

Tick

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Ticks are small arachnids, part of the order Parasitiformes. Along with mites, they constitute the subclass Acari. Ticks are ectoparasites (external parasites), living by feeding on the blood of mammals, birds, and sometimes reptiles and amphibians. Ticks had evolved by the Cretaceous period, the most common form of fossil being immersed in amber.

Almost all ticks belong to one of two major families, the Ixodidae or hard ticks, which are difficult to crush, and the Argasidae or soft ticks. Adults have ovoid or pear-shaped bodies which become engorged with blood when they feed, and eight legs. As well as having a hard shield on their dorsal surfaces, hard ticks have a beak-like structure at the front containing the mouthparts whereas soft ticks have their mouthparts on the underside of the body. Both families locate a potential host by odour or from changes in the environment. Because of their habits of ingesting blood, ticks are vectors of at least twelve diseases that affect humans and other animals.

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Taxonomy and phylogeny



Fossilised tick in Dominican amber

Fossilized ticks are known from the Cretaceous onwards, most commonly in amber. They most likely originated in the Cretaceous (65 to 146 million years ago), with most of the evolution and dispersal occurring during the Tertiary (5 to 65 million years ago).^[1] The oldest example is an argasid bird tick from Cretaceous New Jersey amber. The younger Baltic and Dominican ambers have also yielded examples which can be placed in living genera.^[2]

There are three families of ticks. The two large ones are the sister families of Ixodidae (hard ticks) and Argasidae (soft ticks). The third is Nuttalliellidae, named for the bacteriologist George Nuttall. It comprises a single species, *Nuttalliella namaqua*,^{[3][4]} and is the most basal lineage.

Ticks are closely related to the mites, within the subclass Acarina.^{[5][6][7]} rDNA analysis suggests that the Ixodidae are a clade, but that the Argasidae may be paraphyletic.^{[8][9]}

The Ixodidae contains over 700 species of hard ticks with a scutum or hard shield, which the Argasidae lack. The Argasidae contains about 200 species; the genera accepted as of 2010 are *Antricola*, *Argas*, *Nothoaspis*, *Ornithodoros* and *Otobius*.^[3] They have no scutum, and the capitulum is concealed beneath the body.^[10] The family Nuttalliellidae contains only a single species, *Nuttalliella namaqua*, a tick found in southern Africa from Tanzania to Namibia and South Africa.^{[3][11]}

The phylogeny of the Ixodida within the Acari is shown in the cladogram, based on a 2014 maximum parsimony study of amino acid sequences of twelve mitochondrial proteins. The Argasidae appear monophyletic in this study.^[12]

Tick



Ixodes ricinus, a hard tick

Scientific classification

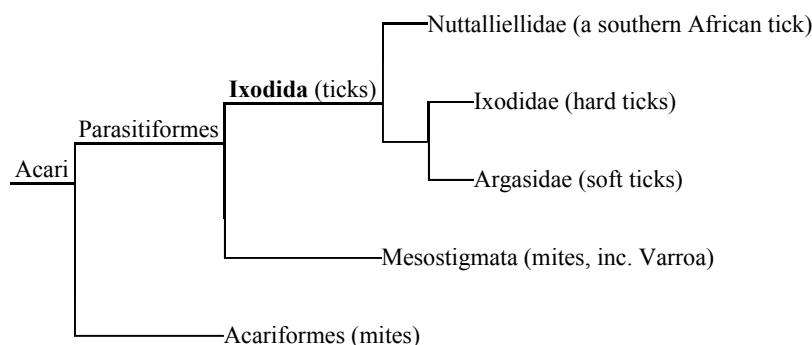
Kingdom: Animalia
 Phylum: Arthropoda
 Class: Arachnida
 Subclass: Acari
 Superorder: Parasitiformes
 Order: **Metastigmata=Ixodida**
 Superfamily: **Ixodoidea**
 Leach, 1815

Families

- Ixodidae – hard ticks
- Argasidae – soft ticks
- Nuttalliellidae

Diversity

18 genera, c. 900 species



Range and habitat

Tick species are widely distributed around the world,^[13] but they tend to flourish more in countries with warm, humid climates, because they require a certain amount of moisture in the air to undergo metamorphosis, and because low temperatures inhibit their development from egg to larva.^[14] Ticks of domestic animals are especially common and varied in tropical countries, where they cause considerable harm to livestock by transmission of many species of pathogens and also causing direct parasitic damage.

