New Records of Ticks (Acari: Argasidae, Ixodidae) from South Carolina

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ABSTRACT  Tick-borne diseases are of increasing economic importance. The biogeographical distributions of tick species are important in the distribution of tick-borne diseases. The tick fauna of South Carolina was previously known to include 19 species, and the most recent tick checklist focused primarily on the coastal counties in the state. We report an additional seven species of ticks from South Carolina, bringing the total number of tick species collected in the state to 26, and provide information on tick species in the foothills and mountainous area of the state. The newly reported species are Aponomma trimaculatum (Lucas), Argas persicus (Oken), Haemaphysalis chordelis (Packard), Ixodes dentatus Marx, I. muris Bishop & Smith, Otobius megnini (Dugès), and Rhipicephalus appendiculatus Neumann.

KEY WORDS  ticks, Argasidae, Ixodidae, South Carolina, vectors, zoonoses, Acari, tick-born disease, ectoparasites

Ticks transmit more kinds of pathogens than any other group of blood-feeding arthropods and are second only to mosquitoes in their importance as disease vectors. In South Carolina, ticks are important vectors of the agents of zoonotic diseases, such as Lyme disease, ehrlichiosis, and Rocky Mountain spotted fever. Williams et al. (1999) presented an annotated checklist of the ticks of South Carolina that included records for 19 species throughout the state. Their records primarily focused on ticks in the Coastal Plain and lower Piedmont or records from the U.S. National Tick Collection, Statesboro, Georgia. Records and specimens from the Clemson University Arthropod Collection (CUAC), Clemson, South Carolina were not included and some older literature was overlooked. From an examination of specimens and records in the CUAC we are able to add six new species records for South Carolina and to present more complete distribution data for other tick species. An additional state record originated from exotic ticks recovered from a monitor lizard in a pet shop. The tick fauna of South Carolina now include the following species: Amblyomma americanum (L.), A. maculatum Koch, A. tuberculatum Marx, Aponomma latum (Koch), A. trimaculatum (Lucas), Argas persicus (Oken), Boophilus annulatus (Say), B. microplus (Canestrini), Carios capensis (Neumann), Dermacentor albipictus (Packard), D. variabilis

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(Say), *Haemaphysalis chordeilis* (Packard), *H. leporispalustris* (Packard), *Ixodes affinis* Neumann, *I. brunneus* Koch, *I. cookei* Packard, *I. dentatus* Marx, *I. marxi* Banks, *I. minor* Neumann, *I. muris* Bishopp & Smith, *I. scapularis* Say, *I. texanus* Banks, *I. woodi* Bishopp, *Otodis meganii* (Duges), *Rhipicephalus appendiculatus* Neumann, and *R. sanguineus* (Latreille). Of these 26 species, *A. latum*, *A. trimaculatum*, *B. annulatus*, *B. microplus*, and *R. appendiculatus* have either been eradicated or did not become established in South Carolina, and the record for *I. muris* might be erroneous. Our annotated checklist includes only county or host records not reported by Williams et al. (1999). Life stages are reported when that information is available. All tick species are arranged alphabetically and the format follows that of Williams et al. (1999). Unless otherwise noted, representative specimens are in the CUAC.

**Amblyomma americanum** (lone star tick)

New county records: Anderson, Berkeley, Chester, Colleton, Dorchester, Edgefield, Greenwood, McCormick, Oconee, Pickens, Richland, Spartanburg, Sumter, Williamsburg.

New host records: *Colinus virginianus* (L.), *Felis silvestris* Schreber (domestic cat) (1 adult), *Scirurus carolinus* Gmelin (1 nymph), *Cardinalis cardinalis* (L.), *Urocyon cinereoargenteus* (Schreber) (1 adult male).

References: (Peters 1933, 1936, Carpenter et al. 1946).

Remarks: Our new records for the lone star tick change the distribution from that presented by Williams et al. (1999). *Amblyomma americanum*, found in all physiographic regions of the state, is locally common and in spring is a dominant human-biting tick in the upper piedmont and mountains. The new distribution data are especially relevant because they can be related to the distribution of *Ehrlichia chaffeensis*, the agent of human monocytic ehrlichiosis, in South Carolina. *Amblyomma americanum* is a vector of the blood parasite *Theileria cervi* Bettencourt, Franca & Borges of *Odocoileus virginianus* in eastern North America (Kocan & Kocan 1991).

**Amblyomma maculatum** (Gulf Coast tick)

New county records: Aiken, Clarendon, Colleton, Darlington, Dorchester, Kershaw, Oconee, Pickens.

New host records: *Peromyscus gossypinus* (LeConte) (1 larva), *Pipilo erythrophthalmus* (L.), *Thryothorus ludovicianus* (Latham).

Reference: (Peters 1936).

