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A Guide to the Ticks of Mississippi

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A Guide to the Ticks of Mississippi

INTRODUCTION

Members of the superfamily Ixodoidea, or ticks, are acarines that feed obligately on the blood of mammals, amphibians, reptiles, and birds. Ticks have significant medical and veterinary importance, and knowledge of species present in a given area is important to physicians, veterinarians, wildlife biologists, and farmers of livestock.

The two major families of ticks recognized in North America (Figure 1) are Ixodidae (hard ticks) and Argasidae (soft ticks). Hard ticks have a hard scutum on top of their bodies and display obvious sexual dimorphism (Figure 2); the blood-fed females are capable of enormous expansion (Color Figure 1). Their mouthparts are anterior and visible from dorsal view. Soft ticks lack a hard scutum and sexual dimorphism and are mainly adapted for feeding rapidly and leaving the host promptly. Their mouthparts are generally subterminal and not visible from a dorsal view.

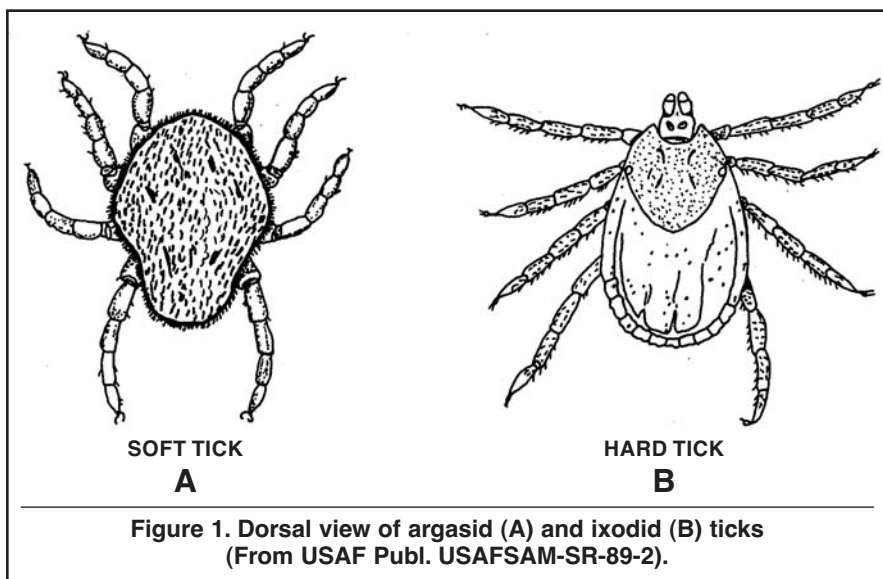
Hard ticks have three motile life stages (Figure 3A). Some ticks complete their development on only one or two hosts, but most Mississippi ticks have a three-host life cycle. A fully fed female tick drops from the host animal to the ground and lays from 5,000 to 18,000 eggs. The eggs hatch in about 35 days into a six-legged larva (seed tick stage), which feeds predominantly on small animals. The fully fed seed ticks drop to the ground and transform into eight-legged



Color Figure 1.
Engorged female tick.

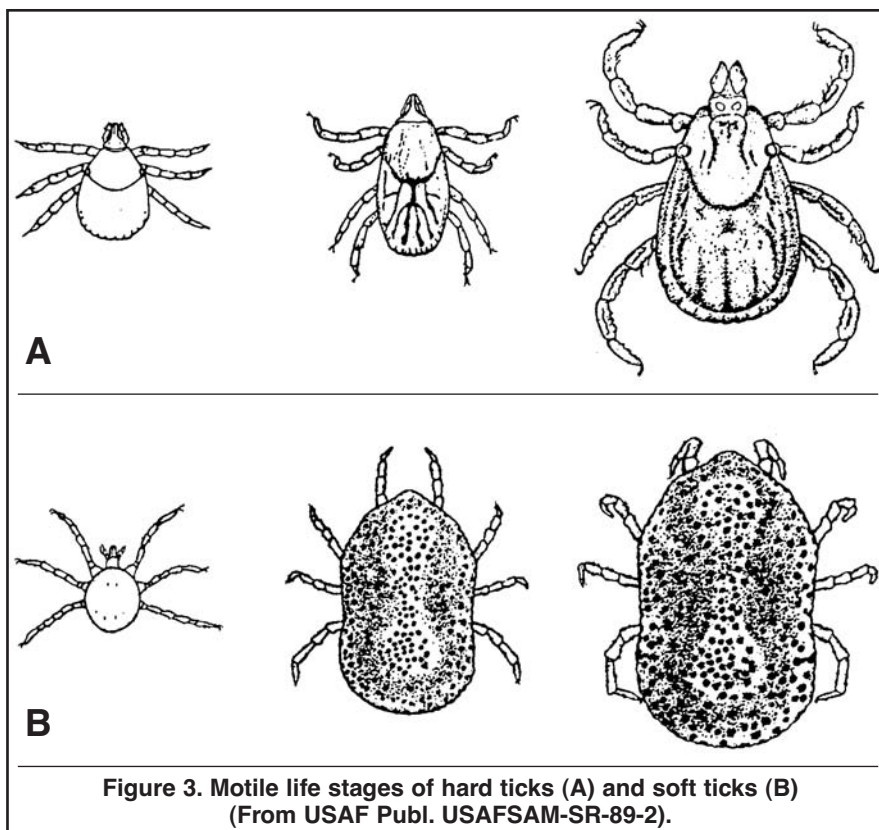
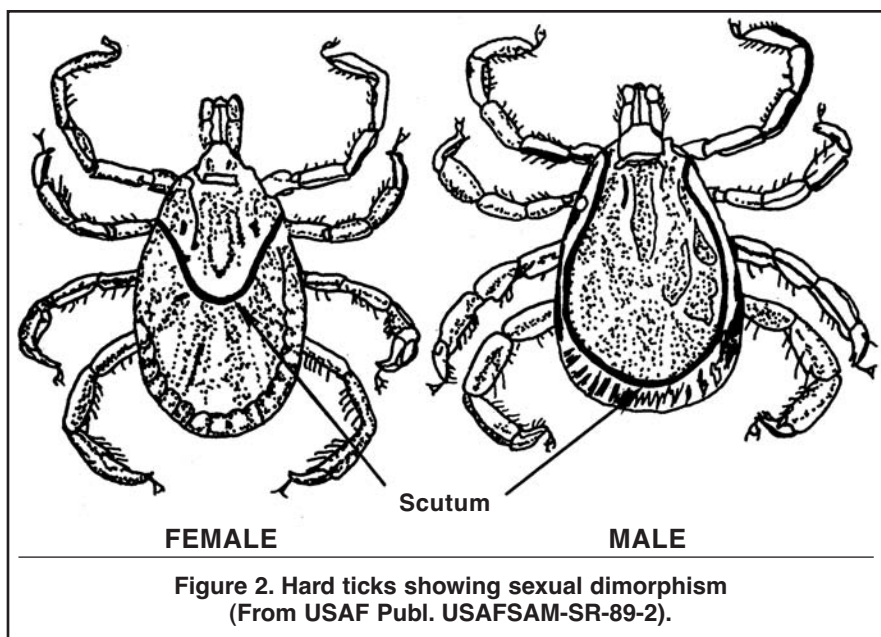
nymphs. These nymphs seek an animal host and likewise feed and drop to the ground. They then molt into the adult stage, thus completing the life cycle.

