introduction. Since *A. rotundatum* typically reproduces by parthenogenesis, theoretically, only a single replete nymph, which subsequently molts

to a female, would be needed in a new geographic locality to initiate a new colony. Because *A. rotundatum* was not apparently native to Florida, this novel bird parasitism casts a new perspective on how this tick species may have been introduced into the southeastern United States.

Based on the native range of *A. rotundatum*, it is highly unlikely that an immature *A. rotundatum* would have the winter hardiness to survive frigid, sub-zero, Canadian winters. Even though *A. rotundatum* is established in southern Florida, it is primarily a Neotropical tick.

In conclusion, the discovery of an *A. rotundatum* nymph on a Veery at Long Point, Ontario constitutes the northernmost report of this tick species. This collection also provides a new distributional record for *A. rotundatum*; biogeographically, we document this ixodid ectoparasite much further north than its established range. Significantly, we report the first-ever record of *A. rotundatum* on an avian host, and, synchronously, on a Veery. Health-care professionals should take heed that *R. bellii*-infected immature stages of *A. rotundatum* and other ticks and vector-borne pathogens may be introduced into Canada by migratory songbirds. Before the frosty fall weather arrives in Canada, *Amblyomma* ticks may molt during the early summer and, during the late summer, parasitize and infect people with tick-borne pathogens.

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