

Short Communication

Discovery of *Haemaphysalis longicornis* (Ixodida: Ixodidae) Parasitizing a Sheep in New Jersey, United States

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Abstract

We report the discovery of large numbers of *Haemaphysalis longicornis* Neumann (Ixodida: Ixodidae) infesting a sheep in Hunterdon County, New Jersey, United States. All life stages were found on the sheep, which had no history of travel outside the country. *H. longicornis* is native to East Asia, and there are invasive populations in Australia, New Zealand and several Pacific islands, where this tick is a major livestock pest. It is currently unknown whether the New Jersey collections represent a limited or established population, but because this species could present a significant threat to human and animal health in the United States, vigilance is encouraged.

Key words: invasive species, bush tick, longhorned tick, cattle pest, veterinary health

New Jersey (NJ) is a state in the U.S. Northeast, on the Atlantic coast. The northeastern part of the state, near New York City, and the southwestern section, opposite Philadelphia, are highly urbanized, as is the corridor between these metropolises, but other areas are surprisingly rural and often comprise farms and ranchlands. Hunterdon County, situated in western NJ, falls in the latter category. According to a 2012 agricultural census, Hunterdon has the largest population of sheep in the state and the second largest horse population (USDA-NASS 2014).

As in much of the northeastern United States, ticks and tick-borne disease constitute a significant public health problem in NJ. The state has one of the highest burdens of Lyme disease (LD) in the nation, with 13.8% of all the cases reported nationally during 2015 (Adams et al. 2017). Other diseases of concern are anaplasmosis and babesiosis, which, like LD, is vectored by the blacklegged tick, *Ixodes scapularis* Say (Acari: Ixodidae); ehrlichiosis, transmitted by the lone star tick, *Amblyomma americanum* (L.) (Acari: Ixodidae); and spotted fever rickettsioses, thought to be vectored by the American dog tick, *Dermacentor variabilis* (Say) (Acari: Ixodidae). Besides these three, the only other tick species of medical or veterinary importance known to be present in the state are the brown dog tick, *Rhipicephalus sanguineus* (Latreille) (Acari: Ixodidae), which can complete its life cycle in homes or kennels, and *Ixodes cookei* Packard, a tick often associated with woodchucks that has been linked to Powassan encephalitis virus (Ebel 2010).

Materials and Methods

On 1 August 2017, a resident brought samples of ticks that were afflicting a 12-yr-old Icelandic sheep to the Hunterdon County Health Department. The animal was located on a Hunterdon County property within a single paddock approximately 0.4 ha (1 ac) in size surrounded by a manicured lawn. The sheep had no history of travel outside the country and had not traveled locally for several years prior. There were no other domestic animals on the property. The surrounding neighborhood contains large homes situated on 1.2–2.0 ha (3–5 ac) lots, again with manicured lawns, although there are substantial farms with livestock elsewhere in the county.

The tick specimens were identified as belonging to the genus *Haemaphysalis* using the key of Keirans and Litwak (1989). However, female and nymphal specimens could not be keyed to any of the three *Haemaphysalis* species known to be native to the Western Hemisphere (Cooley 1946). Subsequently, the specimens were identified as *Haemaphysalis longicornis* Neumann using standard cytochrome c oxidase I barcoding primers (Folmer et al. 1994). The top match in NCBI GenBank was to *H. longicornis* sequence from southern Australia (Accession No. KM821501, Hammer et al. 2015) with 99.9% identity. This preliminary identification was confirmed on November 9 by the National Veterinary Services Laboratories (NVSL, Ames, IA). The NVSL made their determination based on

morphology, utilizing published descriptions and reference specimens in their collection.

The Hunterdon property was visited on several occasions through 21 November 2017. Additional tick collections were made from the sheep, and the grounds both inside and outside the paddock were flagged for questing ticks.

Results

Investigation of the Hunterdon property in early October revealed a large number of ticks both on the sheep and throughout the paddock. The ticks in the paddock were so numerous that they crawled on investigators' pants soon after setting foot inside. The sheep was supporting hundreds of ticks, including all three active life stages (larva, nymph, adult) (Table 1). Although ticks were concentrated on the sheep's ears and face (Fig. 1), engorged ticks of all stages were readily found all over its body, including areas beneath the animal's thick coat. In contrast, questing ticks recovered from the field were almost exclusively larvae (Table 1). Only a single male specimen was noted from a vial collected from the sheep on 24 August 2017.