The biology of soft ticks differs from that of hard ticks. Adult soft ticks feed and lay eggs repeatedly, whereas hard ticks feed once and then lay eggs. Argasid females may feed and lay eggs several times, but they lay fewer eggs than do hard ticks. Also, soft tick species may undergo several nymphal molts before reaching the adult stage (Figure 3B).



This bulletin summarizes the knowledge on ticks occurring in Mississippi. Many of the distribution records used to generate this list of species are the result of extensive collecting conducted by the senior author from 1982 to 2004 throughout much of the state (Goddard and Norment 1983a, 1983b; Goddard 1986, 1992, 1993; Jackson and Goddard 1995; Jackson et al. 1996, Goddard 1997a, 2002a). In addition, several projects conducted by wildlife researchers have cited tick records from Mississippi (Prestwood 1968, Smith 1977, Andrews et al. 1980, Handrick 1981). Other medical or veterinary projects have reported tick records from the state (Ward 1932, Archer 1946, Carpenter et al. 1946, Philip and White 1955, Rhodes and Norment 1979, Nause and Norment 1984, Norment et al. 1984, Goddard et al. 2003). The collection records and literature show 19 tick species as occurring or having occurred in Mississippi. Voucher specimens

representing 16 of the 19 species discussed are deposited in the Mississippi Entomological Museum or in the National Tick Collection (originally, Rocky Mountain Laboratory specimens). Three species have been reported for which specimens have not been examined by the authors or verified as valid.



TICKS AND HUMAN DISEASE

Lyme Disease

Lyme disease, more accurately termed Lyme borreliosis (LB), is caused by the spirochete, *Borrelia burgdorferi*, and is a systemic illness with many clinical manifestations. It occurs in temperate zones over much of the world (Goddard 1997c). Although rarely fatal, the disease may be long and debilitating with heart, nerve, and joint involvement (Burrascano 1989). Initial symptoms include a flu-like syndrome with headache, stiff neck, pain in the joints and muscles, a generalized feeling of weakness, and low-grade fever. Often, a more-or-less circular, painless rash called erythema migrans (EM) is present at the bite site. The EM lesion is often said to be the hallmark sign for LB, although not all patients develop it. EM lesions may steadily increase in size with subsequent central clearing, resembling a bull's-eye. Untreated EM and associated symptoms usually resolve in 3 to 4 weeks. However, the disease often spreads throughout the body within weeks or months, resulting in cardiac, neurologic, and joint manifestations that may last for years. The number of reported LB cases in the U.S. continues to increase annually. There were 23,763 cases reported to the Centers for Disease Control and Prevention (CDC) during 2002 (CDC 2004). In the U.S., the vast majority of cases are from the northeastern and north-central states. Only about 11-20 cases of LB are reported in Mississippi annually, although these are usually not officially confirmed.

Lyme borreliosis is transmitted by tick bite. In the U.S., *Ixodes scapularis* is the primary vector in the East, and *Ixodes pacificus* in the West. Other tick species may be involved in the ecology of Lyme borreliosis in the U.S. Alternatively, there may be several, as-of-yet undescribed *Borrelia* species that cause Lyme-like illness. In the southern U.S., researchers have doubted for several years whether reports of an LB-like illness are actually true LB. Also, it

has been widely known for some time that 1–3% of lone star ticks, *Amblyomma americanum*, carry spirochetes similar to *B. burgdorferi*. Therefore, cases of LB-like illness in the southeastern and south-central U.S. could be caused by this new spirochete (or others) and not by *B. burgdorferi*. At least one case of erythema migrans has been caused by a spirochete called *B. lonestari* (James et al. 2001).

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever (RMSF) is the most frequently reported rickettsial disease in the U.S. with about 600 cases reported each year (CDC 2001). Many more cases probably occur but are unreported. People with RMSF usually show the classic triad of RMSF features — fever, rash, and history of tick bite. Other symptoms are weakness, severe headache, chills, and body aches. Sometimes gastrointestinal symptoms such as abdominal pain and diarrhea are reported. The rash, appearing on about the third day, usually begins on the extremities and then spreads to the rest of the body. However, there have been confirmed cases of RMSF without rash. Mental confusion, coma, and death may occur in severe cases. The mortality rate is about 20% if untreated and 4% if treated.

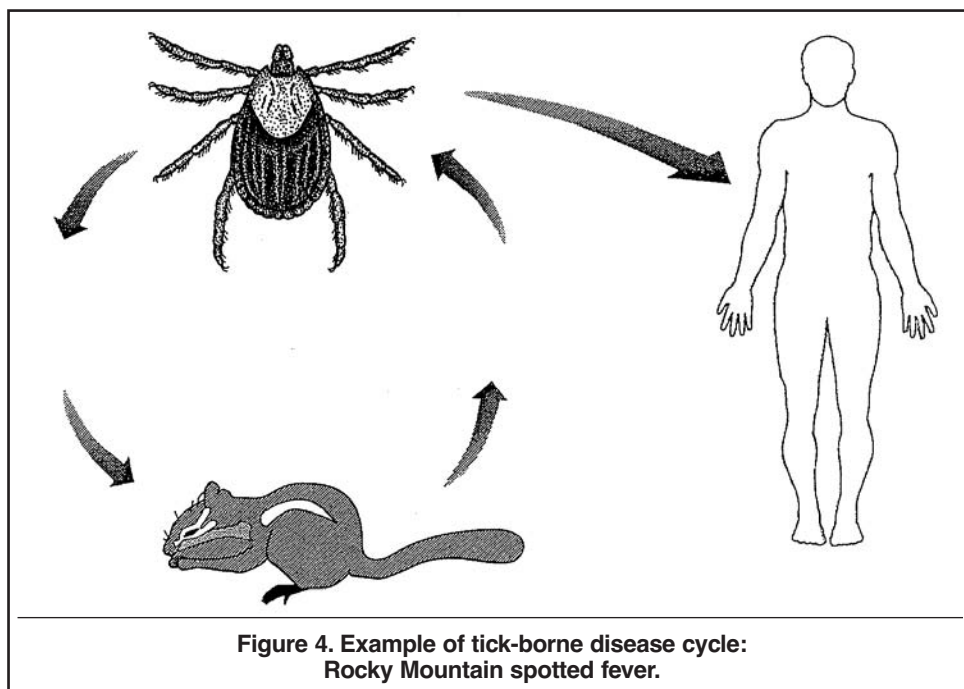


Figure 4. Example of tick-borne disease cycle: Rocky Mountain spotted fever.

