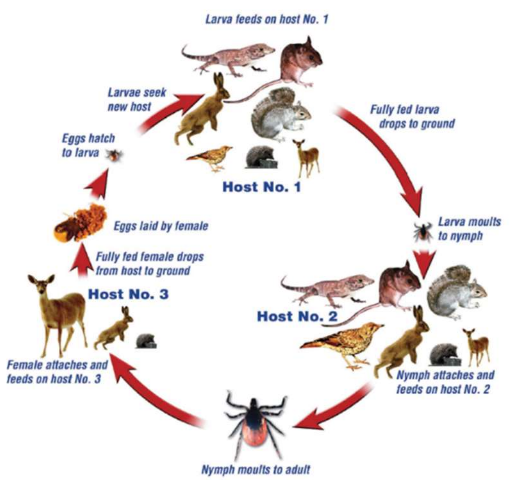
‘You’re really ticking me off!’- The wild world and dangerous diseases of the humble tick
By Jesse Jankowski, based on a presentation by Nick Booster
February 25, 2018

If you enjoy spending time outdoors, or at least have a curious pet or child that rolls around in the forest, you’ve probably crossed paths with a tick now and then. But while most people see these creatures as bloodthirsty parasites, sneaky freeloaders, or just plain pests, there is much more to the tick than meets the eye. They have evolved over millions of years to feed on a wide variety of animals and can act as efficient carriers for several infectious diseases. Despite this, scientific knowledge of tick ecology is limited and there is continued disagreement about how to characterize the ways they carry bacteria.

Surprisingly, ticks are not technically insects; they diverged from them about 600 million years ago and are part of the eight-legged *arachnid* class. Compare that to humans’ divergence about 800 million years ago, and it’s easy to see that ticks have had time to diversify their food network and adapt to feed on many different hosts. Most ticks live about two years and go through three to eight growth cycles, including hatching, moulting, maturing, and egg laying. Each cycle is preceded by a blood feeding on a new host. These hosts come in many sizes and cover a variety of species. Few other parasites would be so inclined to consider rodents, lizards, birds, large mammals, and humans all suitable meals, but ticks will sink their teeth into nearly any animal that crosses their path.



The lifecycle and many hosts of the tick.

There are two main types of ticks: hard-bodied and soft-bodied. Hard ticks, who live on their hosts and feed for extended periods, are likely more familiar to outdoor enthusiasts. Though humans might notice these ticks and quickly remove them, other animals act as incubators for immature ticks who feed on them before dropping to the ground and advancing to their next growth stage. Soft-bodied ticks are more mobile and difficult for a host to notice, as they feed for short periods of about 20 minutes and live close to their hosts in their home. This might include bird nests, rodent burrows, and even human dwellings like cabins which are also hosting rodent guests.


A hard tick (left) and a soft tick (right).

The diverse feeding networks of ticks, both hard and soft-bodied, make them well-suited to act as carriers of disease between these species, or what scientists call “vectors.” When a tick feeds on a rodent or deer that carries a disease, that bacteria colonizes its digestive “midgut.” After a period of about 10-14 days, the bacteria move to the tick’s salivary glands and can be transferred into the bloodstream of the tick’s next host. There it replicates for a period of three to ten days until the new host is fully infected. In the Eastern United States, hard ticks are well-known to carry Lyme Disease from small mammals or birds to humans. Lyme disease is a spirochete bacteria, which looks like microscopic twisted pasta noodles. A similar spirochete disease carried by soft ticks in the Western U.S. is Relapsing Tick-Borne Fever. Its symptoms include fever, headache, and joint pain about five to fifteen days after tick exposure. Like an impersonator who only works on the weekend, the fever changes its appearance to the immune system and “relapses” for periods of three days, followed by seven days off. Luckily it can be treated with tetracycline antibiotics, but it is important to recognize the signs of Relapsing Tick-Borne Fever rather than mistaking it for a normal sickness. There have been two known outbreaks of Relapsing Tick-Borne Fever in the Grand Canyon in 1973 and 1990.

Relapsing Tick-Borne Fever cases in the Western U.S.

Scientists have tried to characterize the ways in which ticks transmit bacteria like Lyme Disease and Relapsing Tick-Borne Fever to humans, but unfortunately there is not great agreement about these relationships. The traditional Amplification Effect theory, championed by the University of California Santa Cruz and Santa Barbara, states that a diverse host network like that of the tick will cause a disease to spread more rapidly as many species are infected. However, scientists at the Cary Institute of Ecosystem Studies in New York have introduced the contradictory Dilution Effect theory. It acknowledges that some hosts (like mice) are better carriers for a disease because they allow it to spread to new ticks. Other hosts (like possums and humans) do not transmit the disease as easily, so as a result the disease tends to occur less frequently. Though these theories are only conceptual models which help scientists think about disease transmission, it is clear that the interactions between disease vectors (ticks) and their hosts (rodents, deer, humans, etc.) are complex and warrant further study before they can help inform public policy. Regardless of the disease model, policy actions which affect or change human and animal populations to bring diseases and their carriers together in new ways or at new times may affect disease transmissions through small but mighty avenues like the tick.