

Pictorial Key for Identification of Immature Stages of Common Ixodid Ticks Found in Pastures in Oklahoma

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Abstract. Many species of ixodid ticks in the United States are parasitic on cattle and pose a threat to veterinary and public health for those engaged in occupations in pasturelands. While encountered often, nymphs and larvae of the most common tick species can be difficult to identify, yet research associated with tick ecology and epidemiology of tick-borne infection requires proper identification. High-quality images were prepared of the larval and nymphal stages of the most common species of ticks in Oklahoma pastures: larvae of the lone star tick, *Amblyomma americanum* (Linnaeus), Gulf coast tick, *Amblyomma maculatum* Koch, winter tick, *Dermacentor albipictus* (Packard), American dog tick, *Dermacentor variabilis* (Say), blacklegged tick, *Ixodes scapularis* Say, and brown dog tick, *Rhipicephalus sanguineus* (Latrielle); and nymphs of *A. americanum*, *A. maculatum*, *D. variabilis*, *I. scapularis*, and *R. sanguineus*. A dichotomous key and pictorial guide for each life stage were prepared.

Introduction

Ticks are major threats to veterinary and public health. With direct damage from their bites, many species of ticks transmit a variety of pathogens to livestock and humans. Parasitism by ticks and tick-borne infection have been estimated to cost the beef cattle industry more than \$165 million annually (Drummond 1987, Polito et al. 2013). Research is necessary to prevent parasitism by ticks and risk of tick-borne infection in livestock and humans. While proper identification of field-collected specimens is essential, few pictorial resources are available to aid in identification of immature stages of common ticks in the United States.

Most guides for identification of tick larvae or nymphs are limited to one genus or life stage (Webb et al. 1990, Robbins and Keirans 1992, Durden and Keirans 1996, Keirans and Durden 1998) or include only line drawings (Clifford et al. 1961). Illustrated keys involving scanning electron micrographs (SEM) are available for nymphs in the genus *Amblyomma* (Keirans and Durden 1998), larvae of the genus *Ixodes* found in California (Robbins and Keirans 1992), and larvae of 16 tick species of public health importance in the U.S. (Coley 2015). However, SEM-based guides are often difficult to use for identifying field-collected specimens because many characteristics are visible only by scanning electron microscopy and are not easily observable with the aid of a stereomicroscope. Other guides are based on black and white images of slide-mounted specimens (Webb et al. 1990, Kleinjan and Lane 2008) that often are difficult to use for identification of immature

ticks. This guide was developed using high-resolution color photographs and key to larvae and nymphs of ixodid ticks most commonly associated with cattle and encountered in pastures specifically in the state of Oklahoma in the southern Great Plains region of the United States.

Materials and Methods

Larvae and nymphs of *Amblyomma americanum* (Linnaeus, 1758); *Amblyomma maculatum* Koch, 1844; *Dermacentor variabilis* (Say, 1821); *Ixodes scapularis* Say, 1821; and *Rhipicephalus sanguineus* (Latrielle, 1806) were obtained from colonies maintained in a laboratory at the Tick Rearing Facility at Oklahoma State University. Larvae of *Dermacentor albipictus* (Packard, 1869) were obtained from eggs laid by a field-collected gravid female kept in incubation at the tick-rearing facility. Dr. Rick Grantham used an Olympus SZX16 stereomicroscope (10x ocular, 0.7-11.5x zoom) with a Nikon DS5M 5 megapixel digital camera to make the photographs.

Key to the Larvae of Common Ixodid Ticks Found in Oklahoma Pastures:

1. Palpi and hypostome longer in proportion to the base of the capitulum and somewhat slender (Fig. 1A).....2
 Palpi and hypostome shorter and more proportionate in length to the base of the capitulum. Palpi may be tapered inward toward the hypostome (Fig. 1B).....3
2. Hypostome wider than palpi. Basis capituli with rounded lateral edges dorsally, and round at the base ventrally. Light brown in color...*Amblyomma americanum*
 Hypostome virtually equal in width to palpi. Basis capituli with acute lateral edges dorsally and square at the base ventrally. Dark grey in color
 *Ixodes scapularis*
3. Basis capituli acute laterally (Fig. 1E).....4
 Basis capituli squared or subtly extending outward laterally (Fig. 1F).....5
4. Palpi tapered inward toward hypostome. Basis capituli narrowed ventrally, approximately one half the width of the palpi and hypostome
 *Dermacentor variabilis*
 Palpi not tapered or only slightly. Basis capituli as wide as palpi and hypostome ventrally. Spur on coxae I present.....*Amblyomma maculatum*
5. Capitulum octagonal in shape. Spur present on coxae I.....
 *Rhipicephalus sanguineus*
 Capitulum square in shape. Spur on coxae I absent.....*Dermacentor albipictus*