The agent of RMSF circulates in nature among small mammals (an example of a tick-borne disease life cycle is given in Figure 4) and is usually transmitted to people by the bite of an infected tick, although it is possible for a person to get the disease while manually de-ticking dogs when infectious fluids get on the skin. Not all tick species are effective vectors of the rickettsia, and even in the vector species, not all ticks are infected. Generally, only 1% to 5% of vector ticks in an area are infected. Several tick vectors may transmit RMSF organisms, but the primary one in the eastern U.S. is the American dog tick, *Dermacentor variabilis* (Burgdorfer 1975). Ticks are often brought into close contact with people via pet dogs or cats (dog ticks may also feed on cats).

Other Spotted Fever Group Rickettsioses

There are several other human diseases caused by spotted fever group rickettsias, including rickettsialpox and Mediterranean spotted fever. In the southern U.S., a new spotted-fever-like disease called American bouton-neuse fever, transmitted by *Amblyomma maculatum*, was recently discovered that causes fever, headache, body aches, and a spot of necrosis (an eschar) at the site of tick bite (Goddard 2004, Paddock et al. 2004). Since the agent of this disease has been found in Mississippi ticks (Goddard and Norment 1986), cases of the disease likely occur here also.

Ehrlichiosis and Anaplasmosis

Ehrlichia organisms are tiny bacteria that primarily infect circulating white blood cells. Much of the knowledge gained concerning ehrlichiae has come from the veterinary sciences with intensive studies on *Anaplasma marginale* (a cattle disease agent), *Ehrlichia (Cowdria) ruminantium* (cattle, sheep, goats), *Ehrlichia equi* (horses), and *Anaplasma (Ehrlichia) phagocytophila* (sheep, cattle, deer). Canine ehrlichiosis, caused by *Ehrlichia canis*, killed many military working dogs during the Vietnam War. There are at least three ehrlichial disease agents infecting humans in the U.S. (Bakken and Dumler 2004). One, *Ehrlichia chaffeensis*, the causative agent of human monocytic ehrlichiosis (HME), occurs mostly in the southern and south-central U.S. and infects mononuclear phagocytes in blood and tissues. Another, *Anaplasma (Ehrlichia) phagocytophilum*, infects granulocytes and causes human granulocytic anaplasmosis (HGA). It is mostly reported from the upper midwestern and northeastern U.S. The third, *E. ewingii*, causes a clinical illness similar to the

other two, but thus far, has only been identified in a few patients, most of whom were immune compromised. Therefore, much is yet unknown about human infection with this agent.

Clinical and laboratory manifestations of infection with HME or HGA are similar (Goddard 1997b). The patient usually gets a fever, headache, body aches, and progressive leukopenia (low white cell count). Sometimes there is a cough, gastroenteritis, or meningitis. Rarely is there a rash, so ehrlichiosis is sometimes called “spotless” Rocky Mountain spotted fever. Illness due to HME is thought by some to be milder than with HGA based on reported fatality rates of 2–5% and 7–10% for HME and HGA, respectively.

Ehrlichiosis is transmitted to humans via the bite of an infected tick. HME, which primarily occurs within the geographic distribution of the lone star tick, *Amblyomma americanum*, seems to have a close association with that tick and the white-tailed deer. However, detection of the HME agent in other tick vectors and a few cases outside the distribution of the lone star tick suggests that additional vectors occur.

The ecology of HGA is not well known. It has been diagnosed mostly in patients from the upper midwestern and northeastern U.S., although cases have been reported from Florida, Arkansas, and California. The tick vector is *Ixodes scapularis*, the same species that transmits the agent of Lyme borreliosis; thus, there is the possibility of co-infection with Lyme borreliosis and HGA (and even babesiosis). Possible animal reservoirs of the HGA agent include deer and small rodents.

Tularemia

Tularemia, sometimes called rabbit fever or deer fly fever, is a bacterial zoonosis that occurs throughout temperate climates of the northern hemisphere. Approximately 150 to 300 cases occur in the U.S. each year, but most cases occur in Arkansas, Missouri, and Oklahoma (Cross 1997, Goddard 2002b). The causative organism, *Francisella tularensis*, is a small, gram-negative, bacterium named after Sir Edward Francis (who did the classical early studies on the organism) and Tulare, California (where it was first isolated). The disease may be contracted in a variety of ways — food, water, mud, articles of clothing, and arthropod bites. Arthropods involved in transmission of tularemia include ticks, biting flies, and possibly even mosquitoes. Ticks account for more than 50% of all cases, especially west of the Mississippi River (Goddard 1998a). Tularemia may cause an influenza-like

disease with high initial fever, temporary remission, and a subsequent period of fever lasting at least 2 weeks. Later, a local spot of necrosis with or without glandular involvement may occur. Untreated, the mortality rate for tularemia is about 8%; early diagnosis and treatment can reduce that to 2% or less.

The three major North American ticks involved in transmission of tularemia organisms are the lone star tick, *Amblyomma americanum*; the Rocky Mountain wood tick, *Dermacentor andersoni*; and the American dog tick, *Dermacentor variabilis*. Two of these, the lone star tick and the American dog tick, commonly occur in Mississippi.

Tick Paralysis

Tick paralysis is characterized by an ascending paralysis that may be fatal if the tick is not located and removed. The causative agent is believed to be a salivary toxin produced by ticks when they feed. The disease is fairly common. In North America, hundreds of cases have been documented from the Montana–British Columbia region. It occurs in the southeastern U.S. as well. The senior author has investigated two cases of tick paralysis in children in Mississippi (Goddard 2002a).

