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TICK INFESTATIONS OF WHITE-TAILED DEER IN ALABAMA

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ABSTRACT: Four species of ticks were collected from 537 white-tailed deer (*Odocoileus virginianus*), examined during the hunting seasons (November to January) of 1988–89 and 1989–90 at selected locations in Alabama (USA). *Ixodes scapularis* was the most common tick recovered (2,060 specimens) and infested 54% of the deer. *Dermacentor albipictus* was the second most frequent tick (1,253 specimens) and infested 15% of the deer. *Amblyomma americanum* was the third most frequent tick (315 specimens) and infested 24% of the deer; this was the only species of tick collected from deer at all sampling locations. *Amblyomma maculatum* was an infrequent parasite (five specimens) and infested only 1% of the deer; this tick species was only recorded during the 1989–90 season. Year-to-year and geographical differences in tick infestation parameters were noted. The data are compared with those reported for previous surveys of ticks infesting white-tailed deer in Alabama and adjacent states.

Key words: Ticks, Ixodidae, *Amblyomma americanum, Amblyomma maculatum, Dermacentor albipictus, Ixodes scapularis*, ectoparasites, white-tailed deer, *Odocoileus virginianus*, survey.

INTRODUCTION

Based on an extensive literature survey, Smith (1977) reported 17 species of ticks to be parasitic on white-tailed deer (*Odocoileus virginianus*) in the United States. Strickland et al. (1981) subsequently recorded 18 species of ticks from this host in North America. Kellogg et al. (1971) collected 12 species of ticks from *O. virginianus* in the USA, Cuba and the U.S. Virgin Islands. *Ixodes dammini* should be added to these species lists because it was not distinguished from *Ixodes scapularis* in the above surveys (Spielman et al., 1979).

Although some tick collections have been made from *O. virginianus* in the southeastern United States, comparatively little data are available for Alabama. Cooney and Hays (1972) collected three species of ticks from 56 *O. virginianus* in Alabama: the lone star tick (*Amblyomma americanum*) the American dog tick (*Dermacentor variabilis*) and the black-legged tick (*I. scapularis*). Kellogg et al. (1971) recorded four species of ticks from 135 white-tailed deer sampled in Alabama including *A. americanum*, the Gulf Coast tick (*A. maculatum*), the winter tick (*Dermacentor albipictus* recorded as *Dermacentor nigrolineatus* which is currently considered to represent a dark morph of *D. albipictus*), and *I. scapularis*. From 686 *O. virginianus* harvested in Alabama, Smith (1977) similarly recorded *A. americanum, A. maculatum, D. albipictus* (as *D. nigrolineatus*) and *I. scapularis*.

Surveys of ticks associated with white-tailed deer have been conducted in states adjoining Alabama. Two separate studies at Land Between the Lakes in Tennessee and Kentucky have yielded important data on deer ticks. Cooney and Burgdorfer (1974) examined 75 *O. virginianus* at this site and collected *A. americanum, D. albipictus* and *D. variabilis*. Bloemer et al. (1988) examined 97 *O. virginianus* and collected *A. maculatum, D. albipictus*, the rabbit tick (*Haemaphysalis leporispalustris*) and *A. americanum* with 95 of 97 deer (98%) parasitized by large numbers of this last species.

Wilson and Baker (1972) recorded five species of ticks from *O. virginianus* in Georgia including *A. americanum, A. maculatum, D. albipictus, Ixodes affinis*

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and *I. scapularis*. Oliver et al. (1987) similarly reported *I. affinis* from white-tailed deer in Georgia. Goddard and Norment (1985) and Demerais et al. (1987) together reported five species of ticks from *O. virginianus* in Mississippi; *A. americanum, A. maculatum, D. albipictus, D. variabilis* and *I. scapularis*.