Remarks: Sonenshine (1974) reported that this species ranges as far north as Virginia. Our distribution data include records from the upper piedmont and mountains, which extend the range of *A. maculatum* from the coast to the higher elevations of the state. *Amblyomma maculatum* is a vector of *Hepatozoon americanum* Vincent-Johnson, Macintire, Lindsay, Lenz, Baneth, & Shkap, a blood parasite of coyotes and domestic dogs (Mathew et al. 1998, Ewing et al. 2002). One larva from *P. gossypinus* was deposited at the National Tick Collection.

**Aponomma trimaculatum**

New county record: Pickens.

New host record: *Varanus macraei* Bohme & Jacobs (6 nymphs, 58 larvae)
Remarks: Immatures of this Indo-Australian tick were recovered from a monitor lizard from a pet show. Although the immature stages of this tick have not been described, our determination was based on comparing specimens to immatures with accompanying adults in the U.S. National Tick Collection. This appears to be the second record of this exotic tick in the U.S. (Keirans & Durden 2001). The collection of immature ticks suggests that either the host was very recently imported, or that this tick was breeding in the rearing facility. The host lizard also had intramuscular and gastrointestinal helminths.

*Argas persicus* (fowl tick)

New county record: Unknown.
New host record: *Gallus gallus* (L.) (3 adults).
Remarks: Several specimens from South Carolina are pinned in the CUAC. Exact collection data are missing; the specimens were collected in the 1940s.

*Boophilus annulatus* (cattle tick)

New county records: All counties in the state.
New host record: *Bos taurus* L.
Remarks: Unpublished records of *B. annulatus* in the CUAC list infestations throughout the state. Although this tick has been eradicated, if reestablished it could infest cattle anywhere in the state.

*Carios capensis*

New county record: None.
New host record: *Larus atricilla* L. (larvae, nymphs, and adults)
Remarks: *Carios capensis* was collected from the nests of *Pelecanus occidentalis* L. and *Larus atricilla* on Devaux Island, Charleston County, for attempted arbovirus isolations. All life stages were present in the nests of both bird species. In Texas, Yunker et al. (1979) reported Aransas Bay virus from this tick species in association with *P. occidentalis*. No arboviruses were isolated from our collections, but these ticks were not previously known to feed on *L. atricilla*.

*Dermacentor albipictus* (winter tick)

New county records: Anderson, Horry.
New host record: *Canis lupus* L. (domestic dog)
Reference: (Carpenter et al. 1946).
Remarks: *Dermacentor albipictus* is a one-host tick and rarely bites humans or dogs. Aberrant feeding records typically occur after contact with an infested deer.

*Dermacentor variabilis* (American dog tick)

New host records: *Agelaius phoeniceus* (L.), *Dendroica palmarum hypochrysea* Ridgeway, *Lynx rufus* (Schreber), *Peromyscus maniculatus* (Wagner) (1 larva), *Pipilo erythrophtalmus* (L.), *Sciurus carolinensis*, *Thryothorus ludovicianus*.

References: (Peters 1936, Carpenter et al. 1946)

Remarks: *Dermacentor variabilis* potentially is the most common human-biting tick in the state. Our records fill in some of the range for this tick, which is in all physiographic areas of the state. Williams et al. (1999) reported only mammalian hosts for *D. variabilis*; however, Peters (1936) collected this species from birds. *Dermacentor variabilis* is known to transmit a potentially fatal parasite *Cytotauxzoon sylvicapræ* Neitz & Thomas to domestic cats in Georgia (Kocan & Kocan 1991). *Dermacentor variabilis* is the principal vector of the agent of Rocky Mountain spotted fever in eastern North America and also causes tick paralysis in dogs and humans (Strickland et al. 1976).

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**Haemaphysalis chordeilis**

New county record: Dorchester.

New host record: *Passerculus sandwichensis savanna* (Wilson).

Reference: (Peters 1936).

Remarks: This rarely collected tick feeds on birds. Peters (1936) reported ticks from several bird species in the eastern United States. Unpublished notes maintained at the CUAC indicate that his material came from Summerville, Dorchester County. Williams et al. (1999) did not list this tick species from South Carolina.

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**Haemaphysalis leporispalustris** (rabbit tick)

New county records: Chester, Dorchester, Greenville, Hampton, Oconee, Pickens, Williamsburg.


Remarks: The rabbit tick feeds on additional bird hosts and might be involved in the enzootic maintenance of West Nile encephalitis virus.

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**Ixodes brunneus** (bird tick)

New county record: Oconee.

New host records: *Dumetella carolinensis* (L.), *Hylocichla guttata faxoni* Bangs & Penard, *Pipilo erythrophtalmus* (L.), *Seiurus aurocapillus* (L.), *Spizella pusilla*.

References: (Wharton 1931, Peters 1933, 1936).

Remarks: Our records of *I. brunneus* from Oconee County extend the range of this tick to the mountainous region of the state.
**Ixodes cookei**

New county records: None.
New host records: *Sciurus carolinensis, Urocyon cinereoargenteus*.
Remarks: Our collections are from Pickens County in the Piedmont, a region of South Carolina previously not known to contain this species.