For an ecosystem to support ticks, it must satisfy two requirements: the population density of host species in the area must be high enough, and humidity must be high enough for ticks to remain hydrated.^[15] Due to their role in transmitting Lyme disease, ixodid ticks, particularly *I. scapularis*, have been studied using geographic information systems (GIS), to develop predictive models for ideal tick habitats. According to these studies, certain features of a given microclimate – such as sandy soil, hardwood trees, rivers, and the presence of deer – were determined to be good predictors of dense tick populations.^[16]

Anatomy and physiology



A hard-bodied tick of the family Ixodidae, the lone star tick

Ticks, like mites, are arthropods that have secondarily lost the segmentation of the abdomen, which has subsequently fused with the cephalothorax.^[17] The tagmata of other Chelicera have been replaced by two new body sections, the anterior *capitulum* (or *gnathosoma*), which is retractable and contains the mouthparts, and the posterior *idiosoma* which contains the legs, digestive tract, and reproductive organs.^[15] The capitulum is a feeding structure with mouthparts adapted for piercing skin and sucking blood; it is only the front of the head and contains neither the brain nor the eyes.^[17] The ventral side of the idiosoma bears sclerites, and the gonopore is located between the fourth pair of legs. In the absence of segmentation, the positioning of the eyes, limbs and gonopore on the idiosoma provide the only locational guidance.^[17]

Larval ticks hatch with six legs, acquiring the other two after a blood meal and molting into the nymph stage.^[18] In the nymphal and adult stages, ticks have eight legs, each of which has seven segments and is tipped with a pair of claws. The legs are sometimes ornamented and usually bear sensory or tactile hairs.^[19] In addition to being used for locomotion, the tarsus of leg I contains a unique sensory structure, Haller's organ, which can detect odors and chemicals emanating from the host, as well as sensing changes in temperature and air currents.^{[20][21][22]} When not being used for walking, the legs remain tightly folded against the body.^{[20][21]}

In nymphs and adults of the family Ixodidae, the *capitulum* is prominent and projects forwards from the body, a feature not present in the Argasidae. The eyes are close to the sides of the scutum, and the large spiracles are located just behind the coxae of the fourth pair of legs.^[10] The hard, protective scutellum, characteristic of this family, covers the whole dorsal surface in males but is restricted to a small, shield-like structure behind the capitulum in females and nymphs.^[23] They differ, too, in their life cycle; Ixodidae that attach to a host bite painlessly and generally unnoticed, and they remain in place until they engorge and are ready to change their skin; this process may take days or weeks. Some species drop off the host to moult in a safe place, whereas others remain on the same host and only drop off once they are ready to lay their eggs.^[24]

The body of the soft tick, family Argasidae, is pear-shaped or oval with a rounded anterior portion. The mouthparts cannot be seen from above as they are on the ventral surface. The cuticle is leathery; there is often a centrally positioned dorsal plate, with ridges which project slightly above the surrounding surface, but there is no decoration. A pattern of small, circular depressed areas show where muscles are attached to the interior of the integument. The eyes are on the sides of the body, the spiracles open between legs 3 and 4, and males and females only differ in the structure of the genital pore.^[25]



A soft-bodied tick of the family Argasidae, beside eggs it has just laid

The Argasidae also differ from the Ixodidae in their habits and ecology. Many of them feed primarily on birds, though some *Ornithodoros*, for example, feed on mammals. Both groups feed rapidly, typically biting painfully and drinking their fill within minutes. None of the species stick to the host in the way that hard ticks do. Unlike the Ixodidae that have no fixed dwelling place except on the host, they live in sand or in crevices near animal dens or nests, or in human dwellings where they come out nightly to attack roosting birds, or emerge when they detect carbon dioxide in the breath of their hosts.^[16]