Tick infestations can adversely affect white-tailed deer, particularly when these parasites are present in large numbers. Detrimental effects include pruritus, hematomas, intradermal hemorrhages, blood loss, abcess formation and/or secondary skin thickening at feeding sites, tick paralysis, and infections with tick-borne disease agents (Bolte et al., 1970; Kellogg et al., 1971; Strickland et al., 1981). Heavy tick infestations also may culminate in anemia, weight loss, pelage loss, blindness (if numerous ticks aggregate around the eyes), behavioral anomalies or even death. Several pathogens associated with white-tailed deer can be transmitted by ticks. *Amblyomma americanum* is an experimental vector of the agents of theileriasis among deer and a potential or proven vector of the agents of deer babesiosis, Rocky Mountain spotted fever, Q fever and tularemia (Samuel and Trainer, 1970; Kellogg et al., 1971; Cooney and Hays, 1972; Strickland et al., 1981). *Dermacentor albipictus* is a vector of the bovine anaplasmosis agent and may also be involved in the transmission of deer anaplasmosis (Kellogg et al., 1971; Strickland et al, 1981). *Ixodes scapularis* is an efficient laboratory vector of *Babesia odocoilei* between deer (Waldrup et al., 1990); this tick also will readily bite other hosts, including humans, and is strongly suspected to be a principal vector of Lyme disease in the southeastern United States (Piesman and Sinksky, 1988). Similarly, *I. affinis* should be considered as a potential vector of Lyme disease because it has a wide host range and belongs to the *I. ricinus* species complex (Oliver et al., 1987).

This study was conducted in conjunction with ongoing field research to identify the host associations of ticks that may be involved in the maintenance and transmission of the Lyme disease spirochete in Alabama. The objectives of this study were (1) to determine the geographic occurrence and infestation parameters of tick species on deer during the winter months in Alabama and (2) to identify demographic changes that may be taking place in incidence of ticks on deer in the state by comparing this work with that of previous investigators.

MATERIALS AND METHODS

During the 1988–89 and 1989–90 hunting seasons (November to January), white-tailed deer were examined for ticks at hunter check stations and in various Alabama counties as shown in Figure 1. Most of the collections were made at hunter check stations at six locations. These were at Barbour County Wildlife Management Area (WMA) (31°56′ to 32°02′N, 85°26′ to 85°36′W) on three occasions (8 and 16 December 1989, 12 January 1990), at Butler County WMA (31°39′ to 31°48′N, 86°46′ to 86°52′W) on three occasions (29 December 1989, 20 and 31 January 1990), at Choccolocco WMA (33°38′ to 33°49′N, 85°28′ to 85°38′W) in Cleburne County on 3 occasions (7 January 1988, 9 December 1989, 6 January 1990), at Coosa County WMA (32°47′ to 32°57′N, 85°20′ to 86°29′W) on four occasions (14 December 1988, 13 December 1989, 5 and 19 January 1990), at Hollins WMA (33°05′ to 33°14′N, 86°03′ to 86°12′W) in Clay County on three occasions (1 and 15 December 1989, 26 January 1990), and at Oakmulgee WMA (32°51′ to 33°00′N, 87°20′ to 87°33′W) in Hale County on one occasion (27 January 1990). In addition, ticks were collected from deer in Bullock, Chambers, Lee, Macon, Tallapoosa, and Wilcox Counties during the hunting seasons.

Age, sex, and weight were recorded for individual deer. Each animal was carefully examined for ticks by pulling back the fur and visually, as well as tactilely, searching the skin surface. Particular attention was given to the head and ears, chin, chest, neck, axillae, escutcheon, back, and inguinal regions. Each animal was searched for a minimum of five minutes. More time, however, was spent examining deer that were positive for ticks. Ticks were removed with fine forceps, transported to the laboratory in vials containing slightly moistened cotton, and maintained there at 4 C until they were identified.

Infestation parameters calculated for each tick species collected from white-tailed deer were

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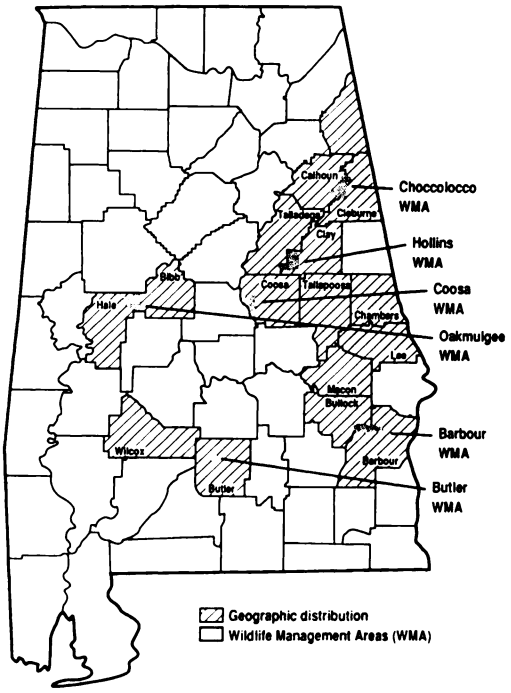


FIGURE 1. Geographic distribution of tick collections from white-tailed deer in Alabama.

prevalence (percent of deer infested), mean intensity (mean number of ticks per infested host), and infestation range. Because of the non-uniform nature of the sampling protocol followed in this study, the data are not appropriate for statistical analysis.