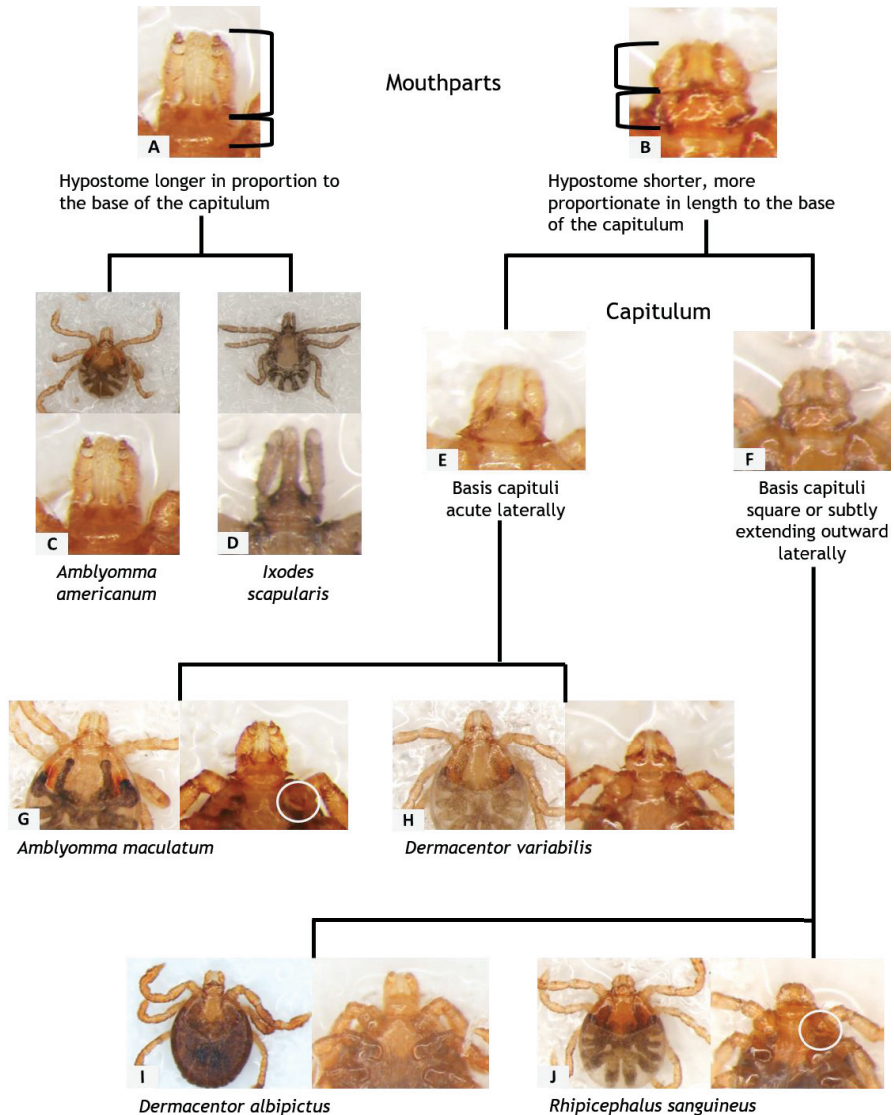


Fig. 1. Pictorial guide to the larvae of common ticks affecting cattle. Flow chart accompanies preceding Key to the Larvae of Common Ixodid Ticks Free-living in Oklahoma Pastures.

Key to the Nymphs of Common Ixodid Ticks Found in Oklahoma Pastures:

1. Mouthparts tapered inward or long and slightly tapered. Body teardrop shaped2
- Long, slender mouthparts. Body round.....*Amblyomma americanum*

2. Mouthparts long and slender (Fig. 2C).....3
 Mouthparts short, palpi tapered inward toward hypostome. Capitulum triangular (Fig. 2D).....4
3. Body light brown in color. Dark spots on lateral margins of the scutum.....
*Amblyomma maculatum*
 Body dark grey/black in color with dark scutum and legs.....*Ixodes scapularis*
4. Hypostome extending beyond palpi. Basis capituli squared.....
*Rhipicephalus sanguineus*
5. Hypostome not extending beyond palpi. Basis capituli rounded ventrally.....
*Dermacentor variabilis*