The Nuttalliellidae can be distinguished from both ixodid and argasid ticks by a combination of a projecting capitulum at the front and a soft, leathery skin. Other distinguish characteristics include the position of the stigmata, the lack of setae, the strongly corrugated integument, and the form of the fenestrated plates.^{[26][27]}

Diet and feeding



A questing tick, fingers for scale

Ticks satisfy all of their nutritional requirements as ectoparasites, feeding on a diet of blood. They are obligate hematophages, needing blood to survive and move from one stage of life to another. Ticks die if unable to find a host.^[28] This behavior evolved approximately 120 million years ago through adaptation to blood-feeding.^[29] The behavior evolved independently in the separate tick families, with differing host-tick interactions driving the evolutionary change.^[30]

Ticks extract the blood by cutting a hole in the host's epidermis, into which they insert their hypostome, and keep the blood from clotting by excreting an anticoagulant or platelet aggregation inhibitor.^{[31][32]}

Ticks find their hosts by detecting animals' breath and body odors, or by sensing body heat, moisture and vibrations. They are incapable of flying or jumping, but many tick species, particularly Ixodidae, lie in wait in a position known as "questing". While questing, ticks cling to leaves and grasses by their third and fourth pair of legs. They hold the first pair of legs outstretched, waiting to grasp and climb on to any passing host. Tick questing heights tend to be correlated with the size of the desired host; nymphs and small species tend to quest close to the ground where they may encounter small mammalian or bird hosts; adults climb higher into the vegetation where larger hosts may be encountered. Some species are hunters and lurk near places where hosts may rest. On receiving an olfactory or other stimulus, they crawl or run across the intervening surface.^[33]

Other ticks, mainly the Argasidae, are "nidicolous", finding hosts in their nests or burrows, and in caves in the case of bats. They use the same stimuli as non-nidicolous species to identify hosts, with body heat and odors often being the main factors.^[33] Some ticks attach quickly while others wander looking for thinner skin such as on the ear. Depending on the species and the life stage, preparing to feed can take from ten minutes to two hours. On locating a suitable feeding spot, the tick grasps the host's skin and cuts into the surface.^[28]

In the Ixodidae, the tick stays in place until it is completely engorged. Its weight may increase by 200 to 600 times as compared to its unfed weight. To accommodate this large expansion, its cuticle actually grows larger, and the tick may remain attached for days or weeks, depending on species, life stage and host.^[34] In the Argasidae, the tick's cuticle expands to accommodate the fluid ingested but does not grow, the weight of the tick increasing five to tenfold over the unfed state. The tick then drops off the host and typically remains in the nest or burrow until its host returns to provide its next meal.^[25]

Life cycle

Both ixodid and argasid ticks have four lifecycle stages: egg, larva, nymph, and adult.^[35]

Ixodidae

Ixodid ticks require three hosts, and their life cycle takes at least one year to complete. Up to 3,000 eggs are laid on the ground by an adult female tick. When the larvae emerge, they feed primarily on small mammals and birds. After feeding, they detach from their host and molt to nymphs on the ground, which then feed on larger hosts and molt to adults. Female adults attach to larger hosts, feed, and lay eggs, while males feed very little and occupy larger hosts primarily for mating.^[16]

Argasidae

Argasid ticks, unlike ixodid ticks, may go through several nymphal stages, requiring a meal of blood each time.^[36] Their life cycles range from months to years. The adult female argasid tick can lay a few hundred to over a thousand eggs over the course of her lifetime. Larvae feed very quickly and detach to molt into nymphs. Nymphs may go through as many as seven instars, each requiring a blood meal. Both male and female adults feed on blood, and they mate off the host. During feeding, any excess fluid is excreted by the coxal glands, a process which is unique to argasid ticks.^[16]