The site of tick bite in a case of tick paralysis looks no different from that in cases without paralysis. Paralysis does not begin immediately following tick attachment. There is a latent period of 4–6 days before the patient becomes restless and irritable. Within 24 hours after onset of these symptoms, paralysis usually begins with weakness of the lower limbs, progressing in a matter of hours to falling down and obvious incoordination, which is principally due to muscle weakness. In children, symptoms of the disease may include restlessness, irritability, malaise, and sometimes anorexia and/or vomiting. A tick usually may be found attached to the head or neck of the patient. Although ticks causing paralysis are often attached to the head or neck, it must be noted that cases of paralysis may occur from tick bites anywhere on the body (published examples are the external ear, breast, groin, and back) (Gregson 1973). Once the tick is found and removed, all symptoms usually disappear rapidly.

As many as 43 tick species in 10 genera have been incriminated in tick paralysis in humans, dogs, other mammals, and birds (Gregson 1973). Tick paralysis in dogs and humans in Mississippi is mainly caused by one tick, *Dermacentor variabilis*, the American dog tick.

Identification Guide to Ticks Affecting Humans in Mississippi by Season.¹

Winter (December-January)

If adult ticks, probably *Ixodes scapularis*.

Early Spring (February-March)

If adult ticks, probably *Ixodes scapularis* or *Amblyomma americanum*.

If nymphal ticks, probably *Amblyomma americanum*.

Late Spring (April-May)

If adult ticks, probably *Amblyomma americanum*, *Amblyomma maculatum*, or *Dermacentor variabilis*. If nymphal ticks, probably *Amblyomma americanum*

Early Summer (June-July)

If adult ticks that bite people, either *Amblyomma americanum*, *Amblyomma maculatum* or *Dermacentor variabilis*.

If adult ticks in or around homes with dogs and don't bite people, then *Rhipicephalus sanguineus*. If nymphal ticks, probably *Amblyomma americanum*.

Late summer (August-September)

If adult ticks that bite people, probably *Dermacentor variabilis* or *Amblyomma maculatum*. If adult ticks in and around homes that don't bite people, then *Rhipicephalus sanguineus*

If larval or nymphal ticks probably *Amblyomma americanum*.

Fall (October-November)

If adult ticks, possibly *Dermacentor variabilis* or *Ixodes scapularis*. If larval ticks, probably *Amblyomma americanum*.

¹Including only the five most common Mississippi ticks and intended as a guide only; not for definitive identification.

KEY TO FAMILIES AND GENERA OF ADULT TICKS

Scutum present, Capitulum terminal
and conspicuous from above (Figure 1B) Family Ixodidae

Scutum absent, Capitulum on underside of body
and inconspicuous (Figure 1A) Family Argasidae

Family Argasidae *Key to Genera of Argasidae* *(Mississippi)*

- 1a. Margin of body with definite sutural line;
body distinctly flattened dorso-ventrally (Figure 5) Genus *Argas*
- 1b. Margin of body thick, rounded, and without sutural line;
body plump 2
- 2a. Integument with spines, especially in nymphal stage;
adult with granular integument and poorly developed hypostome
(Figure 1A and Color Figure 1) Genus *Otobius*
- 2b. Integument mammillated (Figure 5) and without spines;
adult with well-developed hypostome Genus *Carios (Ornithodoros)*

Family Ixodidae *Key to Genera of Ixodidae* *(Mississippi)*

- 1a. Anal groove on ventor curves about the anus in front (Figure 6E);
no eyes or festoons; scutum without white or silver markings Genus *Ixodes*
- 1b. Anal groove on ventor curves about the anus behind or is absent;
festoons present or absent; eyes present or absent;
scutum may or may not have white or silver markings 2
- 2a. Eyes absent; second palpal segment projects laterally
beyond basis capituli (Figure 7C) Genus *Haemaphysalis*
- 2b. Eyes present; second palpal segment does not project laterally
beyond basis capituli (Figure 7B) 3
- 3a. Basis capitulum laterally produced;
scutum usually without white or silver markings 4
- 3b. Basis capitulum not laterally produced;
scutum usually with white or silver markings 5
- 4a. Spiracular plate (Stigma) oval;
festoons absent (Figure 6A) Genus *Boophilus*
- 4b. Spiracular plate (Stigma) comma-shaped;
festoons present (Figure 6C) Genus *Rhipicephalus*
- 5a. Second segment of palpi about as long as wide (short mouthparts);
Coxa 1 deeply bifid (Figures 6B, 7D) Genus *Dermacentor*
- 5b. Second segment of palpi twice as long as wide (long mouthparts);
Coxa I not bifid (Figures 6D, 7E) Genus *Amblyomma*

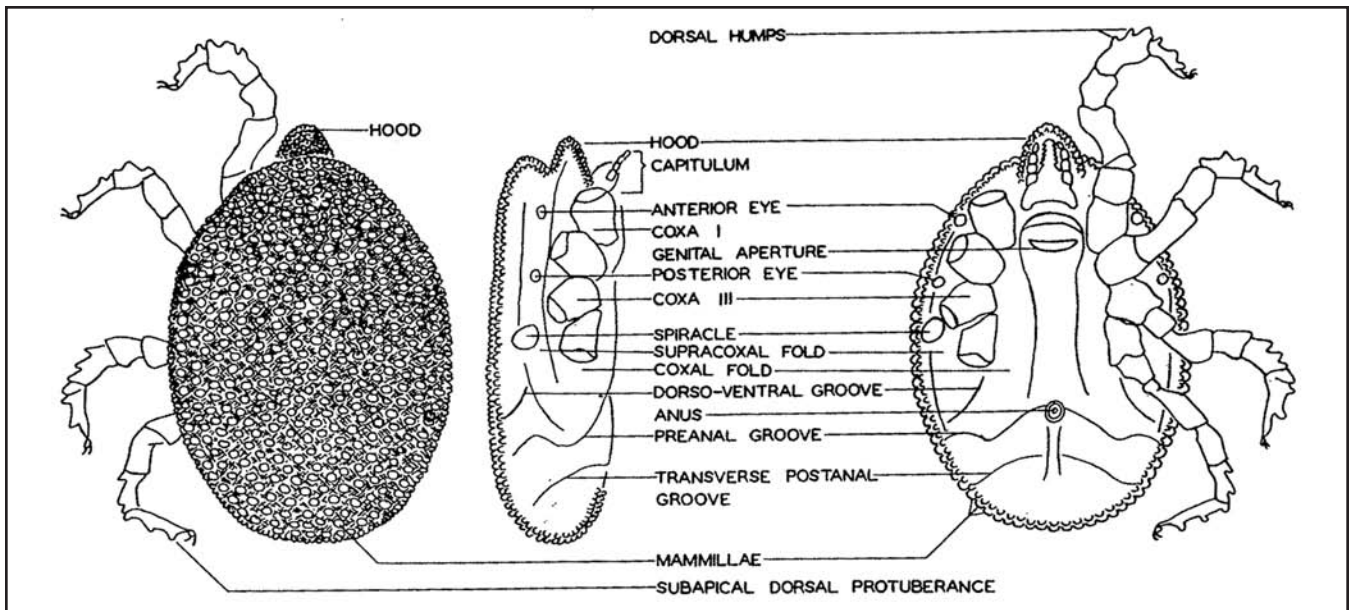


Figure 5. Soft tick morphological characters
(From Strickland et al. 1976, Ticks of Veterinary Importance, USDA Agri. Hdbk No. 485).