Voucher tick specimens from this study have been deposited with the United States National Tick Collection (% Georgia Southern University, Statesboro, Georgia 30460, USA; accession number RML 119,900).

RESULTS

Three-thousand six-hundred thirty-three ticks were collected from 537 white-tailed deer (268 males, 269 females). Table 1 summarizes the collections of ticks from deer at three Alabama locations during both the 1988–89 and the 1989–90 seasons. Table 2 presents similar data for ticks collected from deer examined at Alabama locations only surveyed during the 1989–90 season. Three species of ticks were collected during both seasons (*A. americanum*, *D. albipictus*, and *I. scapularis*). A fourth species (*A. maculatum*) was collected only during the 1989–90 season.

For the two seasons combined, *I. scapularis* was the most abundant tick collected (2,060 specimens), followed by *D. albipictus* (1,253 specimens), *A. americanum* (315 specimens), and *A. maculatum* (5 specimens). Overall, 54% of all deer examined were infested by *I. scapularis* ($\bar{x}$/host = 3.8), 15% were infested by *D. albipictus* ($\bar{x}$/host = 2.3), 24% were infested by *A. americanum* ($\bar{x}$/host = 0.6), and 1% were infested by *A. maculatum* ($\bar{x}$/host = 0.009).

Some year-to-year differences in infestation prevalences for these ticks were apparent. *Amblyomma americanum* infested 39% of the deer examined during the 1988–89 season but only 18% during the 1989–90 season. Comparable 1988–89 versus 1989–90 infestation prevalences were 0% and 1% for *A. maculatum*, 15% and 16% for *D. albipictus* and 41% and 59%, for *I. scapularis*, respectively.

In Table 1, infestation parameters can be compared for the three locations at which ticks were collected during both seasons. *Amblyomma americanum* was the only tick species recovered from deer at Choccolocco WMA; twice the proportion of hosts (50%) were infested by this tick during 1988–89 when compared to 1989–90 (25%); the mean intensity was also higher during the 1988–89 season. Similarly, Table 1 shows that *A. americanum* was more prevalent on deer from Lee County during 1988–89 but that year-to-year infestation figures were fairly similar for both seasons at Coosa County WMA. Infestation parameters are difficult to interpret for *D. albipictus* because this tick was sometimes present in large numbers on individual deer (as shown by the infestation ranges listed in the Tables). Nevertheless, the prevalence of *D. albipictus* on deer in Lee County was clearly higher during the 1988–89 season. *Ixodes scapularis* infested fairly high proportions (42% to 90%) of deer in both seasons at Coosa County WMA and in Lee County but infested the highest percentage of hosts at the latter location during the 1988–89 season.

In Tables 1 and 2, infestation data are

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TABLE 1. Ticks frequently collected from white-tailed deer in Alabama, 1988–89 and 1989–90.[a]

