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## Persistence of Transported Lichen at a Hummingbird Nest Site

Gary R. Graves<sup>1,2,\*</sup> and Manuela Dal Forno<sup>3</sup>

**Abstract** - *Archilochus colubris* (Ruby-throated Hummingbird) invariably decorate the exterior surface of their nests with living foliose lichen. Lichen fragments may be carried considerable distances, but it is unknown whether transported thalli survive at nest sites. Here we report the multi-year persistence of a transported thallus of *Myelochroa aurulenta* (Powdery Axil-bristle Lichen) at a hummingbird nest site. Our observation suggests that hummingbirds may be important dispersal agents for foliose lichens.

### Introduction

Avian transport of lichen is amply documented by a voluminous literature on nest building (Bent 1940; Hansell 1996, 2000; Richardson 1974; Richardson and Young 1977), but the extent to which birds may be biologically important dispersal agents of lichens has been sparingly addressed (Bailey and James 1979, Lewis et al. 2014). Many species of hummingbirds adorn the surface of their nests with foliose lichens (Bent 1940, Schuchmann 1999). Lichen-ornamented nests are thought to mimic knots or swellings on tree branches (Collias and Collias 1984, Hansell 1996). Pale-colored lichen could also confer crypsis by making the nests appear to blend into the background. Lichen use appears invariant in *Archilochus colubris* (L.) (Ruby-throated Hummingbird), the only breeding hummingbird in eastern North America (Audubon 1835, Wilson 1828). Every detailed nest description published during the past 2 centuries has mentioned lichen ornamentation, e.g.:

“The outward coat is formed of small pieces of a species of bluish grey lichen that vegetates on old trees and fences, thickly glued on with the saliva of the bird, giving firmness and consistency to the whole, as well as keeping out moisture ... The base of the nest is continued round the stem of the branch, to which it closely adheres; and, when viewed from below, appears a mere mossy knot or accidental protuberance.” (Wilson 1828)

Although it is now recognized that lichen, bud scales, flower pappi, and other plant materials are bound with spider silk rather than saliva (Saunders 1929, Tyler 1940), Wilson’s description was otherwise accurate. Several species of foliose lichens of eastern North America have pale greenish-gray or gray thalli with brown

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or black ventral (lower) surfaces (Brodo et al. 2001). Female hummingbirds prise lichen fragments from bark or wood substrates, carry them to nest sites, and carefully arrange them on the exterior surfaces of the nest with the pale (upper) surfaces of the thalli facing outward. This arrangement places rhizines, the root-like attachment structures on the ventral surfaces of lichen thalli, in direct contact with the nest matrix and bark of the supporting branch. To date, only a single peer-reviewed paper has addressed the taxonomic identity of lichens used as hummingbird nest material (McCormac and Showman 2009–2010). Those authors identified 5 species of foliose lichen in a collection of 11 Ruby-throated Hummingbird nests collected in Ohio: *Parmelia sulcata* Taylor, *Punctelia* sp., *Flavoparmelia caperata* (L.) Hale, *Parmotrema* sp., and *Myelochroa aurulenta* (Tuck.) Elix & Hale.

Most breeding populations of Ruby-throated Hummingbirds are believed to be double-brooded, building 2 nests each breeding season, although nests may occasionally be used twice (Tyler 1940, Weidensaul et al. 2013). Nests usually fall apart or are blown down between breeding seasons. Until our study, it was unknown whether residual lichen fragments remain attached to the nest substrate, reestablish rhizine attachments, or grow and survive at nest sites for more than a few months.

### Methods and Results

We monitored a hummingbird nest during incubation and brooding from 31 July through 18 August 2014 in a suburban yard in Fairfax County, VA (38°46.3'N, 77°5.7'W; Graves 2014). The lichen-ornamented nest (Fig. 1) was built ~9 m above



Figure 1. Incubating *Archilochus colubris* (Ruby-throated Hummingbird) photographed on 5 August 2014. The nest is bound to the branch by spider or caterpillar silk. Lichen thalli are attached to the exterior of the nest including the underside of the supporting branch.

ground level on a thin, sloping branch in the subcanopy of a mature *Quercus alba* L. (White Oak). We observed the female hummingbird collecting flakes of lichen from the bark of an oak about 40 m from the nest site (Graves 2014) and spider silk from a nearby *Lagerstroemia indica* L. (Crapemyrtle). After the nestlings had fledged, we monitored the nest over the following winter to determine its fate. The slender supporting branch (13 mm diameter) died during the winter of 2014–2015. On 10 July 2015, we mounted the branch and nest remnant on a wooden support 3.5 m above ground where it would receive 4–6 h of direct sunlight each day. We used the hatching date (10 August 2014) as the zero day in calculating the persistence time of nest lichen.

