Lichen Composition in Blue-gray Gnatcatcher and Ruby-throated Hummingbird Nests

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Abstract

Blue-gray Gnatcatchers (*Polioptila caerulea*) and Ruby-throated Hummingbirds (*Archilochus colubris*) heavily utilize macrolichens in their nests. We are unaware of any study that documents the species and composition of lichens that are used by these two bird species. This paper reports the results of a detailed study of 26 gnatcatcher and hummingbird nests, mostly from Ohio. Lichens found on these nests were common foliose (leaf-like) species that grow on twigs and branches. Further, they all had lobe tips that were somewhat loosely attached to the bark. Tightly appressed lichen species were not found on any of the nests.

Introduction

Lichens are the product of an intricate symbiosis: composite organisms that contain both an alga (sometimes a cyanobacterium) and a fungus. The fungal component is known as a *mycobiont*, which creates the color and structure of the lichen. The algal partner is the *photobiont*, which photosynthesizes and produces food for the lichen. Lichens are not commonly used as construction material in North American bird nests (Box 1). However, two well-known and notable exceptions are the Blue-gray Gnatcatcher and the Ruby-throated Hummingbird. Because these species are common and widespread in eastern North America, including Ohio (McCormac and Kennedy 2004), their nests are often seen and described. Literature references to these two species' nests abound. Perhaps every published nest description mentions the presence of lichens as exterior shingling on gnatcatcher and hummingbird nests.

We can find no study that documents lichen species and their relative abundance in nest composition. At best, the presence of lichens in nests is described in very general terms, such as this reference for the Blue-gray Gnatcatcher: "…*decorated with large quantities of crustose lichens (Parmelia* spp., *Physcia* spp.)" (Ellison 1992). It should be noted that crustose lichens are in general crustlike and tightly appressed to their growth substrate. Sometimes crustose lichens even grow within the substrate. It is highly unlikely that crustose lichens are harvested by hummingbirds or gnatcatchers, and Ellison's reference to their use is undoubtedly in

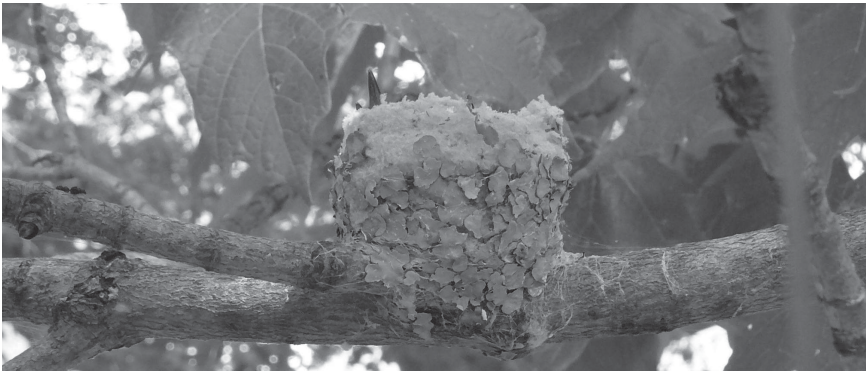


Figure 1. *Ruby-throated Hummingbird nest in Black Maple* (Acer nigrum)*, Knox County, Ohio, July 2010. Decoration of* Flavoparmelia caperata *provides camouflage. Photo by Jim McCormac*

error and underscores the issues with lichen identification.

A few bird species are known to use plant material with insecticidal properties in nest construction. Among these are Red-shouldered Hawks (*Buteo lineatus)*, which often use black cherry (*Prunus serotina)* (Dykstra *et al.* 2009). A recent study also suggests that Carolina Chickadees (*Poecile carolinensis*) might select moss species that have insecticidal properties (Andreas 2009). Some lichen species are known to produce secondary chemical metabolites that can inhibit invasion by potentially predacious small animals (Lawrey *et al.* 1999). However, chemical properties in lichens that might inhibit nest parasites are unknown, and little if any research has been done in this area.

Some evidence suggests that lichens routinely used in Blue-gray Gnatcatcher nests do not serve as parasite repellants. Gnatcatchers are well known for frequently deconstructing their nests and incorporating used material in second nesting attempts (Root 1969). There are at least three documented cases in which gnatcatchers avoided the reuse of materials in nests that were infested with mites (*Ornithonyssus sylviarum*), even though their second nesting was quite near the infected nests (Root 1969), suggesting that lichens employed in gnatcatcher nest construction are ineffective at repelling common nest parasites.