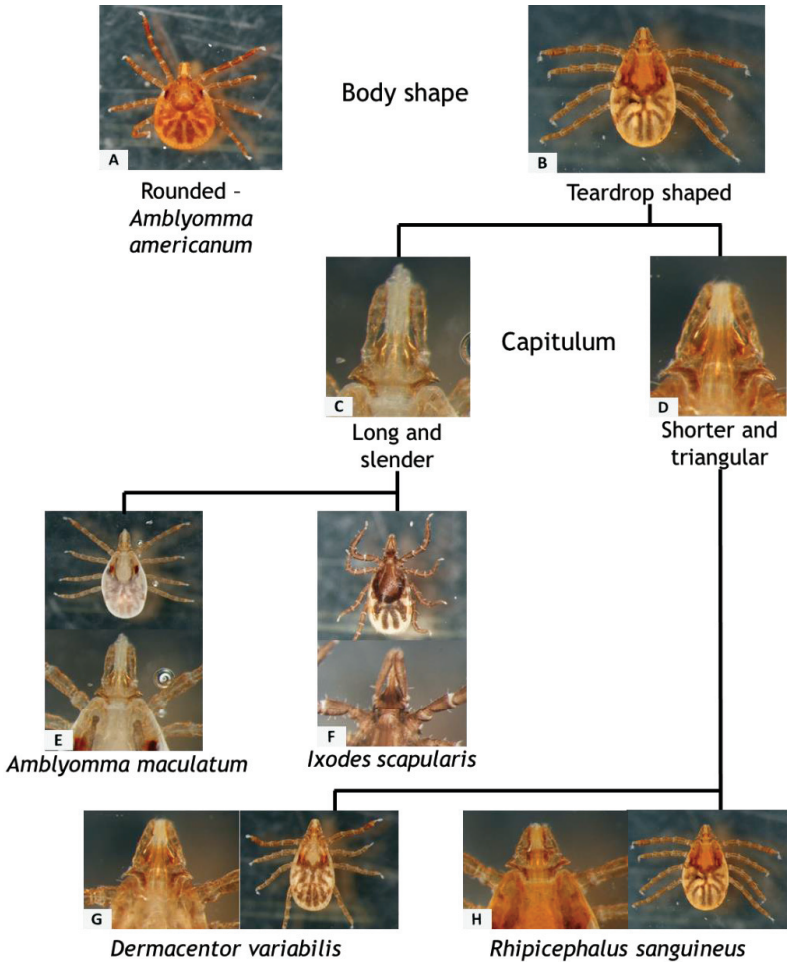


Fig. 2. Pictorial guide to the nymphs of common ticks affecting cattle. Flow chart accompanies preceding Key to the Nymphs of Common Ixodid Ticks Free-living in Oklahoma Pastures.

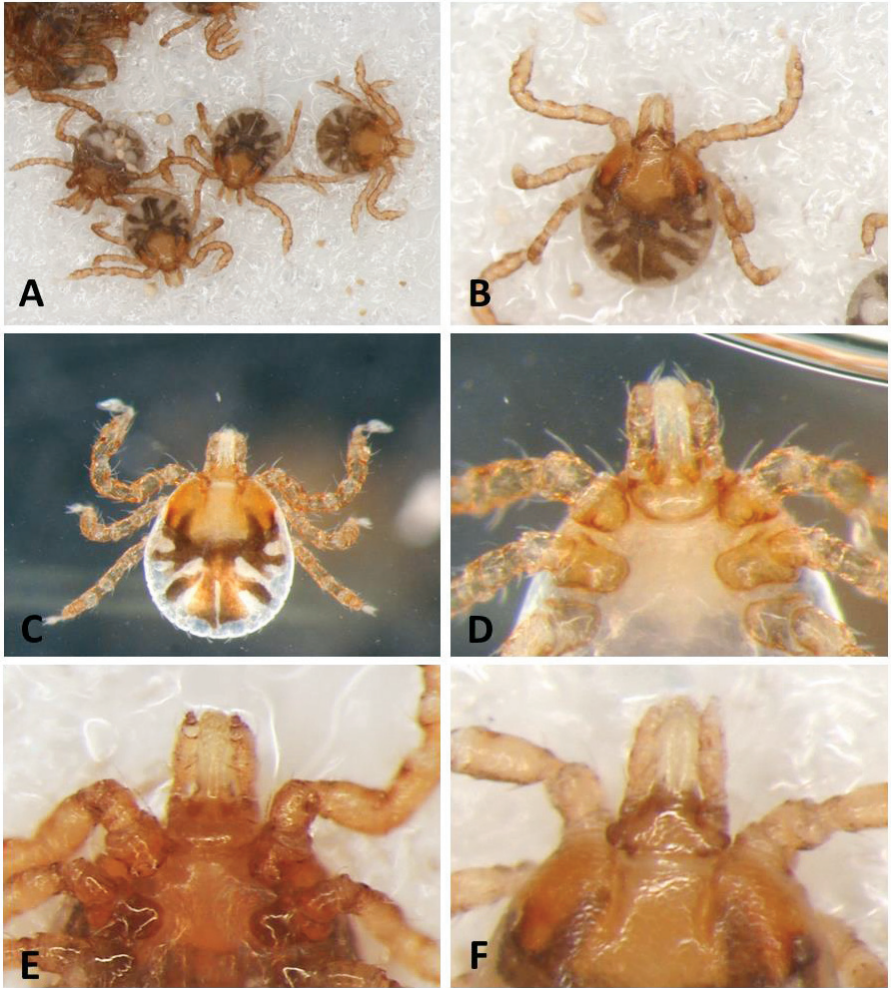


Fig. 3. *Amblyomma americanum* larvae: A) collected on masking tape, B) dorsal view, C) dorsal view of slide-mounted larva, D) slide-mounted ventral close up of capitulum and coxae I-III, E) ventral close up of capitulum and coxae I-III, F) dorsal close up of capitulum and scutum.