In late September, the sheep was treated with a permethrin wash (Permanone 10 EC, Bayer Environmental Science, Research Triangle Park, NC) by the owner, at a rate of 44 ml of product per 3.8 liters of water (1.5 oz per 1 gal). A post-treatment visit on 3 November 2017 resulted in a determination that the sheep was free of all *Haemaphysalis* ticks. Flagging throughout the paddock showed scores of larvae still present in the vegetation, although they were less numerous than on the previous visit, and no ticks were found outside the paddock in areas where grass was kept mowed. Follow-up visits on 15 and 16 November 2017 found no evidence of ticks on the sheep or anywhere else on the property, but this was after several nights of temperatures well below freezing, and the ticks (if any remained) likely had been killed or had retreated to the soil to withstand the low temperatures.

Discussion

H. longicornis is native to East Asia (Japan, China, the former USSR, Korea) but has become a major invasive pest of cattle in New Zealand, parts of Australia, and several Pacific islands (New Caledonia, Fiji, Western Samoa, Tonga, Vanuatu) (Heath et al. 2011). *H. longicornis* is also known to parasitize humans, with published reports, often describing numerous cases, from Australia (four reports), China (1), Japan (18), New Zealand (2), Russia (1), and South Korea (4) (Guglielmone and Robbins, unpublished bibliography). Populations in their native range survive cold winters (e.g., in northeast China, mean monthly temperatures of -5°C in December and January) (Zheng et al. 2011), while invasive populations occur primarily in warmer areas (Heath 1979). Susceptibility to dry conditions may also place a limitation on this species' range (Neilson 1980). Interestingly, invasive populations of *H. longicornis* are parthenogenetic, while the native range contains both parthenogenetic and bisexual populations (Oliver et al. 1973). The finding of only a single male specimen within our collections suggests that the



Fig. 1. Closeup of ear from the 12-yr old female Icelandic sheep supporting all life stages of *Haemaphysalis longicornis* in Hunterdon County, NJ.

H. longicornis detected in Hunterdon County, NJ may come from a parthenogenetic source population, where males are extremely rare (approximately 1 in 400, Hoogstraal et al. 1968). Studies on the genetics of these specimens are ongoing to more accurately identify their geographic origin, as this could portend their ability to survive an NJ winter and establish a local population.

While the primary threat posed by this species is intense infestations of cattle that can lead to weakness and, in some cases, exsanguination and death (Hoogstraal et al. 1968), it has also been implicated in transmission of several diseases of medical and veterinary concern, including *Rickettsia japonica*, the agent of Oriental spotted fever (Tabara et al. 2011), *Theileria orientalis*, the agent of cattle theileriosis (Watts et al. 2016), and a newly described bunyavirus causing Severe Fever with Thrombocytopenia Syndrome (SFTS) (Li et al. 2016). Additionally, field populations of ticks have been found infected with *Anaplasma*, *Ehrlichia*, and *Borrelia* spp. in China and Korea (Sun et al. 2008, Oh et al. 2009, Hou et al. 2015, Kang et al. 2016), including relatives of species known to occur in NJ (e.g., *Anaplasma phagocytophilum*, *Ehrlichia chaffeensis*) (Adelson et al. 2004, Schulze et al. 2005).

This is the first description of multiple life stages of *H. longicornis* infesting an animal within the United States, although single specimens have been occasionally intercepted at quarantine stations, including a single specimen on a horse at a quarantine station in Clifton, NJ in 1969 (Burrige 2011). It is unknown whether the current specimens represent an established and/or widespread population. There is evidence of wildlife, including deer and rabbits, in the vicinity of the Hunterdon property, and *H. longicornis* is known to parasitize such animals (Heath et al. 1987, Guglielmone et al. 2014). Studies are under way by the New Jersey Department of Environmental Protection, United States Department of Agriculture–Animal and Plant Health Inspection Service, and Southern Cooperative Wildlife Disease Study on wildlife in the surrounding area to determine whether the species is parasitizing nearby wildlife. This potential for a more widespread infestation is particularly concerning due to the sheep's lack of travel history, and the presence of multiple life stages suggests the population could have been present in the paddock for some time.

Ultimately there is great concern about the potential for an *H. longicornis* infestation in NJ, and this is being actively investigated, although the issue will likely not be settled before the spring (March–April) of 2018, when any surviving ticks would exit diapause and begin host seeking. Meanwhile, we advocate continued vigilance because even if this species is not already established in the

Table 1. Number of *H. longicornis* ticks collected from the host (sheep) and from field vegetation, Hunterdon County, NJ

	Sheep	Field
Adults	27	0
Nymphs	39	2
Larvae	156	902

United States, suitable hosts and habitats are common and widespread here.

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