	Choccolocco WMA[b]	Coosa County WMA	Lee County
Number deer examined, 1988–89 (M, F)[b]	56 (24, 32)	91 (31, 60)	10 (8, 2)
Number deer examined, 1989–90 (M, F)	32 (16, 16)	71 (32, 39)	24 (15, 9)
Amblyomma americanum			
1988–89 Prevalence (M, F)	50 (67, 38)	31 (36, 28)	50 (38, 100)
Mean intensity (M, F)	2.8 (3.3, 2.2)	1.5 (1.3, 1.7)	3.2 (2.3, 4.5)
Infestation range	1–6	1–4	1–8
Number of ticks	79 (54M, 7F, 18N)[b]	43 (42M, 1N)	16 (14M, 1F, 1N)
1989–90 Prevalence (M, F)	25 (25, 25)	25 (44, 10)	17 (13, 22)
Mean intensity (M, F)	1.4 (1.3, 1.5)	2.2 (2.4, 1.5)	1.0 (1.0, 1.0)
Infestation range	1–3	1–4	1
Number of ticks	11 (7M, 4N)	40 (33M, 3F, 4N)	4 (3M, 1N)
Dermacentor albipictus			
1988–89 Prevalence (M, F)	0	17 (29, 10)	80 (88, 50)
Mean intensity (M, F)	—	1.8 (2.1, 1.3)	34.6 (38.6, 7.0)
Infestation range	—	1–7	1–122
Number of ticks	0	27 (7M, 2F, 18N)	277 (138M, 87F, 50N, 2L)[b]
1989–90 Prevalence (M, F)	0	32 (47, 21)	29 (40, 11)
Mean intensity (M, F)	—	7.4 (9.9, 2.6)	2.1 (2.3, 1.0)
Infestation range	—	1–51	1–9
Number of ticks	0	170 (76M, 19M, 75N)	15 (2M, 3F, 10N)
Ixodes scapularis			
1988–89 Prevalence (M, F)	0	62 (71, 57)	90 (88, 100)
Mean intensity (M, F)	—	3.3 (5.2, 2.0)	7.1 (6.4, 9.5)
Infestation range	—	1–11	1–17
Number of ticks	0	182 (51M, 131F)	64 (30M, 34F)
1989–90 Prevalence (M, F)	0	49 (72, 31)	42 (60, 11)
Mean intensity (M, F)	—	4.6 (5.0, 3.8)	8.2 (8.7, 4.0)
Infestation range	—	1–12	1–34
Number of ticks	0	160 (58M, 102F)	82 (42M, 40F)

[a] Two males and one female *Amblyomma maculatum* were also recovered from a buck at Barbour County WMA and two does at Coosa County WMA (one specimen/deer).
[b] F, females; L, larvae; M, males; N, nymphs; WMA, Wildlife Management Area.

TABLE 2. Ticks frequently collected from white-tailed deer in Alabama, 1989–90.[a]

	Barbour County WMA[c]	Butler County WMA	Chambers County	Oakmulgee WMA	Other Alabama Counties[b]
Number deer examined (M, F)	139 (82, 57)	36 (24, 12)	16 (8, 8)	39 (8, 31)	23 (20, 3)
Amblyomma americanum					
Prevalence (M, F)[c]	1 (1, 0)	25 (33, 8)	50 (38, 63)	49 (75, 42)	9 (5, 33)
Mean intensity (M, F)	1.0 (1.0, 0)	2.0 (1.6, 5.0)	4.0 (5.7, 3.0)	2.7 (2.5, 2.8)	9.5 (3.0, 16.0)
Infestation range	1	1–5	1–8	1–9	3–16
No. ticks	1 (N)	18 (9M, 5F, 4N)[c]	32 (25M, 7N)	53 (31M, 14F, 7N)	19 (10M, 9F)[c]
Dermacentor albipictus					
Prevalence (M, F)	9 (15, 0)	28 (42, 0)	19 (25, 13)	0	17 (20, 0)
Mean intensity (M, F)	6.5 (6.5, 0)	32.9 (32.9, —)	4.7 (6.0, 2.0)	—	86.0 (86.0, —)
Infestation range	1–61	1–313	1–9	—	1–241
No. ticks	78 (57M, 9F, 12N)	329 (74M, 18F, 237N)	14 (11M, 2F, 1N)	0	344 (143M, 19F, 182N)
Ixodes scapularis					
Prevalence (M, F)	81 (89, 70)	75 (79, 67)	25 (38, 13)	69 (75, 68)	39 (40, 33)
Mean intensity (M, F)	10.7 (13.3, 6.0)	7.7 (9.8, 2.9)	6.4 (8.3, 1.0)	3.8 (8.2, 2.6)	2.9 (1.2, 3.0)
Infestation range	1–58	1–39	1–19	1–17	1–5
No. ticks	1,208 (506M, 702F)	209 (98M, 110F, 1N)	26 (12M, 13F, 1N)	103 (40M, 63F)	26 (14M, 12F)

[a] Two *Amblyomma maculatum* males were also recovered from two bucks (one specimen/deer) at Butler Co. WMA.