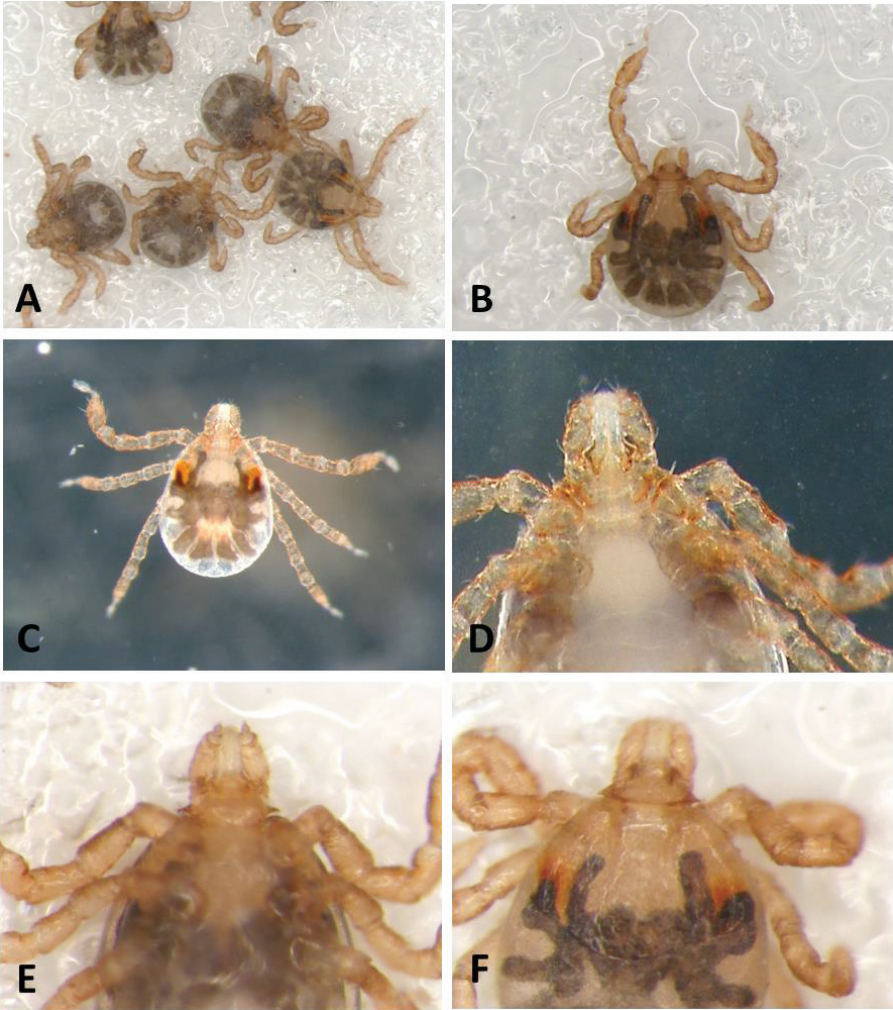


Fig. 4. *Amblyomma maculatum* larvae: A) collected on masking tape, B) dorsal view, C) dorsal view of slide-mounted larva, D) slide-mounted ventral close up of capitulum and coxae I-III, E) ventral close up of capitulum and coxae I-III, F) dorsal close up of capitulum and scutum.