Bird species that routinely utilize lichens in nest construction probably do so primarily for purposes of camouflage. Ruby-throated Hummingbirds and Blue-gray Gnatcatchers typically site their nests on small branches of trees, often at the axil of two branches (Baicich and Harrison 2005). Arboreal habitats selected by these species are often liberally encrusted with lichens. The copious shingling of the nests with lichens clearly helps them to blend with their surroundings (Figure 1), and the nests often resemble lichen-covered knots (Figure 2).

Figure 2. *Blue-gray Gnatcatcher nest in Fraser Magnolia* (Magnolia fraseri)*, Fayette County, West Virginia, 26 April 2010. A shingling of* Parmelia sulcata *blends the nest with its surroundings. Photo by Jim McCormac.*

Materials and Methods

Fourteen Ruby-throated Hummingbird nests were examined. Nests were from the Ohio State Museum of Biodiversity, the Cleveland Museum of Natural History, Lake County Metroparks, Dawes Arboretum, Huston-Brumbaugh Nature Center, and various individuals as listed in the acknowledgments. Of these, 11 were from various locations in Ohio, two were from Pennsylvania, and one came from Indiana. All of these locations are in the heart of the eastern deciduous forest biome and do not differ appreciably in regards to vegetative habitat characteristics. All of the nests were heavily ornamented with lichens. Twelve Blue-gray Gnatcatcher nests were examined. All came from various sites within Ohio. These nests were all heavily shingled with lichen lobe tips.

Nests were examined with the aid of a dissecting microscope, and the lichens incorporated in the nests were identified to species when possible. Most of the lichens had faded to a uniform brownish color—the nest specimens varied from a few years to several decades in age—rendering color largely useless as an identification character. However, identification of most lichens was possible based on lobe size and shape, surface characteristics, the presence of cilia, and undersurface color (Showman and Flenniken 2004).

Results and Discussion

Table 1 lists the lichen species found and the estimated composition of each nest examined. Lichens identified on the nests included the following:

Hammered Shield Lichen (*Parmelia sulcata*): 23 nests (88%)
Common Greenshield Lichen (*Flavo parmelia caperata*): 15 nests (58%)
Speckled Shield Lichens (probably *Punctelia subrudecta*; may also in clude *P. rudecta*): 13 nests (50%)
Ruffle Lichen (*Parmotrema* spp.): 4 nests (2%)
Powdery Axil-bristle Lichen (*Myelo chroa aurulenta*): 1 nest (<1%)

Both gnatcatchers and hummingbirds used many of the same lichen species in their nests, but there was

Box 1. North American bird species, other than gnatcatchers and hummingbirds, that regularly use lichens in nest construction

Eastern Wood-Pewee: Lichens often figure prominently in the exterior shingling of nests of this species (McCarty 1996). We would have liked to have had a large sample size of pewee nests to analyze, but they apparently are not well represented in collections, due to the difficulty of accessing nest sites. Two nests were made available to us, both from Lake County, Ohio, collection dates unknown. In both cases, Hammered Shield Lichen, *Parmelia sulcata*, was the only species used.

Olive-sided Flycatcher: Beard lichens, genus *Usnea** (Altman and Sallabanks. 2000)

Vireo species: Most, if not all, species found in eastern North America regularly use lichens in nest building, at least sparingly. But they do not generally heavily shingle the exterior (Baicich and Harrison 2005).

Golden-crowned and **Ruby-crowned Kinglet**: Beard lichens, genus *Usnea* (Baicich and Harrison 2005).

Cedar Waxwing: May sometimes use *Usnea* lichens (Baicich and Harrison 2005). However, an exhaustive study of waxwings that examined dozens of nests in Ottawa County, Ohio, fails to mention lichens as nest material (Putnam 1949). Moss is often mentioned as a component of Cedar Waxwing nests, and bryophytes (mosses) are probably fairly often confused with lichens, especially prominently tufted species such as *Usnea*, by generalists.