[b] Bullock County (2 deer), Hollins Wildlife Management Area in Clay County (8 deer), Macon County (4 deer), Tallapoosa County (1 deer), Wilcox County (2 deer), and from unspecified counties in Alabama (6 deer).

[c] F, females; M, males; N, nymphs; WMA, Wildlife Management Area.

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segregated according to geographical location. Only *A. americanum* and *I. scapularis* were collected at Oakmulgee WMA. At Barbour County WMA, *I. scapularis* was especially abundant (1,208 specimens from 139 deer) whereas *A. americanum* was represented by only a single specimen. *Amblyomma maculatum* was rarely collected at any of the sampling sites.

DISCUSSION

The four species of ticks collected from white-tailed deer in this survey are typical ectoparasites of this host in the southeastern United States. In analyzing the infestation parameters it is important to bear in mind that the present collections were made during the winter months; this has not been the case for some other surveys of ticks from white-tailed deer. Infestation parameters noted for each tick species are generally consistent with data reported for some previous studies (Kellogg et al., 1971; Smith, 1977; Strickland et al., 1981). Cooney and Hays (1972) did not record *D. albipictus* from Alabama, although they did state that this tick was probably present; nor did they collect *A. maculatum* from *O. virginianus*.

Dermacentor variabilis apparently does not commonly infest deer in the southeastern states, at least not during the fall and winter months. This tick was not collected from deer in this survey despite the fact that it is a frequent parasite of white-tailed deer in other parts of North America (Kellogg et al., 1971). Cooney and Hays (1972) recovered only one specimen of *D. variabilis* whereas neither Kellogg et al. (1971) nor Smith (1977) collected this tick from white-tailed deer in Alabama. *Dermacentor variabilis* is similarly scarce on deer in Tennessee and Kentucky (Cooney and Burgdorfer, 1974; Bloemer et al., 1988).

Ixodes scapularis was the most frequently collected tick. Adults of *I. scapularis* are most common during winter (Bishopp and Trembley, 1945; Wilson and Baker, 1972; Goddard, 1986). Immature *I. scapularis* are not common on deer but are known to parasitize various reptiles, birds and small mammals (Bishopp and Trembley, 1945; Clifford et al., 1961). Smith (1977) reported a 75% infestation prevalence for *I. scapularis* examined in 20 counties across Alabama mainly from October through January; this figure is higher than the overall infestation prevalence of 54% reported here. The high mean infestation intensities (up to 10.7 per infested animal) noted here for *I. scapularis* on deer from some Alabama locations (e.g., Barbour and Butler Counties) are in marked contrast to the comparatively low mean intensities previously recorded for this tick on deer from Alabama by Cooney and Hays (1972) and from Mississippi by Goddard (1986) and Demerais et al. (1987). *Ixodes scapularis* infestation levels were similarly high at Barbour County WMA in January, 1988 (G. R. Mullen, unpubl. data); at this time, 80% of 25 deer were infested with a mean intensity of 15.8 *I. scapularis*.

Dermacentor albipictus was the second most abundant tick collected. Although it infested only 15% of the total deer examined, sometimes more than 200 ticks were collected from a single host. *Dermacentor albipictus* is a one-host tick that characteristically parasitizes large domestic and wild mammals (Bishopp and Trembley, 1945; Clifford et al., 1961). Although Cooney and Hays (1972) did not collect *D. albipictus* from Alabama deer, surveys by Kellogg et al. (1971) and Smith (1977) reported this tick (as *D. nigrolineatus*) to be a common parasite of *O. virginianus* in the state. The 16% prevalence for this tick on Alabama deer reported by Smith (1977) agrees well with the prevalence of 15% recorded for the present study. In contrast, Cooney and Burgdorfer (1974) found 61% of the white-tailed deer they examined in Tennessee and Kentucky to be parasitized by *D. albipictus*. Because *D. albipictus* is typically found on large mammalian hosts in late fall, winter, and spring months (Bishopp and Trembley,

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1945) the data obtained in this survey probably reflect the peak population level for this tick. *Dermacentor albipictus* and *D. nigrolineatus* are currently considered to be color morphs of the same species with the name *D. albipictus* having precedence (Ernst and Gladney, 1975). Alabama populations of *D. albipictus* have previously been reported to be dark-colored morphs (Kellogg et al., 1971; Smith, 1977). However, about 5% of the specimens we examined were clearly ornamented, suggesting that the accepted geographic limits of the two morphs warrants reassessment.