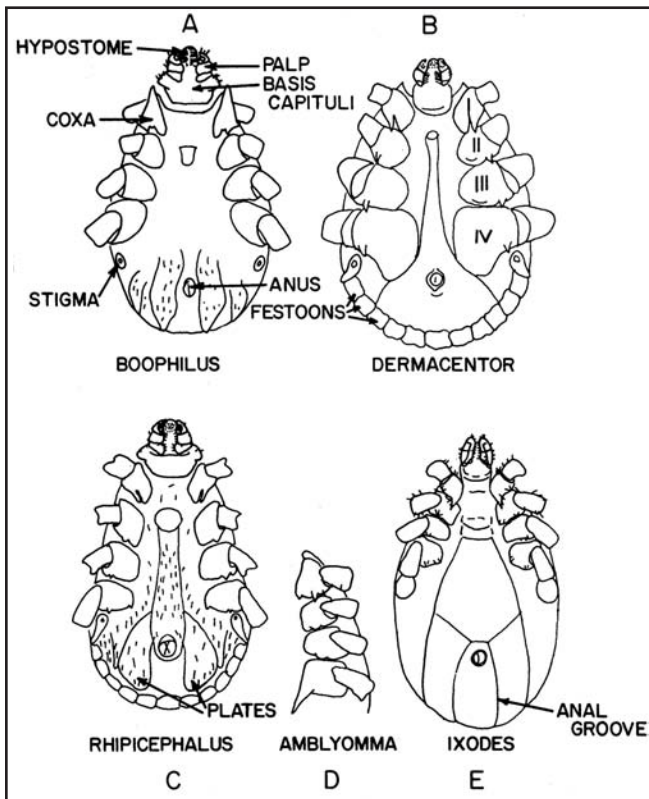


Figure 6. Ventral aspects of male ixodid ticks
(Redrawn with permission from Gerogi, 1974, Parasitology for Veterinarians, W.B. Saunders Co.).

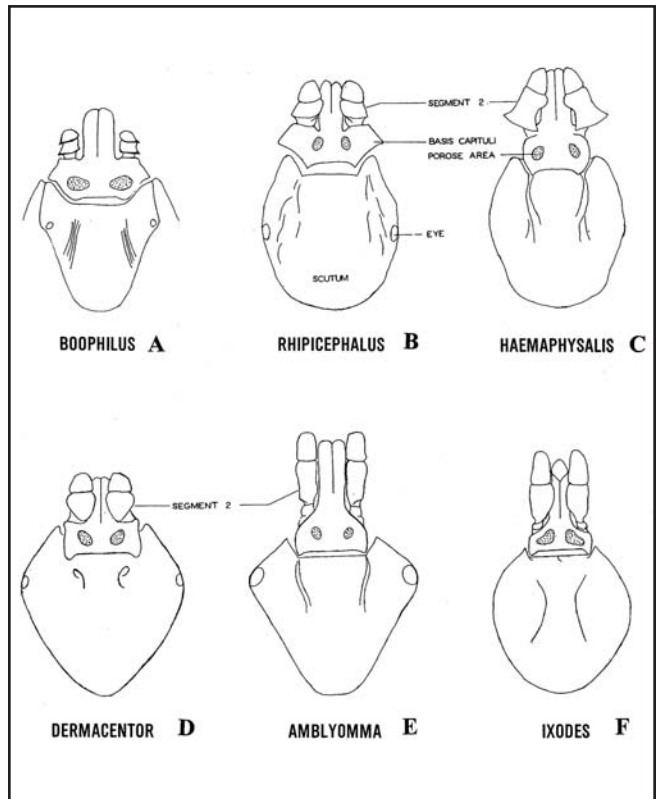


Figure 7. Mouthparts and scuta of several genera of hard ticks
(From: Strickland et al. 1976, Ticks of Veterinary Importance, USDA Agri. Hdbk No. 485).

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LIST OF TICK SPECIES OCCURRING IN MISSISSIPPI

Sixteen of the species presented on the following pages are Ixodidae (hard ticks), and three are Argasidae (soft ticks). The records for *Argas persicus* (Oken), the fowl tick; *Amblyomma cajennense* (Fabricius), the cayenne tick; and *Ixodes kingi* Bishopp, the rotund tick, are questionable in that we do not have specimens available for verification. Also, *Boophilus annulatus* (Say), the cattle tick, was eradicated during the cattle tick eradication program of the early 1900s and no longer occurs here.

Family Argasidae

***Otobius megnini* (Duges), Spinose Ear tick** — The spinose ear tick (Color Figure 2) is widely distributed throughout the western United States (but is often introduced into eastern states) and is an important parasite of horses, mules, sheep, cats, dogs, and especially cattle. Nymphs may occasionally be found attached in the ears of people. We only have records of this species from cattle in Warren County. **Voucher specimen:** Mississippi Entomological Museum, Mississippi State University (MEM #8-3).



Color Figure 2.
Spinose Ear Tick.

Argas persicus (Oken), **Fowl tick** — The fowl tick is one of the most cosmopolitan poultry parasites, and it was common at one time in rural areas when many families had their own chicken houses. However, modern, mass-scale poultry operations have virtually eliminated this practice in Mississippi. *A. persicus* is active at night, traveling some distance to its hosts and then back to hiding places where it stays during the day. The only collection record we have is from Oktibbeha County during the 1930s. **Voucher specimen:** None available.

Carios (Ornithodoros) kelleyi, **Bat tick** — The bat tick is a parasite of bats. Larvae are often found attached to their hosts, whereas nymphs and adults are found in bat roosts and feed more rapidly on the host. This tick is generally not considered to be a parasite of humans, although it has been reported to bite people. One larval *C. kelleyi* was collected by the author in Tishomingo County during a study of bat ectoparasites. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 199664.

