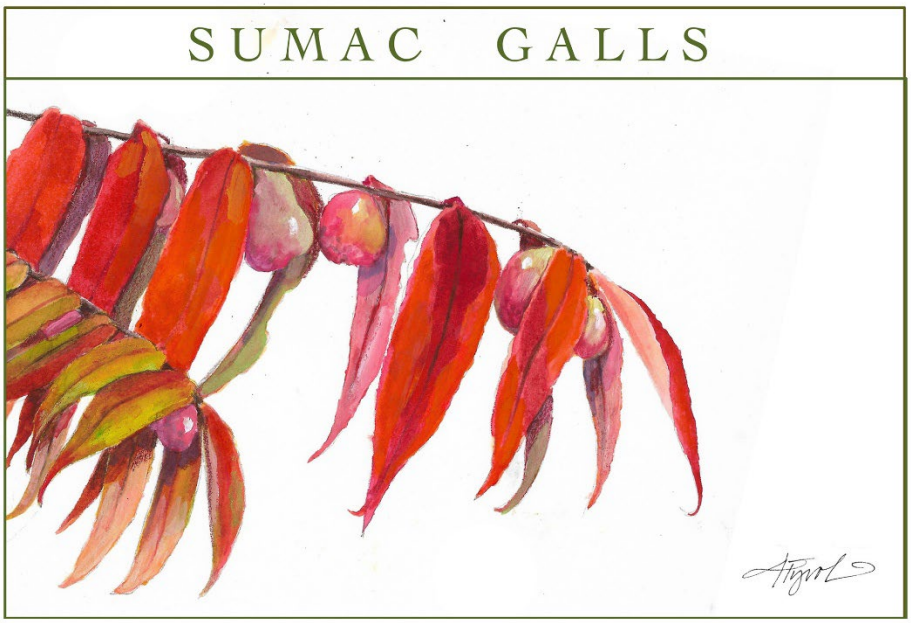
The Outside Story

Sumac Galls: An Ancient Association

By Loren Merrill



The staghorn sumac (*Rhus typhina*) is a ubiquitous shrub of human-impacted northeastern habitats. Sumac stands occur along most highways and county roads, as well as in disturbed areas and abandoned fields transitioning to shrubland. With the onset of late summer's cooler nighttime temperatures and shorter days, staghorn sumacs are among the first leafy plants to lose chlorophyll from their cells. The breakdown of this pigment triggers the transition from green foliage to yellow, orange, and red, often starting as early as mid-August. After a striking autumnal display, their rich red to burgundy-colored fruit clusters remain all winter.

But in addition to their distinct leaves and fruits, some sumac plants have another feature that turns vibrant colors: a bladderlike protrusion hanging from the underside of a leaflet. This incongruous growth is a gall, triggered by the tiny sumac gall aphid (classically presented as *Melaphis rhois*, but recent molecular work suggests it may be two or more species) hijacking the sumac's defenses as part of a complex life cycle.

The sumac's role in this story starts in the early spring when winged, asexual female aphids land on the sumac branches, deposit sexual (male and female) larvae along the stem, and promptly die. The larvae have no mouthparts and thus do not feed, but they mature in four to five days and mate. The female carries a single developing egg inside her for two to three weeks until it is ready to hatch. Then she deposits the membranous egg on a sumac twig, where the larva emerges almost immediately. This larval aphid crawls to the end of a newly unfolded leaflet and begins eating. (Eventually the aphid will develop into a wingless, asexually reproducing female called the "fundatrix" or "stem mother" – terms referring to her role as the founding member of a new colony.)

Feeding activity by the fundatrix stimulates the formation of a gall which encloses the female. The gall itself is made entirely by the plant; chemicals in the aphid's saliva trigger a process called *metaplasia*,

during which the plant cells around the aphid feeding site begin changing from typical leaflet cells into gall cells. The gall grows different tissues on the exterior and interior; the exterior wall is usually light but tough, and the interior wall may be composed of a highly nutritious layer of cells that the developing aphids feed on.

This strategy of eliciting a gall response in the host plant is far from unique – there are thousands of species of insects, arachnids, nematodes, bacteria, and fungi that induce galls – but the aphid's life cycle is perhaps a bit more unusual than many of the other gall-makers.

Following the formation of the gall (which starts off light green in color), the female completes development inside the gall and undergoes asexual reproduction, laying clonal eggs that develop into wingless females within the gall. At least three generations of aphids develop inside the gall, and sometimes several more; some galls contain thousands of aphids. Typically, in mid- to late August, the aphids in the gall (which has often turned red or pink by this time) begin producing winged females, and when a slit opens in the gall in early fall, the winged generation emerges and takes flight. They generally don't fly far; their destination is a bed of moss underneath or close to the sumac, where they again start a colony of wingless, asexually reproducing aphids that live on the moss. Subsequent generations live on the moss as well, where they can persist for a year or more. The following spring, the moss-inhabiting aphid colonies may produce a generation of winged migrants that ascend to sumac branches, starting the cycle anew.

The association between the aphid, the sumac, and the moss appears to be quite old, dating back at least 48 million years. Despite the parasitic nature of the relationship, the aphid's impact on the sumac is thought to be negligible. So, as you admire the autumn colors, keep an eye out for sumacs harboring these tiny gall-makers, and take a moment to consider this fascinating and ancient phenomenon.

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