

Manipulation of host behavior by *Leskia aurea* (Fallén) (Tachinidae)

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Host behavioral manipulation by parasites and parasitoids is a well-known phenomenon (Poulin 2013, Libersat *et al.* 2009). Popular examples include parasitic fungi, which force their insect host to climb and die in an open location from which the fungal spores will spread best to the environment, and horsehair worms that guide the host to jump into water before dying (e.g., McAuliffe 2016). Many parasitoid wasps are also known to induce behavioral changes in their host, which benefit the parasitoid development (Libersat & Gal 2013, Alford *et al.* 2016). The exact mechanisms of host manipulation are poorly known, but they are thought to be achieved by specific inhibition or activation of host neural signaling pathways by chemicals or proteins secreted by the parasite.

I would like to report here an obvious behavioral change in a lepidopteran host parasitized by a tachinid, *Leskia aurea* (Fallén) (Tachininae, Leskiini). *Leskia aurea* is widespread in Europe, although uncommon and mostly observed as single specimens. My own northernmost record is from the shore of Lake Sompio in Finnish Lapland (68.110N, 27.460E). The species parasitizes the larvae of wood boring clearwing moths (Lepidoptera: Sesiidae), apparently mainly *Synanthedon vespiformis* (L.) and *S. myopaeformis* (Borkhausen) in Central Europe (Tschorsnig 2017). In Finland, *Leskia aurea* has been reared only from *Synanthedon spheciformis* (Schiffermüller) and *S. scoliaeformis* (Borkhausen). Parasitism rates in *S. spheciformis* can reach up to 50% (Vuola & Korpla 1978), whereas *S. scoliaeformis* is attacked more rarely (Vuola & Korpla 1977).