Family Ixodidae

Boophilus annulatus (Say), **Cattle tick (eradicated)** — The cattle fever tick feeds on ungulates, especially cattle, deer, horses, mules, sheep, goats, and bison. It was widely distributed in the southern U.S. in the early 1900s. There is only one collection record from Mississippi dated December 31, 1914, from Franklin County. **Voucher specimen:** U.S National Tick Collection, Georgia Southern University, RML accession number 060956.

Amblyomma americanum (Linnaeus), **Lone Star tick** — The lone star tick (Color Figures 3 and 4) is the most abundant and annoying tick species in Mississippi. It is nonspecific, feeding on a wide variety of birds and mammals, and it often occurs in extremely large numbers. Adults are especially common on white-tailed deer. Larval stage lone star ticks are sometimes called “seed ticks” and are active in late summer and early fall in Mississippi. *A. americanum* is a known vector of the agents of tularemia and human monocytic ehrlichiosis (Walker 1998). It may be a vector of agents of a Lyme-like illness in the South, as well as American boutonuse fever (James et al. 2001; Goddard 2003, 2004). Several studies have failed to find evidence of Rocky Mountain spotted fever rickettsiae in *A. americanum* (Burgdorfer 1975, Goddard and Norment 1986). This species is common in all Mississippi counties. **Voucher specimen:** Mississippi Entomological Museum, MSU, (MEM #8-4).



Color Figure 3. Female Lone Star Tick.



Color Figure 4. Male Lone Star Tick.

***Amblyomma cajennense* (Fabricius), Cayenne tick** — The cayenne tick occurs generally only in the extreme southern U.S. All stages of this species attack humans and many animals. Prestwood (1968) reported collecting the cayenne tick from wild turkeys in the Mississippi Delta, although there are no voucher specimens available to confirm this finding. The presence of *A. cajennense* in Mississippi is thus questionable. **Voucher specimen:** None available.

***Amblyomma maculatum* (Koch), Gulf Coast tick** — The Gulf Coast tick (Color Figures 5 and 6) is a relatively large species that is most abundant along the Gulf and Atlantic coasts. Adults feed on a wide variety of medium and large mammals such as deer and cattle; immatures feed on smaller mammals and birds. *A. maculatum* has been recently found to carry the agent of American boutonniuse fever, *Rickettsia parkeri* (Goddard 2004, Paddock et al. 2004, Goddard and Paddock 2005). In Mississippi, the Gulf Coast tick has been found in 17 counties, primarily in the southern third of the state (Goddard and Paddock 2005). **Voucher specimen:** Mississippi Entomological Museum, MSU (MEM #8-2).



Color Figure 5. Female Gulf Coast Tick.



Color Figure 6. Male Gulf Coast Tick.

***Amblyomma tuberculatum* Marx, Gopher Tortoise tick** — The gopher tortoise tick (Color Figures 7 and 8) is the largest tick species in Mississippi. Adults are host specific for the gopher tortoise, *Gopherus polyphemus*, although larvae have been reported to bite people. This species mainly occurs on the sandy coastal areas of Alabama, Florida, Georgia, Mississippi, and South Carolina. In Mississippi, it occurs mostly in Hancock, Harrison, and Jackson counties. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 056909.



Color Figure 7. Female Gopher Tortoise Tick.



Color Figure 8. Male Gopher Tortoise Tick.

***Dermacentor albipictus* Packard, Winter tick** — Historically, some authors have reported *D. albipictus* as two separate species: a dark form (*D. nigrolineatus*) and a light form (*D. albipictus*). The winter tick is active in the late fall, winter, and early spring and is a significant pest of horses, cattle, and wild hoofed mammals. It is especially troublesome on moose in the northern U.S. and Canada. This species is irregularly distributed in several southern states. In Mississippi, it has been collected from several central and southern counties. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 059856.

***Dermacentor variabilis* (Say), American Dog tick** — The American Dog tick (Figures 9 and 10) is one of the most medically important ticks in the United States. It is the primary vector of the agent of Rocky Mountain spotted fever in the East, has been reported to transmit tularemia organisms to people, and may cause tick paralysis. The senior author has investigated two cases of medically documented tick paralysis in Mississippi caused by this species. The preferred host of the adult stage is the domestic dog, but it readily bites people. Immatures feed on a wide variety of small mammals such as chipmunks, deer mice, and white-footed mice. This species occurs in all Mississippi counties. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 060563.



Color Figure 9. Female American Dog Tick.



Color Figure 10. Male American Dog Tick.

***Haemaphysalis leporispalustris* (Packard), Rabbit tick** — The rabbit tick (Color Figures 11 and 12) is a small tick that is an important parasite of rabbits and ground birds and is distributed widely throughout the U.S. It seldom bites people but may be important in transmitting disease agents from mammals to birds and vice versa. Rabbits are the preferred hosts, but immatures also parasitize birds. This species likely occurs in all Mississippi counties. **Voucher specimen:** Mississippi Entomological Museum, MSU (MEM #8-7).



Color Figure 11. Female Rabbit Tick.



Color Figure 12. Male Rabbit Tick.

***Ixodes brunneus*, Koch, Bird tick** — This bird-feeding tick (Color Figures 13 and 14) occurs primarily in North America; it does not bite people. All active stages of *I. brunneus* have been collected on birds of many species, but commonly reported hosts include blackbirds, jays, robins, sparrows, thrashers, waxwings, and wrens (Bishopp and Trembley 1945). The senior author has collected adults of this tick by the drag cloth method during early spring. Although there are limited records of *I. brunneus* from the state, it probably occurs throughout most of Mississippi. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 058169.



Color Figure 13. Female Bird Tick.



Color Figure 14. Male Bird Tick.

***Ixodes cookei*, Packard, No Common Name** — *Ixodes cookei* is generally distributed throughout the U.S. and parasitizes a wide range of medium-sized mammals, but especially carnivores such as dogs, raccoons, skunks, and weasels. It rarely bites people, but we have documented cases of it doing so. This tick has been found naturally infected with Powassan virus and the agent of Lyme disease. *I. cookei* has only been reported from Clay and Oktibbeha counties in Mississippi. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 035037.

***Ixodes dentatus*, Marx, No Common Name** — *Ixodes dentatus* commonly occurs in the eastern U.S. where it is an important parasite of rabbits. The species has also been reported from other small mammals such as raccoons and white-footed mice. The agent of Lyme disease has been isolated from *I. dentatus* on many occasions. We have collected this species from Marshall and Tishomingo counties, although it likely occurs statewide. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 060563.

