

# *Ixodes scapularis*, black-legged tick, deer tick

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## Brief facts

- *Ixodes scapularis* belongs to the family *Ixodidae*, or **hard-bodied ticks**, (as opposed to the *Argasidae* - **soft-bodied ticks**).
- Ticks may be classified as nest-dwelling (**nidicolous**) parasites or as field-dwelling (**non-nidicolous**) parasites. *Ixodes scapularis* is a non-nidicolous tick.
- The species is distributed in the eastern and northern Midwestern United States and southeastern Canada.
- Adult ticks are about 3 mm and dark brown to black in color. Adults exhibit sexual dimorphism.
- The tick is a vector for several bacterial, rickettsial, viral and protozoan diseases of animals and humans. Important tick-borne diseases include Lyme disease (*Borrelia burgdorferi*), tick-borne relapsing fever, babesiosis (*Babesia microti*), Rocky Mountain spotted fever, and many others. Apart of pathogen transmission, tick bites can cause paralysis, toxicoses, and severe allergic reaction.
- Various laboratories are currently focused on the genomic and proteomic analysis of ticks and in particular, tick salivary gland proteins (the **sialome**) as a source of targets for vaccine development. Tick research offers an opportunity to study parasite/host/pathogen relationships.

## Importance of feeding habits of the vector

- Changing hosts during its life cycle facilitates acquisition of pathogens that can be transmitted to the next host. In many instances, pathogens acquired by larval feedings are passed to the subsequent life stages (so-called, **trans-stadial transmission**). *Ixodes scapularis* is known to be able to feed on more than 100 hosts in North America (at least 52 species of mammals, 60 species of birds, and 8

species of reptiles).

- The relatively slow feeding process and the firm attachment to the host enhance dispersal of the ticks as the host moves about in the environment. For example, *Ixodes scapularis* can travel for miles while feeding on birds. Some ticks are carried between continents in this manner. The slow feeding is associated with the need to produce new cuticle to accommodate the ever increasing volume of blood.
- Tick's saliva, metabolites, and excesses of fluids are secreted back to the host. During this process pathogens are transmitted to the host. Upon completion of feeding, the female can weigh 100 to 120 times its original weight, but because so much water is secreted back to the host, the total volume of blood ingested may be two to three times the amount calculated from post-feeding weight.

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## Feeding stages

1. **Appetence (hunger)** - waiting for or actively seeking a host. *Ixodes scapularis* congregate along animal trails, rest on vegetation and wait for appropriate hosts to brush past them.
2. **Engagement** - adherence to the host's fur, feathers, or skin.
3. **Exploration** - searching the host's external surface for a suitable attachment site.
4. **Penetration** - insertion of the mouthparts into the host's skin, "tasting the host".
5. **Attachment** - feeding site is established
6. **Ingestion** - start of active feeding. There is little if any increase in the parasite's weight during first 24 hours of feeding.
7. **Engorgement (satiation)** - partial or complete blood meals taken. Tick's weight increases gradually and slowly over several days, followed by a rapid increase on the last day. It is believed that high dosages of *Borrelia burgdorferi* (Lyme disease) are transferred during the later period of feeding.
8. **Detachment** - withdrawal of mouthparts.
9. **Disengagement** - tick drops off of the host to complete its current life stage using obtained nutrients.

## Life cycle

*I. scapularis* is a three-host tick; the larva, nymph and adult stages each feed on separate hosts. Although the life cycle of the tick species is relatively long in the wild (2 years), one generation can be produced in the lab within 9 to 12 months.

- o egg

beginning in May, engorged adult females typically lay between 1000 to 3000 eggs on the forest floor at the site where they detached from their hosts

- o larval

eggs hatch into tiny six-legged larvae; peak of larval activity occurs in August; larvae attach and feed on a wide variety of mammals and birds, primarily on white-footed mice after feeding for three to five days, engorged larvae drop from the host to the ground where they overwinter

- o molting

in May, larvae molt into nymphs

- o nymph

nymphs feed on a variety of hosts for three to four days; engorged nymphs detach and drop to the forest floor where they molt into the adult stage, which becomes active in October; human exposure to blacklegged ticks is greatest during the summer months when high nymphal and human outdoor activity coincide

- o adult

adult ticks remain active through the winter on days when the ground and ambient temperatures are above freezing; adult female ticks feed for five to seven days while the male tick feeds only sparingly, if at all; adult ticks feed on large mammals, primarily upon white-tailed deer

## Tissue

- o tick

- capitulum

or gnathosoma

- mouthparts

- palps

2 four-segmented palps, each of which has numerous chemosensory organs; the palps

are pressed against the skin during the feeding

- **chelicerae**

two sclerotized, 2-segmented tubular chelicerae extends from the basis capituli and are located medially to the palps

- **digits**

movable sharp digits are located laterally and are used to cut the skin

- **hypostome**

the organ is used as food canal and as holdfast organ; the size and shape of the hypostome and the arrangement of denticles (teeth) on its surface are important for species identification

- **body**

or **idiosoma**

- **legs**

6 (nymph) or 8 legs (adult) are attached to the body

- **central nervous system** MeSH

in ticks called **synganglia**

## Major Ixodes-born diseases in United States

Disease	Causative organism	Organism description	Disease description	Region
Lyme disease	<i>Borrelia burgdorferi</i>	Bacteria (spirochete); invade blood and tissues; white-footed mouse is believed to be a natural reservoir	erythematous lesion at site of bite; fibromyalgia, malaise, fatigue, arthritis, neurologic manifestations (abnormalities in mood, memory, and sleep )	Connecticut, Midwest
Babesiosis	<i>Babesia microti</i>	Protozoa	malaria-like blood parasitic disease; can be asymptomatic (especially in people with healthy spleen); mild to severe fevers and anemia	New York, Massachusetts, Minnesota
Anaplasmosis	<i>Anaplasma phagocytophilum</i> ( <i>Ehrlichia phagocytophilum</i> )	obligate intracellular gram-negative bacteria, rickettsia, infects neutrophils	fever, severe headache, muscle aches (myalgia), chills and shaking, similar to the symptoms of influenza, can be fatal	California, Colorado, Connecticut, Florida, New Jersey, New York, Maryland, Minnesota, Wisconsin

## References

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- Major topic "ticks": free full text articles in PubMed

## Websites

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