Relationship with humans

Despite their poor reputation among humans, ticks play an ecological role in their communities. Mites and nematodes feed on them and they are a minor nutritional resource for birds. More importantly, they carry diseases as the primary hosts of pathogens such as spirochaetes, and without their agency, the organisms could not reach their secondary hosts. The diseases caused may debilitate their victims, and the ticks may thus be assisting in controlling animal populations and preventing overgrazing.^[37]

Certain infectious diseases of humans and other animals can be transmitted by ticks, the species of tick involved tending to be those with a wide host range. Spread of disease in this way is enhanced by the extended time during which a tick remains attached, during which time the mobile host can travel the globe, or migrate, in the case of bird hosts, across the sea. The infective agents can be present not only in the adult tick but also in the eggs produced plentifully by the females. Many tick species have extended their ranges as a result of the movements of people, their pets and livestock. With increasing participation in outdoor activities such as wilderness hikes, more people and their dogs may find themselves exposed to attack.^[38]

Tick-borne disease

Tick-borne illnesses are caused by infection with a variety of pathogens, including *Rickettsia* and other types of bacteria, viruses, and protozoa. Because ticks can harbor more than one disease-causing agent, patients can be infected with more than one pathogen at the same time, compounding the difficulty in diagnosis and treatment. Major tick-borne diseases include Lyme disease, Q fever (rare; more commonly transmitted by infected excreta),^[39] Colorado tick fever, Rocky Mountain spotted fever, African tick bite fever, Crimean Congo hemorrhagic fever, tularemia, tick-borne relapsing fever, babesiosis, ehrlichiosis, and tick-borne meningoencephalitis, as well as bovine anaplasmosis and probably the Heartland virus.^[40] Some species, notably the Australian paralysis tick, are also intrinsically venomous and can cause tick paralysis. Eggs can become infected with pathogens inside a female tick's ovaries, in which case the larval ticks are infectious immediately at hatching, before feeding on their first host.^[36]

Not all ticks in an infective area are infected with pathogens, and both attachment of the tick and a long-feeding session seem to be necessary for transmission of these diseases to take place.^[38] Thus tick bites often do not lead to infection, especially if the ticks are removed within 36 hours.^[41] Adult ticks can be removed with fine-tipped tweezers or proprietary tick removal tools, disinfecting the wound.^{[42][43][44]} It is also possible to freeze them off with a medical wart remover.^[45] If the tick's head and mouthparts break off during removal, they can be removed with tweezers like a splinter.^[46]

Population control measures

With the possible exception of widespread DDT use in the Soviet Union, attempts to limit the population or distribution of disease-causing ticks have been quite unsuccessful.^[47] The parasitoid chalcid wasp *Ixodiphagus hookeri* has been investigated for its potential to control tick populations. It lays its eggs into ticks;^{[48][a]} the hatching wasps kill their hosts.^[49] Another natural form of control for ticks is the guineafowl, a bird species which consumes mass quantities of ticks.^[50]

Topical tick medicines may be toxic to animals and humans. The synthetic pyrethroid insecticide Phenothrin in combination with the hormone analogue methoprene was a popular topical flea and tick therapy for felines. Phenothrin kills adult ticks, while methoprene kills eggs. However, some products have been withdrawn, while others are known to cause adverse reactions.^[51]



A sign in a Lithuanian forest warning of high risk of tick-borne encephalitis infection

See also

- Flea
- Mosquito
- Parasitology
- Vampire bat
- Ticks of domestic animals
- Parasitic Insects, Mites and Ticks: Genera of Medical and Veterinary Importance



Researcher collecting ticks using the "tick dragging" method

(https://en.wikibooks.org/wiki/Parasitic_Insects,_Mites_and_Ticks:_Genera_of_Medical_and_Veterinary_Importance/Hard_ticks) Wikibooks

Notes

- Micrographs of the wasp laying eggs into a tick, and the hole by which the young wasps emerge from the tick's dead body, are available in Plantard et al 2012.^[48]

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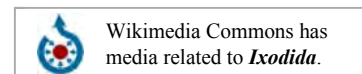
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