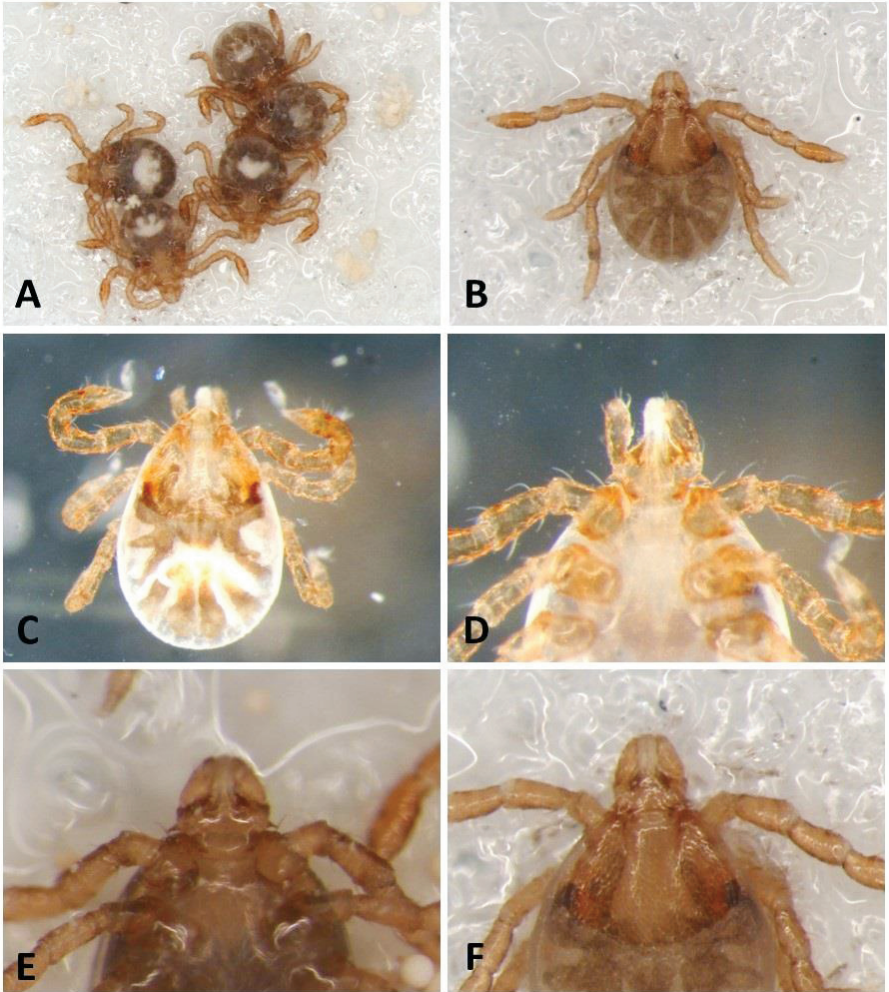


Fig. 5. *Dermacentor variabilis* larvae: A) collected on masking tape, B) dorsal view, C) dorsal view of slide-mounted larva, D) slide-mounted ventral close up of capitulum and coxae I-III, E) ventral close up of capitulum and coxae I-III, F) dorsal close up of capitulum and scutum.

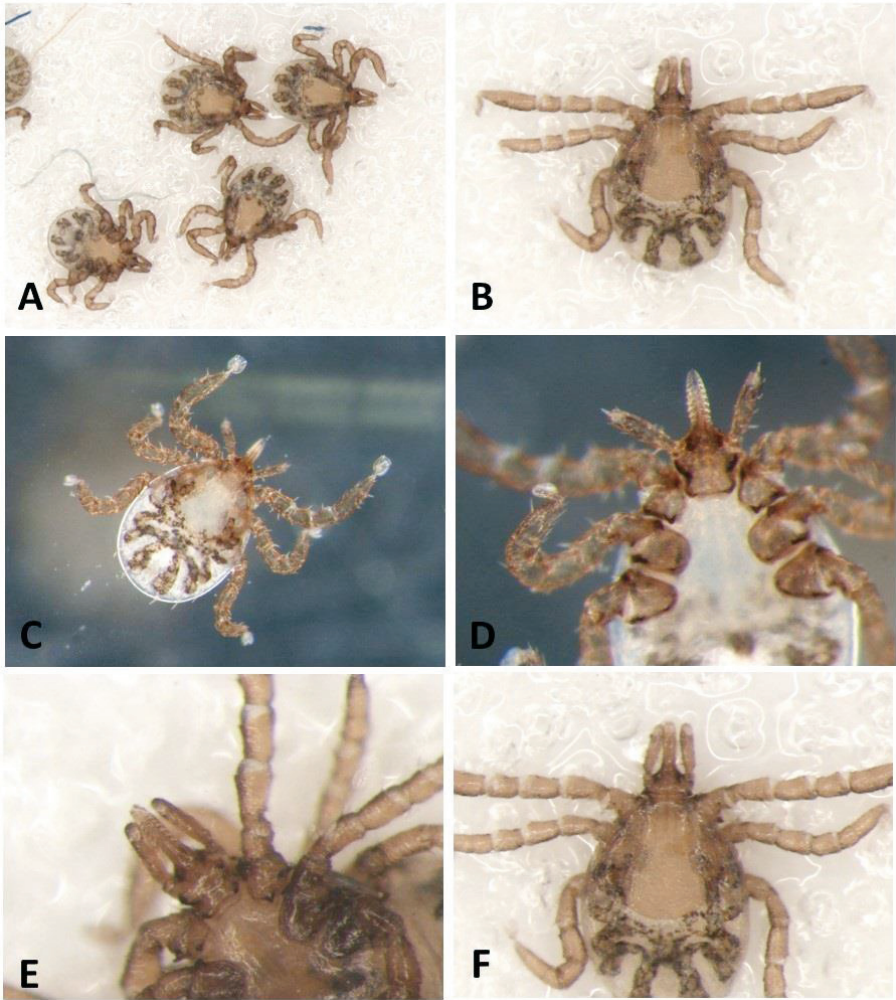


Fig. 6. *Ixodes scapularis* larvae: A) collected on masking tape, B) dorsal view, C) dorsal view of slide-mounted larva, D) slide-mounted ventral close up of capitulum and coxae I-III, E) ventral close up of capitulum and coxae I-III, F) dorsal close up of capitulum and scutum.