We examined and photographed the nest on 28 December 2015 (506 d after hatching) [??]. It had eroded significantly and was reduced to compact pads of plant debris, bud scales, and lichen fragments bound by spider silk to the sides of the supporting branch (Fig. 2). Additional flakes of lichen were attached by silk to the



Figure 2. Decomposed nest on 28 December 2015 (506 d after hatching). Upper side of branch (left); lower side (right). Several lichen thalli are bound to the lower side of the branch with spider or caterpillar silk. Scale bar = 10 mm.

lower surface of the branch immediately below the base of the nest. We observed no other foliose lichen on the supporting branch or on thin branches of similar diameter on the nest tree.

Our observations terminated on 31 May 2017 (1026 d after hatching) when we discovered that a squirrel had knocked the branch off the supporting mount sometime during the previous month. We recovered the branch from the interior of a dense growth of garden flowers. Most of the lichen and binding silk that had been present on the nest substrate during the winter of 2016–2017 had disappeared. The remains of the largest lichen fragment visible in the righthand photograph in Fig. 2 were tenuously attached by 2 rhizines to the bark on the lower side of the branch, although we could not be certain whether the rhizines were bound by silk or had actually fastened to the bark. We subsampled this fragment for DNA extraction followed by fungal barcoding (Schoch et al. 2012).

The ITS region of nuclear DNA was Sanger-sequenced in the Laboratory for Analytical Biology (LAB) at the National Museum of Natural History (Washington, DC) following previously published protocols (Dal-Forno et al. 2013) and utilizing the primers ITS1F (Gardes and Bruns 1993) and ITS4 (White et al. 1990). A BLAST search of the contig of the 2 generated sequences in GenBank (<http://blast.ncbi.nlm.nih.gov>) revealed the sequence to be identical to that of *Myelochroa aurulenta* (GenBank # JQ301701), which occurs widely on the bark of deciduous trees in eastern North America from North Carolina to New York (Brodo et al. 2001). Ours is the second record of *M. aurulenta* in the nest material of the Ruby-throated Hummingbird (see McCormac and Showman 2009–2010), and the first report confirmed by DNA barcoding. The 3 lichen taxa cited by McCormac and Showman (2009–2010) at the species level, i.e., *P. sulcata*, *F. caperata*, and *M. aurulenta*, are commonly observed species in northern Virginia.

## Discussion

Abiotic factors appear to be the most important vehicles for dispersal of foliose lichens (Armstrong 1987, 1990; Goward 2003; Marshall 1996; Muñoz et al. 2004). Rain-splashing and running water facilitate short-distance dispersal, whereas wind enables the transport of soredia, isidia, and thallus fragments over longer distances. By comparison, the absolute volume of propagules transported by animals is likely negligible, although migratory birds are thought to be responsible for the amphitropical distributions of lichens north and south of the equator (Garrido-Benavent and Pérez-Ortega 2017).

In a broader context, our report and the records documented by McCormac and Showman (2009–2010) suggest that the Ruby-throated Hummingbird, with a global breeding population of ~20 million (Partners in Flight Science Committee 2013), may be a significant dispersal agent for foliose lichens at intermediate spatial scales (10–100 m) in eastern North America. Whereas the vast majority of wind-blown lichen fragments in forested landscapes may fall on substrates that are unsuitable for colonization (e.g., shaded leaf litter), thalli transported by hummingbirds are placed in favorable orientations with the pale upper surfaces facing outward on

compact substrates at well-lit, elevated nest sites. This observation yields a testable hypothesis—lichen species frequently used as nest material by Ruby-throated Hummingbird, and other species that habitually adorn their nests with lichen (e.g., *Polioptila caerulea* (L.) [Blue-gray Gnatcatcher]) may have relatively large geographic ranges and an enhanced ability to colonize fragmented habitats.

Finally, investigators should determine whether transported thalli retain viability at nest sites. In the case we report here, thallus fragments persisted for nearly 3 years, but we observed no growth or reproduction, so we could not be certain if they were still viable. Long-term monitoring (3–5 y) of hummingbird-nest sites and transplantation experiments (Smith 2014) using thalli salvaged from decomposing nests would shed considerable light on the role of hummingbirds as dispersal agents.

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