***Ixodes kingi* Bishopp, Rotund tick** — The rotund tick is of no known economic or health importance except maybe as a parasite of dogs and certain fur-bearing mammals. This species was reported from Mississippi, but the date and locality are unknown (Bishopp and Trembley 1945). **Voucher specimen:** None available.

***Ixodes marxi*, Squirrel tick** — The squirrel tick is a parasite of squirrels and is known to occur both east and west of the Mississippi River from at least 18 states and Canada (Cooney and Hays 1972, Lancaster 1973). Although its primary host is the red squirrel, *I. marxi* has also been collected from gray squirrels, flying squirrels, chipmunks, snowshoe hares, foxes, and raccoons (Bishopp and Trembley 1945, Cooley and Kohls 1945, Cooney and Hays 1972, Lancaster 1973). This tick is uncommon and males are extremely rare on hosts. The only collection of *I. marxi* in Mississippi was from Noxubee County in mid-December. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 46067.

***Ixodes scapularis* Say, Black-legged tick** — Adults of the black-legged tick (Color Figures 15 and 16) are commonly encountered during the winter months in Mississippi. Adults usually parasitize large mammals including deer and livestock, whereas immatures feed on numerous species of reptiles, birds, and mammals. This tick is an efficient vector of the agent of Lyme disease (Piesman and Sinksky 1988) and is probably responsible for most cases of true LD in the southern U.S. *I. scapularis* has been collected in Mississippi in almost all counties except the northern ones bordering Tennessee, where it seems to be absent. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 058672.



Color Figure 15. Female Black-Legged Deer Tick.



Color Figure 16. Male Black-Legged Deer Tick.

***Ixodes texanus*, Banks, Raccoon tick** — The raccoon tick is an important parasite of raccoons, although it will feed on other mammals such as opossums, rabbits, and even rodents (Keirans and Clifford 1978). It is widely distributed throughout the U.S. but has only officially been recorded from Mississippi in Marshall County. It likely occurs statewide. **Voucher specimen:** U.S. National Tick Collection, Georgia Southern University, RML accession number 065923.

***Rhipicephalus sanguineus*, (Latreille), Brown Dog tick** — The brown dog tick (Color Figures 17 and 18) is probably the most widely distributed tick in the world. Although the preferred host is the domestic dog, there are records of them biting humans (Goddard 1989). *R. sanguineus* may occur in such high numbers on dogs as to cause significant blood loss and discomfort. There is a recent report of an outbreak of Rocky Mountain spotted fever in Arizona attributed to this tick species (Demma et al. 2005). Prior to this report, *R. sanguineus* was generally not thought capable of acquiring and transmitting infections of *Rickettsia rickettsii*. The brown dog tick occurs in all Mississippi counties. **Voucher specimen:** Mississippi Entomological Museum, MSU (MEM #8-5).



Color Figure 17. Female Brown Dog Tick.



Color Figure 18. Male Brown Dog Tick.

GLOSSARY OF TICK TERMS

Anal groove: A sutural line on the ventral side of ticks that comes near or encircles the anal opening.

Anterior: Toward the front end.

Bifid: Clearly divided into two lobes or parts.

Capitulum: Anterior movable portion of body of hard ticks, including basis capituli, palps, hypostome, and chelicerae. Located ventrally in adults and engorged nymphs of soft ticks, anteriorly in larvae.

Chelicerae: Paired structures lying dorsally to the hypostome, which complete the cylindrical mouthparts that are inserted when the tick feeds.

Chitinous tubercles: Small, chitinized, rounded lobes on the posterointernal angle of the festoons of *Amblyomma cajennense* and sometimes *A. maculatum*.

Cornua: Small projections extending from the dorsal, posterolateral angles of the basis capituli.

Coxae (sing. Coxa): Small sclerotized plates on the venter representing the first segment of the leg to which the trochanters are movably attached. From anterior to posterior, the coxae are designated by Roman numerals I, II, III, and IV. Bifed coxae are those that are cleft, divided or forked.

Denticles: Small, recurved projections or “teeth” on the ventral side of the hypostome.

Dentition: Refers to the presence of denticles on the ventral side of the hypostome. The numerical arrangement of the files or rows of denticles is expressed by the dentition formulas. Thus, dentition 3/3 means that there are three longitudinal rows of denticles on each side of the median line of the hypostome.

Dimorphism: Difference in form, color, etc. between individuals of the same species, more particularly between sexes.

Distal: Farthest from the point of attachment or origin.

Dorsal: Pertaining to the back or top of the body.

Dorsum: The upper surface of the body.

Engorged: Enlargement or distention of a tick following a blood meal. Since the scutum is short in the larva, nymph, and the female hard tick (covering about half the dorsal surface in the unfed specimen), the body is capable of pronounced distention. As the body fills with blood, the relative size of the scutum is reduced. In a fully engorged female hard tick, the scutum may appear only as a small plate on the anterior of the body.

In the soft tick, the scutum is absent and both sexes may become enlarged, although not usually to the extent of the engorged female hard tick.

Festoons: Uniform rectangular areas, separated by distinct grooves, located on the posterior margin of most genera of the hard ticks. Very distinct areas in unengorged specimens but may not be visible in fully engorged females.

Files: Longitudinal rows of denticles or “teeth” on the ventral surface of the hypostome.

Genital aperture: External opening of the genital organs. Located anteriorly on the ventro-median line, posterior to the basis capituli.

Hypostome: Median ventral structure of the mouthparts that lies parallel to and between the palps and are immovably attached to the basis capituli. It bears recurved “teeth” or denticles (dentition).

Inornate: Absence of a color pattern on the scutum.

Integument: Outer covering or cuticle of the tick’s body.

Lateral: Relating to the side.

Legs: Segmented appendages. Nymphs and adults have four pair and larvae have three pair. From anterior to posterior, the legs are identified by Roman numerals I, II, III, and IV. The segments from the proximal (next to the body) to the distal end are called coxa, trochanter, femur, tibia, metatarsus, and tarsus.

Mammillate: With nipple-like protuberances or processes.

Medial: Toward the median axis of the body.

Median: The longitudinal axis that divides the body.

Ornamentation: Enamel-like color pattern that is superimposed on the base color of the integument in hard ticks. When present, this color pattern may be white to dirty white in *Dermacentor* or may be an intense copper or bronze color with touches of yellow or green in some *Amblyomma*.