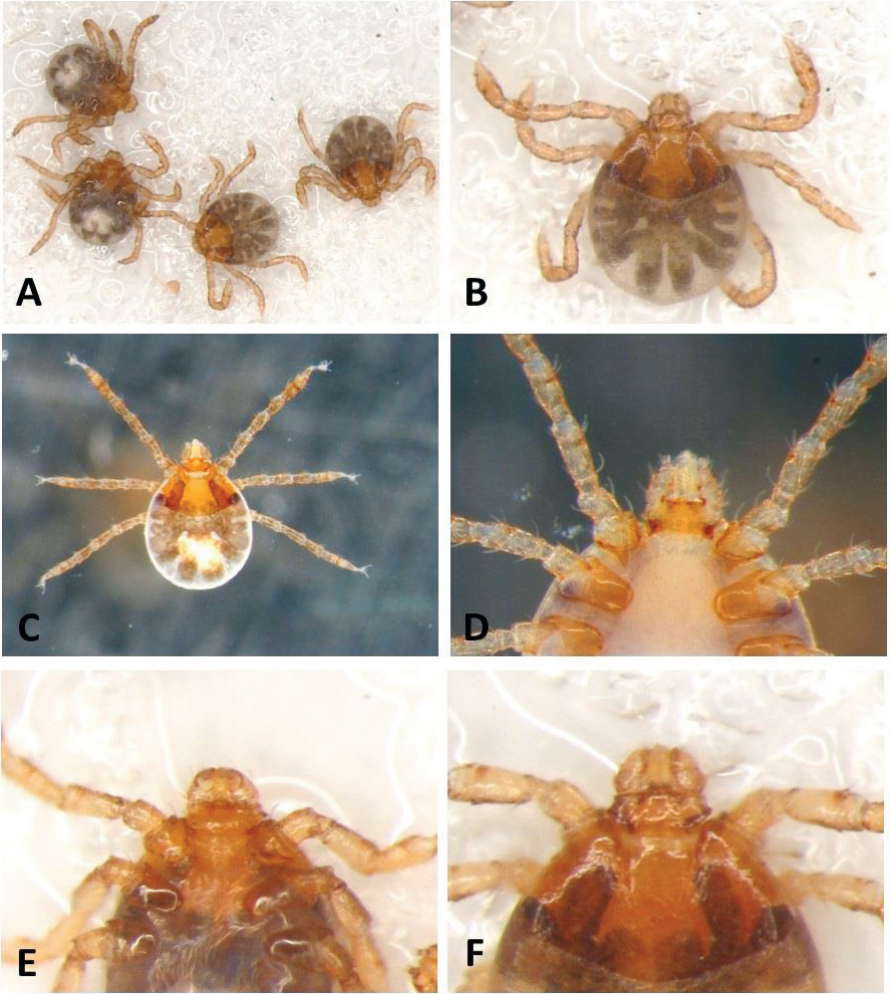


Fig. 7. *Rhipicephalus sanguineus* larvae: A) collected on masking tape, B) dorsal view, C) dorsal view of slide-mounted larva, D) slide-mounted ventral close up of capitulum and coxae I-III, E) ventral close up of capitulum and coxae I-III, F) dorsal close up of capitulum and scutum.