Amblyomma americanum was the third most commonly collected tick from deer in this survey. It was recovered in low infestation intensities (1.0 to 9.5) and from 1% to 50% of the deer examined at the different collection localities. This was the only tick species collected from deer in all areas sampled. However, no *A. americanum* were recovered from 28 deer examined at Barbour County WMA in January, 1988 (G. R. Mullen, unpubl. data) which agrees with the very low intensity reported here for this location. *Amblyomma americanum* is a parasite of white-tailed deer throughout most of the eastern United States and has often been collected in extremely large numbers from this host (Bishopp and Trembley, 1945; Bolte et al., 1970; Strickland et al., 1981; Bloemer et al., 1988). In the Bloemer et al. (1988) study at Land Between the Lakes in Kentucky and Tennessee conducted between the months of March and November, mean half-body infestation densities for *A. americanum* on *O. virginianus* peaked at 67 females and 148 males in May, at 479 nymphs in June and at 1,493 larvae in August. However, this is mainly a summer parasite of white-tailed deer. Bloemer et al. (1988), found *A. americanum* numbers on deer to be comparatively low ($\bar{x}$ = 3.0 adults/deer) from August through November which is in closer agreement with the overall figure of 0.6 *A. americanum*/deer reported here for Alabama. The prevalence of 33% for *A. americanum* infesting *O. virginianus* in Alabama documented by Smith (1977) is similar to the overall figure of 24% reported for this study.

Only 5 specimens of *Amblyomma maculatum* were collected (one tick from each of five hosts). Two of the three sites from which this tick was taken are in southern Alabama, which is consistent with its known Gulf Coast distribution (Bishopp and Trembley, 1945; Cooney and Hays, 1972). Previous surveys have similarly shown *A. maculatum* to be an infrequent parasite of deer in Alabama (Kellogg et al., 1971; Smith, 1977) and elsewhere in the southeastern United States (Kellogg et al., 1971; Strickland et al., 1981; Demerais et al., 1987). Smith (1977) found only 2% of the white-tailed deer he examined from Alabama to be infested by *A. maculatum*; this compares well with the overall prevalence of 1% reported here. Adult *A. maculatum* are important ectoparasites of livestock whereas immatures typically parasitize small mammals and birds (Bishopp and Trembley, 1945; Clifford et al., 1961; Strickland et al., 1981).

The markedly different numbers of ticks that were collected from various locations within Alabama are noteworthy. *Amblyomma americanum* was most commonly recovered from deer in Chambers and Lee Counties and at Choccolocco and Oakmulgee WMA's. This was the only species of tick recovered from 12 deer examined at Choccolocco WMA during the 1985–86 hunting season by J. Piesman (pers. comm.) which agrees with data presented for this study. *Dermacentor albipictus* was collected most frequently from deer in Lee County and was not recovered at Choccolocco or Oakmulgee WMA's. J. Piesman (pers. comm.) collected 77 *A. americanum*, five *D. albipictus* and 81 *I. scapularis* from 18 deer examined at Oakmulgee WMA during the 1985–86 hunting season; except for the presence of *D. albipictus*, these figures are similar to those obtained during this study. *Ixodes scapularis* was abundant on deer in southern Alabama (e.g., Barbour County and Butler

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County WMA's). However, no clear north-to-south increase in prevalence was apparent. This differs from the report of Demerais et al. (1987) in neighboring Mississippi in which they noted an increase in prevalence for *I. scapularis* parasitizing white-tailed deer from northern (13% of all deer infested) through central (31% infested) and southern (50% infested) divisions of that state. Some of these geographical differences may be attributed to climatic or vegetational factors at the various collection localities. Similar factors have been proposed to explain the different tick assemblages and prevalences on white-tailed deer in different ecological areas of Texas (Hunt and Gilbert, 1981).

Data presented here show that *I. scapularis*, *D. albipictus*, and *A. americanum* are the tick species most frequently associated with white-tailed deer in Alabama during the winter months. *Ixodes scapularis* is the most common tick on this host in most geographical locations, but is absent from some areas. *Dermacentor albipictus* infests lower numbers of deer, although hundreds of specimens can parasitize a single host. *Amblyomma americanum* appears to be a widespread parasite of deer in Alabama, but is present in low numbers during the winter months.

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