**Ixodes dentatus**

New county records: Chester, Hampton.
New host record: *Sylvilagus floridanus*.
Remarks: Williams et al. (1999) did not report this species from South Carolina. This tick is an ectoparasite of cottontail rabbits and is an enzootic vector of *Borrelia andersonii* Marconi, Liveris & Schwartz (Oliver 1996).

**Ixodes marxi**

New county record: Williamsburg.
Remarks: *Ixodes marxi* probably is underrepresented in the collections from South Carolina because the principal host, *Sciurus carolinensis*, has not been examined for ticks throughout the state.

**Ixodes minor**

New county record: Beaufort.
Remarks: Two larval *I. minor* were removed from the ears of a *Sigmodon hispidus* Say & Ord skin at the Campbell Museum of Natural History. The ticks were deposited at the U.S. National Tick Collection.

**Ixodes muris**

New county records: Unknown.
Remarks: Durden & Keirans (1996) followed Keirans & Clifford (1978) in reporting *I. muris* from South Carolina, but no specimens from this state can be located in the U.S. National Tick Collection or the CUAC. Because South Carolina is not part of the normal range of this tick, the record of Keirans & Clifford (1978) and Durden & Keirans (1996) might be erroneous.

**Ixodes scapularis** (blacklegged tick)

New county records: Bamberg, Beaufort, Berkeley, Horry, Jasper, Lee, Marlboro, Marion, Orangeburg
New host records: *Anolis carolinensis* (2 nymphs), *Blarina carolinensis* (Bachman) (10 larvae), *Felis silvestris* (2 adult males and 2 adult females), *Lynx rufus, Mephitis mephitis* (Schreber) (1 adult), *Microtus pinetorum* (LeConte) (1 larva), *Sorex longirostris* Bachman (3 larvae).
References: (Carpenter et al. 1946, Fang et al. 2002).
Remarks: In the eastern United States *I. scapularis* is the primary vector of the agents of Lyme disease, human babesiosis, and human granulocytic ehrlichiosis. *Ixodes scapularis* also is a vector of *Babesia odocoilei* in the eastern states.
This tick is the most common tick found on lizards and other terrestrial reptiles. Fifteen specimens from *A. carolinensis*, *B. carolinensis*, *M. pinetorum*, and *S. longirostris* were deposited at the U.S. National Tick Collection.

**Otobius megnini** (spinose ear tick)

New county record: Orangeburg.
New host record: *Bos taurus*.
Remarks: Collections made by T. D. Adkins (Clemson University) from July to September 1960 indicate that *O. megnini* was established in South Carolina. Because no current survey of cattle ticks has been conducted in South Carolina, the status of this tick is unknown. Williams et al. (1999) did not report *O. megnini* from South Carolina.

**Rhipicephalus appendiculatus** (brown ear tick)

New county records: Unspecified.
References: (Keirans & Durden 2001).
Remarks: Keirans & Durden (2001) reported that *R. appendiculatus* was intercepted by the U.S. Department of Agriculture, Division of Animal Health in South Carolina. One of the economically important African species of *Rhipicephalus*, it is not established in the Nearctic Region. This record, however, underscores the importance of identifying any *Rhipicephalus* found in association with exotic animals or abnormal hosts. Because *R. sanguineus* is almost exclusively a dog tick, any specimens of *Rhipicephalus* on other hosts should be examined closely.

**Rhipicephalus sanguineus** (brown dog tick)

New county records: Anderson, Dillon, Greenville, Horry, Lancaster, Marion, McCormick, Oconee, Pickens, Saluda, York.
New host records: *Felis silvestris* (1 adult), *Homo sapiens* L. (1 adult male)
References: (Carpenter et al. 1946).
Remarks: This almost cosmopolitan tick should be found wherever dogs live. The few North American records from other domestic animals and humans probably are the result of crowded indoor conditions.

**Discussion**

The tick fauna of South Carolina, as currently known, includes 26 species. Additional species will undoubtedly be discovered in the state. These species might include the bat tick, *Carios kelleyi* Cooley & Kohls, and *Amblyomma longirostre* (Koch), a Neotropical tick whose immature stages often are attached to migratory birds. Exotic species of *Amblyomma*, *Boophilus*, *Dermaecentor*, *Ixodes*, *Hyalomma*, and *Rhipicephalus* could inadvertently be introduced and become established in South Carolina, as could the tropical horse tick, *Anocentor nitens* (Neumann), which has become established in other southern states. Continued monitoring for exotic ticks is essential in identifying and controlling tick-borne diseases such as tick-borne encephalitis, heartwater disease, East Coast cattle fever, African swine fever, and Texas cattle fever. Additionally, species of
Aponomma will continue to be introduced with the international trade in exotic reptiles (Burridge 2001), but these ticks are unlikely to become established.

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