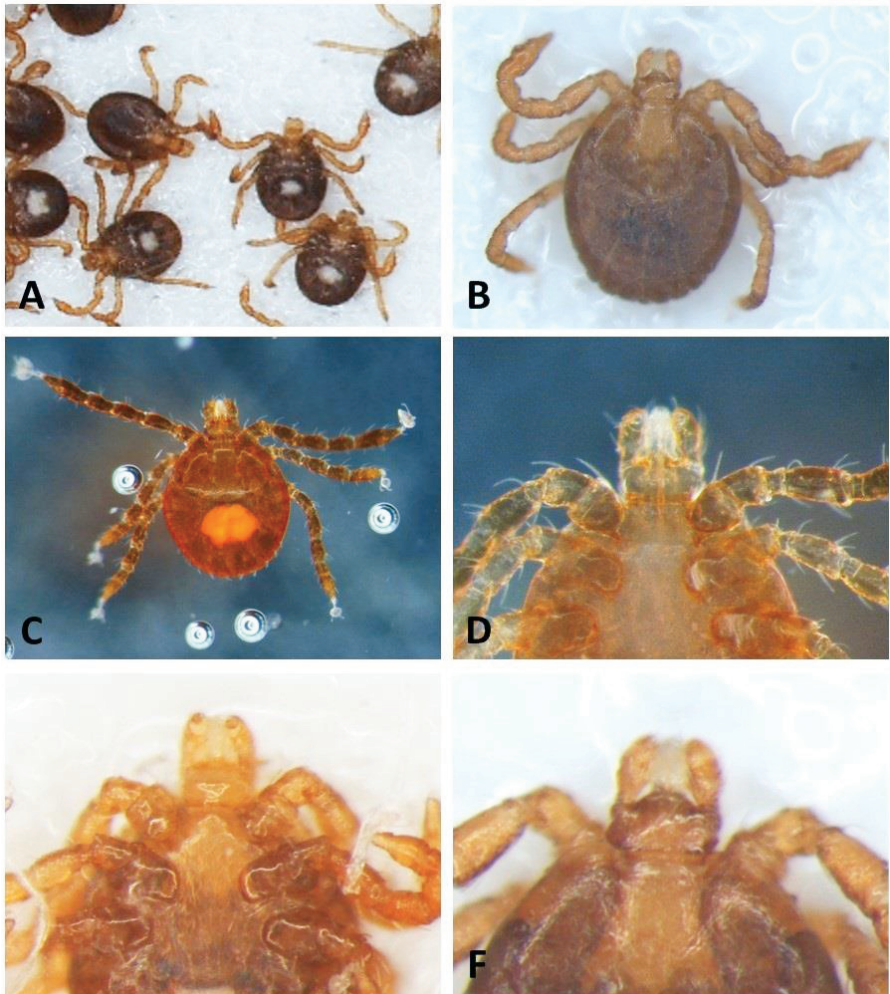


Fig. 8. *Dermacentor albipictus* larvae: A) collected on masking tape, B) dorsal view, C) dorsal view of slide-mounted larva, D) slide-mounted ventral close up of capitulum and coxae I-III, E) ventral close up of capitulum and coxae I-III tape, F) dorsal close up of capitulum and scutum.

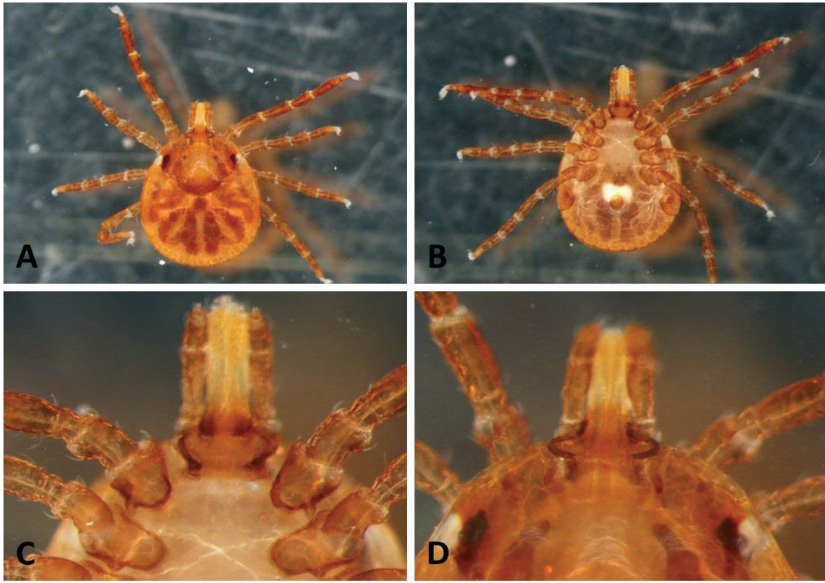


Fig. 9. *Amblyomma americanum* nymph: A) dorsal view, B) ventral view, C) ventral close up of capitulum and coxae I and II, D) dorsal close up of capitulum and scutum

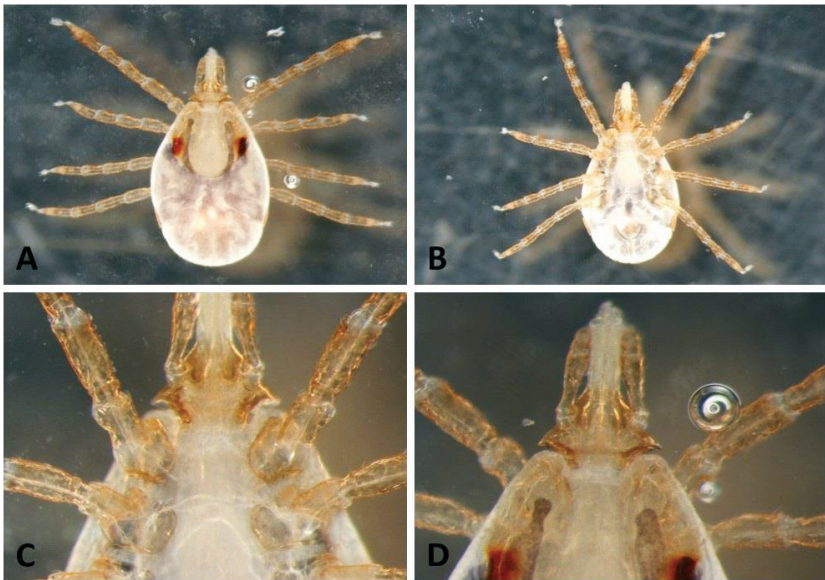


Fig. 10. *Amblyomma maculatum* nymph: A) dorsal view, B) ventral view, C) ventral close up of capitulum and coxae I and II, D) dorsal close up of capitulum and scutum.