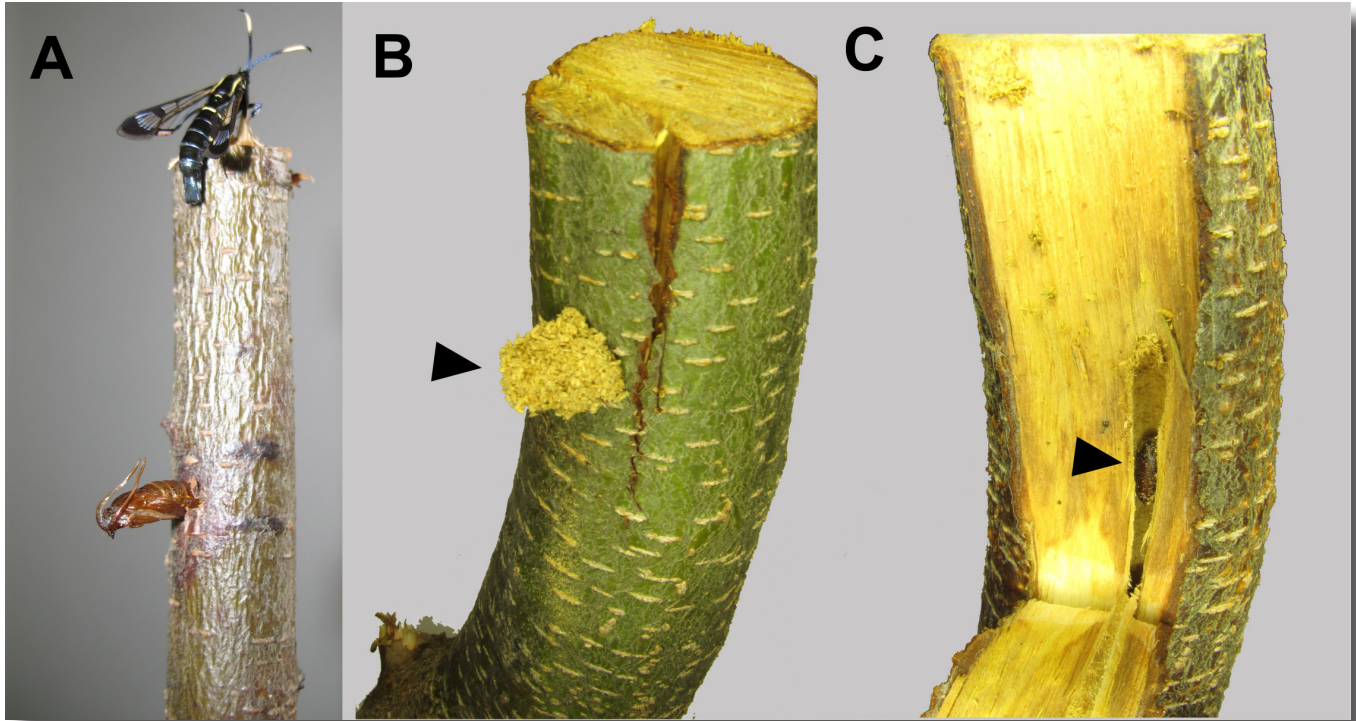


Figure 1. *Synanthedon spheciformis* clearwing and *Leskia aurea* reared from alder (*Alnus incana*) saplings. **A.** Newly emerged male *S. spheciformis* with the empty pupa halfway through the gallery exit. **B.** Larvae of *S. spheciformis* that are parasitized by *L. aurea* open the gallery exit and push out large quantities of frass mixed with silk (see arrow). **C.** The tachinid consumes the host larva completely and pupates close to the opening (see arrow). (Photos by J. Pohjoismäki.)

To the best of my knowledge, *Leskia aurea* is not only a rare example of host manipulation by tachinids in general, but also a particular example where parasitoid influence on host behavior is host specific. As the host hormones are likely to influence also the timing of the parasitoid maturation, the difference between the two hosts could be in the events preceding pupation. Notably, the main developmental difference between the two host species is that unlike *S. spheciformis*, *S. scoliaeformis* spins a cocoon. *Leskia aurea* larva could, for example, measure the host ecdysone hormone levels to decide when to kill and consume the host prior to the last molt. This activation of the parasitoid could also drive the behavioral phenotype in the host and if the host is enclosed within a cocoon, then the behavioral change cannot manifest itself. It makes intuitive sense that the behavioral phenotype in which the host larva opens the gallery exit would have an evolutionary benefit for *Leskia aurea*, by reducing the risk of the fly being trapped within the host gallery. This might also explain the higher parasitism rates in *S. spheciformis* than in *S. scoliaeformis*. These observations underscore the importance of rearing records and the basic understanding of the host biology in tachinid research.

My own records of *L. aurea* are solely from *S. spheciformis* (Figs. 1, 2). The moth larvae infest alder (*Alnus incana* (L.)) or less frequently birch (*Betula* spp.) saplings and young trees of up to 50 mm in diameter. The host plants typically grow on warm sandy soil or in otherwise barren landscapes and the main requirement seems to be that grass or other vegetation should not cover the base of the sapling. The presence of the moth larva can be detected from the extrusion of frass from the root base. Prior to pupation in late May, the full-grown larva will make an emergence tunnel, ending at 10–30 cm from the root base. The larva leaves intact bark to cover the exit, which is completely inconspicuous before the emerging moth breaks the cover, leaving the empty pupa characteristically lodged in the opening (Fig. 1A). In contrast, moth larvae parasitized by *Leskia aurea* open the exit tunnel through the bark and produce a considerable quantity of fine frass mixed with silk around the opening (Fig. 1B) (Vuola & Korpla 1978). Soon afterwards the parasitoid will kill the host and consume it completely before pupating in the host gallery a few centimeters away from the exit opening (Fig. 1C). The behavior of the parasitized larva appears to be highly typical and can be used as a diagnostic feature of *Leskia aurea* parasitism in *S. spheciformis*.

Although it seems straightforward to assume that *Leskia aurea* manipulates the larva of *S. spheciformis* to open an exit for it, the same cannot be said for parasitized larvae of the related species, *S. scoliaeformis*. *Synanthedon scoliaeformis* lives under the bark of full-grown birch trees, pupating in a cocoon under the bark. Larvae of this species parasitized by *L. aurea* spin a normal cocoon and the parasitoid pupates within this after consuming the fully grown host larva. Although I have not reared *S. scoliaeformis* myself, this behavior has been described by Vuola & Korpla (1977) and I can verify the identification of the tachinid involved. I have examined several specimens of *L. aurea* reared from *S. scoliaeformis* that are preserved with the host cocoons and empty puparia. One such series is in the collection of the Tampere Natural History Museum, Finland.



Figure 2. An adult *Leskia aurea* reared from *Synanthedon spheciformis* and recently emerged from its puparium. (Photo by J. Pohjoismäki.)

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