Palps or palpi: Paired articulated appendages located anterolaterally upon the basis capituli and lying parallel with the hypostome. Four distinct segments are present in soft ticks. In all hard ticks the fourth segment is reduced to a small haircrowned papilla lying in a cup-like depression of segment 3. The sequence of numbering of the segments is indicated by Arabic

numerals 1, 2, 3, and 4: 1 being the proximal segment (closest to the basis capituli).

Posterior: Toward the rear end.

Protuberance: Any elevation above the surface.

Scutum: The sclerotized dorsal plate posterior to the capitulum in hard ticks. It covers almost the entire dorsal surface in the male, about one half the dorsal surface in the unengorged female. (See engorged).

Spiracular plates: Paired plates located ventrolaterally and posterior to coxa IV in hard ticks; may be oval, rounded, or comma-shaped. In the soft ticks, the spiracular plates are located ventrolaterally and opposite coxa IV and are usually round or oval. They are the external evidence of the respiratory system.

Spurs: Coxal spurs are projections from the posterior surface of the posterior margin of the coxae. They may be rounded or pointed, small or large. Projections on the median side are called internal spurs; those on the lateral side are called external spurs. Metatarsal spurs are small, pointed projections on the distal end of the metatarsus. Spurs also may be found on the palps of some species.

Tarsus: The terminal leg segment.

Taken in part from Strickland et al., 1976, Ticks of Veterinary Importance. USDA Agricultural Handbook No. 485.

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How to Remove Ticks

Due to folklore, ideas about how to remove attached ticks vary tremendously depending on who you ask and what part of the country you are in. Hard ticks attach themselves firmly to a host for a feeding period of several days and may be difficult to remove. Methods such as touching attached ticks with a hot match, “unscrewing” them, or coating them with mineral oil, petroleum jelly or some other substance are but a few of the home remedies that supposedly induce them to “back out.”

The idea behind coating a tick with fingernail polish, petroleum jelly, or mineral oil is that covering the spiracles with a substance will interfere with their breathing and make the ticks “back out.” However, ticks are able to temporarily shut off their spiracles and certainly do not breathe via the mouthparts. Even if coating a tick with a substance causes it to back out, the time required to accomplish this is unacceptable (usually 1 to 4 hours).

Since the lengthy feeding period is an important factor in disease transmission by ticks, it is crucial that a tick be removed as soon as possible to reduce chances of infection by disease organisms. During several years of field research with ticks, the senior author often had to remove them from himself or others, and pulling them straight off with forceps (tweezers) seemed to work best (See Figure). There has been some research in this area. Glen Needham (1985) at Ohio State University evaluated five methods commonly used for tick removal: (1) petroleum jelly, (2) fingernail polish, (3) 70% isopropyl alcohol, (4) hot kitchen match, and (5) forcible removal with forceps. Needham found that the commonly advocated methods are either ineffective, or worse, actually created greater problems. If petroleum jelly or some other substance causes the tick to back out on its own (and most often it does not), the cement surrounding the mouthparts used for attachment remains in the skin where it continues to cause irritation. Touching the tick with a hot match may cause it to burst, increasing risk of disease pathogen exposure. Furthermore, hot objects may induce ticks to salivate or regurgitate infected fluids into the wound. “Unscrewing” a tick is likely to leave broken mouthparts in the host’s skin.

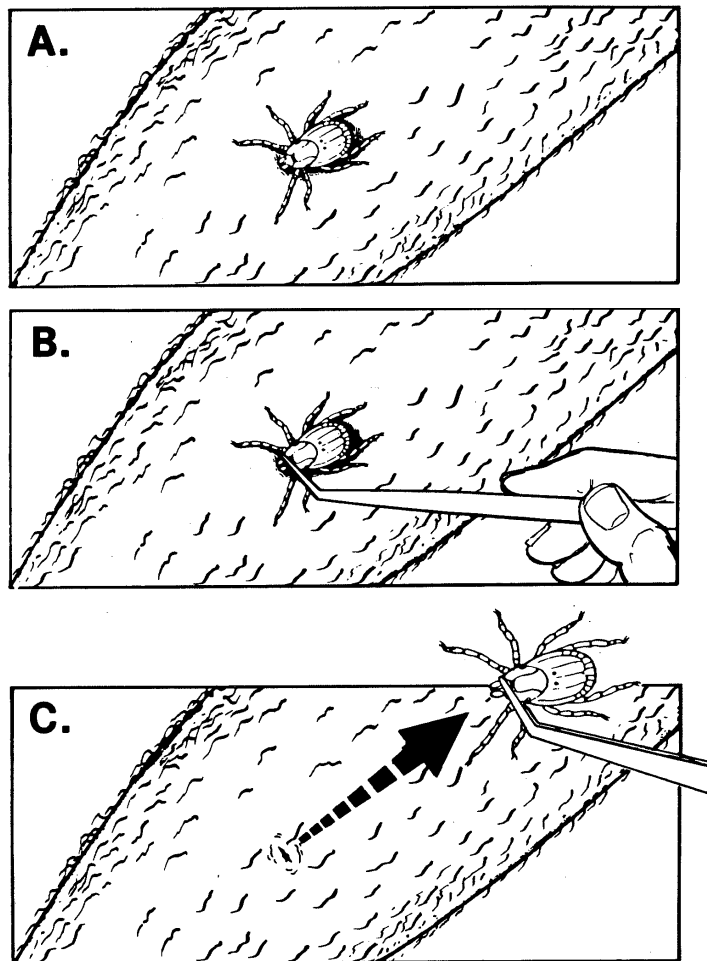
Needham recommended the following procedure for tick removal: (1) use blunt forceps or tweezers; (2) grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure; (3) take care not to squeeze, crush, or puncture the tick; (4) do not handle the tick with bare hands because infectious agents may enter via mucous membranes or breaks in

the skin; and (5) after removing the tick, disinfect the bite site and wash hands thoroughly with soap and water.

Many tick-borne diseases can be successfully treated with antibiotics in their initial stages; therefore, early diagnosis is imperative. For this reason, marking the day of a tick bite on a calendar is a good idea. If unexplained disease symptoms occur within 2 weeks from this day, people should be reminded to see their physicians and specifically inform him or her of the tick bite. This method has proven to be very helpful in diagnosis of tick-borne disease. Although there are a number of well-known tick removal methods (mostly folklore), the best one seems to be the simplest — pull them straight off with blunt forceps and disinfect the bite site.

REFERENCE

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Recommended method for tick removal: grab tick with forceps as close to the skin as possible and pull straight off (From: USAF Publ. USAFSAM-SR-89-2).

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