Fig. 11. *Dermacentor variabilis* nymph: A) dorsal view, B) ventral view, C) ventral close up of capitulum and coxae I and II, D) dorsal close up of capitulum.

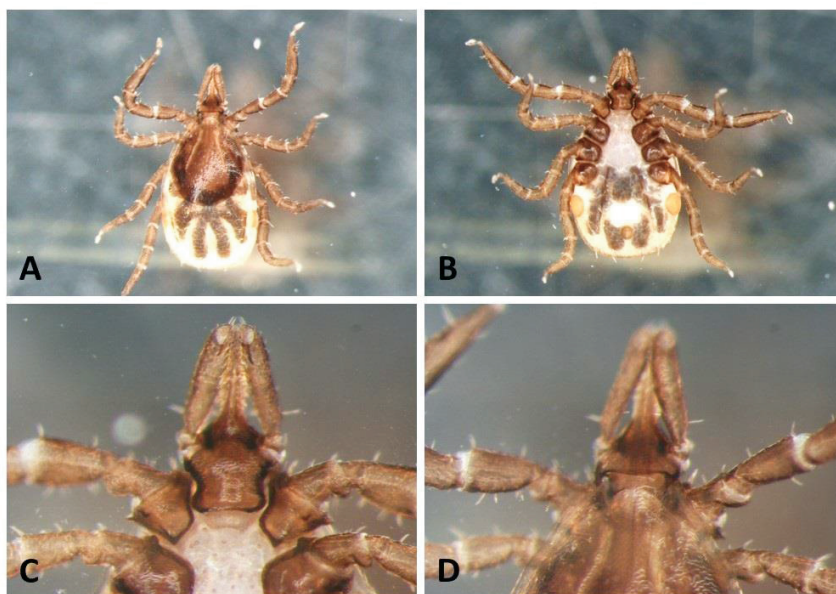


Fig. 12. *Ixodes scapularis* nymph: A) dorsal view, B) ventral view, C) ventral close up of capitulum and coxae I and II, D) dorsal close up of capitulum.

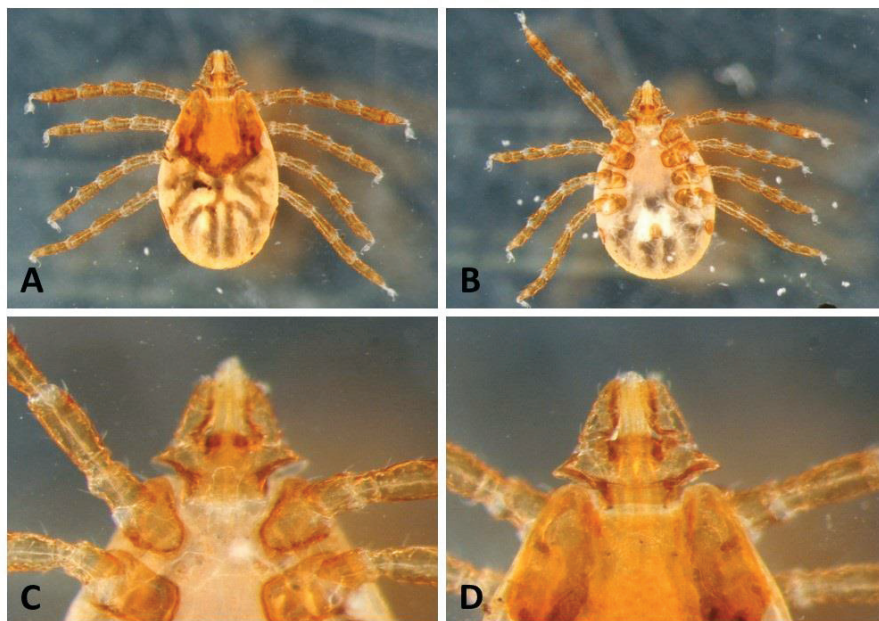


Fig. 13. *Rhipicephalus sanguineus* nymph: A) dorsal view, B) ventral view, C) ventral close up of capitulum and coxae I and II, D) dorsal close up of capitulum.

Conclusions

Research involving tick ecology and epidemiology of tick-borne infection requires proper identification of field-collected specimens. Keys and accompanying pictorial guides to the larvae and nymphs of the most common species of ixodid ticks affecting cattle and encountered in cattle pastures on the southern Great Plains are presented for the first time. Other resources currently available for identification include only SEM and slide-mounted images. This guide provides high-quality, color photographs to aid researchers and other personnel working in veterinary and public health in the identification of immature stages of these common tick vectors.

Acknowledgment

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