Prevalence and Species of Ticks on Horses in Central Oklahoma

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ABSTRACT  Ticks are common on horses, but there is a dearth of contemporary data on infestation prevalence, predominant species, and tick-borne disease agents important in this host. To determine the species of ticks most common on horses and the prevalence of equine exposure to and infection with tick-borne disease agents, ticks and blood samples were collected from 73 horses during May, June, and July of 2010. Adult ticks were identified to species, and antibodies to Ehrlichia spp., Anaplasma spp., and Borrelia burgdorferi were identified using indirect fluorescence antibody assay, a commercial point-of-care enzyme-linked immunosorbent assay, or both. In total, 1,721 ticks were recovered at the majority (85%) of equid examinations. Amblyomma americanum (L.) was the most common tick collected (1,598 out of 1,721; 92.9%) followed by Dermacentor variabilis (Say, 1821) (85 out of 1,721; 4.9%) and Amblyomma maculatum Koch, 1844 (36 out of 1,721; 2.1%); single specimens of Ixodes scapularis Say, 1821 and Dermacentor albipictus (Packard, 1809) were also identified. Antibodies reactive to Ehrlichia spp. were found in 18 out of 73 (24.7%) of horses tested, and were more commonly identified in horses with moderate or high tick infestations than those with low tick infestations (P < 0.001). These data support A. americanum as the most common tick species infesting horses in central Oklahoma from May through July and suggest horses are also commonly exposed to an Ehrlichia sp.

KEY WORDS  Amblyomma americanum, Amblyomma maculatum, Dermacentor variabilis, Ehrlichia spp., horse

Ticks are a common arthropod pest of horses (Equus caballus) in North America (Bishopp and Trembley 1945). In addition to causing irritation, skin wounds, allergy, and blood loss, some tick species are known to transmit pathogens to horses (Träischler 1965, Magnarelli et al. 2000, Stiller et al. 2002). Increased interest regarding the importance of equine infections with tick-borne disease agents such as Borrelia burgdorferi and Anaplasma phagocytophilum together with the recent recognition of equine piroplasmosis in horses in the United States (Scoles et al. 2011, Short et al. 2012), have underscored the importance of improving current understanding of the tick species most commonly found on horses.

Although contemporary surveys are lacking, historic data document the presence of Amblyomma spp., Dermacentor spp., Ixodes spp., and Rhipicephalus (Boophilus) spp. ticks on horses in the United States (Bishopp and Trembley 1945, Carroll and Schmidtman 1986, Schmidtmann et al. 1998); Otobius megnini (Dugès), the spinoce ear tick, is also a common pest of horses in the western United States (Madigan et al. 1995). Both the number and the geographic distribution of reports of tick species have increased in North America in recent years (Childs and Paddock 2003, Mertins et al. 2010), and infestation pressure on horses has undoubtedly also increased. Products labeled against ticks on horses are available commercially, but horse owners continue to struggle to control these arthropods; indeed, equine tick infestations are commonly seen, and complaints regarding ticks are often heard by both veterinarians and extension agents (S. Little and J. Talley, personal communication).

To better understand the nature and importance of tick infestations on horses, we surveyed horses in north–central Oklahoma to determine the current prevalence of adult tick infestations and the predominant species responsible for those infestations. Owing to a concurrent observation that horses in this region commonly have antibodies to Ehrlichia spp. (Carmichael et al. 2010), we also tested horses for serologic reactivity to Ehrlichia spp. and compared those results with our tick infestation data.

Materials and Methods

Privately owned horses at least 6 mo of age were identified for inclusion in the study through extension...
entomologists and clinicians at the Boren Veterinary Medical Teaching Hospital at Oklahoma State University. Horses with a history of tick infestation, frequent exposure to tick-infested habitat, or both, were selected for inclusion. All study protocols were approved through the Institutional Animal Care and Use Committee at Oklahoma State University. Sample collections occurred from May to July of 2010. At enrollment and approximately every 2 wk thereafter, each horse was examined for ticks, and all adult ticks identified were removed and placed into 70% ethanol. Immature ticks, when present, were also occasionally collected but were not enumerated or identified. Tick examination was conducted by close visual inspection by two individuals standing on either side of the horse, beginning at the head and neck and proceeding systematically down the mane along the dorsal midline, across the dorsum and lateral thorax caudally, until the tail was reached. After thorough examination of the tail and perianal region, inspection continued with examination of each foreleg, axillary region, ventrum, hindlegs, and inguinal region. Ticks were collected from the face and external ears when visible. However, horses were not sedated and thus inspection and collection of ticks from the internal ear canals was not performed.

Whole blood (10 ml) was collected from each horse at each examination via jugular venipuncture directly into vacuum tubes containing ethylenediaminetetraacetic acid (EDTA) or no anticoagulant. After blood was allowed to clot at room temperature, serum was harvested by centrifugation at 1,500 × g and stored frozen at −20°C. An aliquot of EDTA-anticoagulated whole blood was tested for antibodies to *B. burgdorferi*, *Ehrlichia* spp., and *Anaplasma* spp. using a commercial enzyme-linked immunosorbent assay (ELISA; 4DX SNAP, IDEXX Laboratories, Westbrook, ME) diluted 1:250 in 0.01 M phosphate-buffered saline (PBS). The maximum titer was reported as the highest dilution at which specific fluorescence was observed.

Immature ticks were evaluated; detection of bound antibodies was achieved using FITC-conjugated antihorse IgG (Kirkegaard and Perry Laboratories Inc., Gaithersburg, MD) diluted 1:250 in 0.01 M phosphate-buffered saline (PBS). The maximum titer was reported as the highest dilution at which specific fluorescence was observed.

Chi-square analysis with significance assigned at *P* < 0.05 was used to compare age and gender of infested horses and prevalence of antibodies reactive to *Ehrlichia* spp. to intensity of tick infestation on horses.

**Results and Discussion**

In total, 73 horses (17 males and 56 females) were examined in this study. Age, as provided by owners, ranged from 6 mo to 34 yr (average 10.6 yr). Ages were not provided for five of the horses enrolled in the study. Adult ticks were identified on 67 out of 73 (91.8%) horses. *Amblyomma americanum* (L.) was the most common tick identified, accounting for 92.9% (1,598 out of 1,721) of all adult ticks collected, and was present on 64 out of 67 (95.5%) horses with tick infestations. Intensity of infestation ranged from 1 to 61 adult ticks (geometric mean 6.5 ticks). Other ticks identified were *Amblyomma varunulas* (Say, 1821) (55 out of 1721; 4.9%) on 29.9% of horses with tick infestations and *Amblyomma maculatum* Koch, 1844 (36 out of 1,721; 2.1%) on 14.3% of horses with tick infestations. Single specimens of *Dermacentor albipictus* (Packard, 1869) and *Ixodes scapularis* Say, 1821 were also recovered (Table 1).

Of infested horses, 14 were males and 53 were females. No significant difference was detected in frequency or intensity of infestation by gender or age of horses compared with the surveyed population as a whole (*P* > 0.05). A slight shift in species composition was detected over time, with *A. maculatum* and *D. variabilis* accounting for 1.6% (6 out of 369) of all ticks collected from horses in May, but 8.5% (115 out of 1352) of those collected in June and July (*P* < 0.001). Antibodies reactive to p30/p30–1 of *Ehrlichia canis* were detected by the ELISA assay in 16 out of 73 horses (21.9%). Antibodies reactive to *E. chaffeensis* on IFA were identified in 18 out of 73 horses (24.7%), with titers ranging from 1:64–1:512 (geometric mean of inverse positive titers = 117.4). Discordant results were present in three horses, one of which was positive on ELISA but negative on IFA, and two of which were positive on IFA but negative on ELISA. Antibodies reactive to p30/p30–1 of *E. canis* on ELISA and
Table 2. Antibodies to *Ehrlichia* sp. on ELISA and IFA in horses with low (0–19 ticks per horse), moderate (20–39 ticks per horse), and high (≥40 ticks per horse) adult *A. americanum* infestations

<table>
<thead>
<tr>
<th>Infestation category</th>
<th>No. of horses</th>
<th>Positive via ELISA</th>
<th>Positive via IFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>56</td>
<td>6/56 (10.7%)</td>
<td>5/56 (9.5%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>9</td>
<td>5/9 (55.6%)</td>
<td>6/9 (66.7%)</td>
</tr>
<tr>
<td>High</td>
<td>8</td>
<td>5/8 (62.5%)</td>
<td>7/8 (87.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>16/73 (21.9%)</td>
<td>18/73 (24.7%)</td>
</tr>
</tbody>
</table>

to *E. chaffeensis* on IFA were identified in 10.7% (6 out of 56) and 8.9% (5 out of 56), respectively, of horses with <20 *A. americanum* ticks, and in 58.8% (10 out of 17) and 76.5% (13 out of 17), respectively, of horses with ≥20 *A. americanum* ticks (P < 0.001). Seroprevalence using both assays was greater in horses with ≥40 *A. americanum*, but sample size limited statistical power and, thus, precluded evaluation of this association. Antibodies to C6 of *B. burgdorferi* and p44/MS2 of *A. phagocytophilum* were detected in one and three horses, respectively (Table 2).

*Americanum* was the most common tick identified on horses, consistent with previous reports of ticks from people and deer from the southern United States (Merten and Durden 2000, Paddock and Yabsley 2007). Over 95% of the >1,700 adult ticks recovered were *A. americanum*. Although an important observation, our results were biased by both season and method of examination. In this area, adults of *A. americanum* are more active in the spring and summer months (Semtner and Hair 1973) whereas *D. variabilis* and *A. maculatum* are more active later in the summer (Kollars et al. 2000a, 2000b, Burg 2001), a finding consistent with our observation of increased recovery of these ticks in the latter weeks of the current study. Had we examined horses through the fall and winter, more *I. scapularis* and *D. albipictus* would likely have been recovered. Another limitation of this study is that we elected, for operator safety reasons, to not remove ticks from the ear canal of these horses, a decision that precluded our ability to recover *O. megnini*, which is found only in the ears of hosts (Keirans and Pound 2003), and likely limited collection of some specimens of *Amblyomma* sp. and *Dermacentor* sp. as well.

The most common tick-borne infections of horses in the United States are *B. burgdorferi* and *A. phagocytophilum* (Mangenareli et al. 2000); infection with both agents can result in clinical disease in horses (Madigan and Pusterl 2000, Imai et al. 2011) although subclinical infections are commonly recognized. Autochthonous transmission of these organisms to people or dogs has not been documented in Oklahoma (Bowman et al. 2009). Although the horses in this study are likely exposed to *I. scapularis* adults in the winter months, the findings in the current study are consistent with previous work showing that this exposure does not result in significant transmission of *B. burgdorferi* or *A. phagocytophilum* in the southern United States (Kollars et al. 1999, Bowman et al. 2009). In contrast, exposure to an *Ehrlichia* sp., as evidenced by serology, appears to commonly occur, particularly in horses heavily infested with ticks. Given the common nature of tick infestations on horses, further investigations into the prevalence and species of ticks infesting horses throughout North America as well as the organisms those ticks may transmit, are warranted.

**Acknowledgments**

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