Northern Parula: Reported using *Usnea* lichens (Baicich and Harrison 2005). However, this largely southern species heavily utilizes Spanish moss, *Tillandsia usneoides* (Moldenhauer *et al.* 1996). The specific epithet *usneoides* means "resembles *Usnea,*" and references to beard lichens in Northern Parula nest construction, especially in the in southern parts of its range, may actually refer to the moss.

Yellow-rumped Warbler: Unspecified lichens (Hunt and Flaspohler 1998).

Blackburnian Warbler: *Usnea* lichens (Griscom and Sprunt 1957).

Blackpoll Warbler: *Usnea* lichens (Baicich and Harrison 2005).

American Redstart: unspecified lichens (Griscom and Sprunt 1957).

Red Crossbill: *Usnea* lichens and "black tree lichen" (genus *Bryoria*) (Adkisson 1996).

White-winged Crossbill: Unspecified lichens (Benkman 1992).

Evening Grosbeak: Unspecified lichens (Gillihan and Byers 2001).

*Beard lichens in the genus *Usnea* reach peak abundance in boreal regions in North America, hence their prevalence in the nests of northern nesting bird species that typically use lichens in nest construction. In Ohio, there are nine *Usnea* species, but most have a limited distribution and none are abundant. Thus, they do not figure prominently in nest construction of Ohio species or species breeding south of the boreal forest in general.

a notable difference in the size of lichen pieces harvested by the two species. Lichen fragments incorporated into Ruby-throated Hummingbird nests averaged 3 to 4 mm in diameter; gnatcatcher fragments averaged 4 to 6 mm in diameter. In all cases, the lichen pieces are exfoliating lobe tips of the lichens—the strap-like outer portions that curl away from the bark and are the easiest portions of the lichen for the bird to grasp and remove (see Figure 3).

All of the hummingbird nest lichens share several characteristics. *Parmelia sulcata* was the most heavily utilized lichen, followed by *Flavoparmelia caperata* and *Punctelia* spp. They are all common foliose lichens, present in most Ohio counties (Showman and Flenniken 2004; Figure 4). Each lichen species grows on twigs and branches, as well as the trunks of trees, and none are tightly appressed to bark (at least the lobe tips are not). All but one of the lichen species documented in this study prefer sunny tree bark as a substrate (the exception, *Myelochroa aurulenta*, prefers shaded tree bark, but only a small quantity was incorporated into one of our study nests). Ruby-throated Hummingbirds presumably choose a nearby lichen to camouflage their nests, making horizontal branches with sufficient sunlight that are festooned with lichens good places to seek the nests.

As with Ruby-throated Hummingbird nests, *Parmelia sulcata* was a favored material for Blue-gray Gnatcatchers. *Flavoparmelia caperata* and *Parmotrema* spp. were also

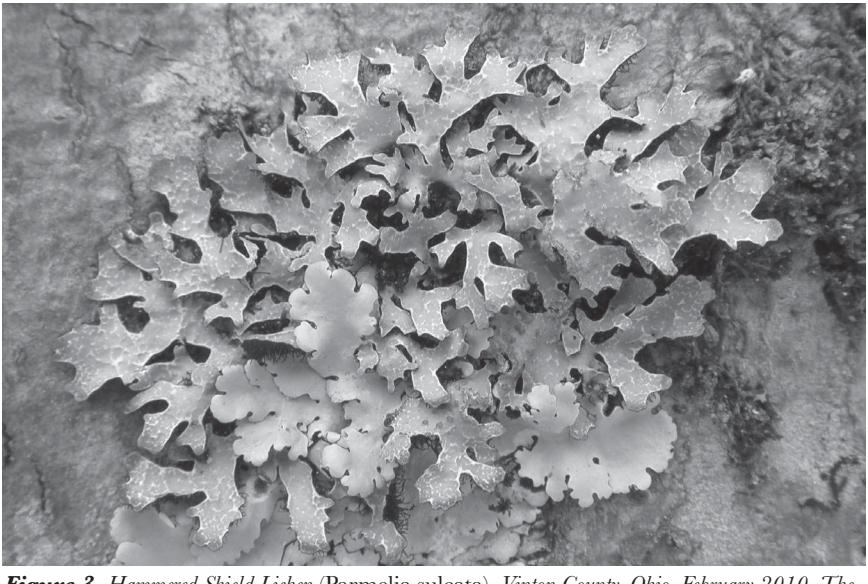


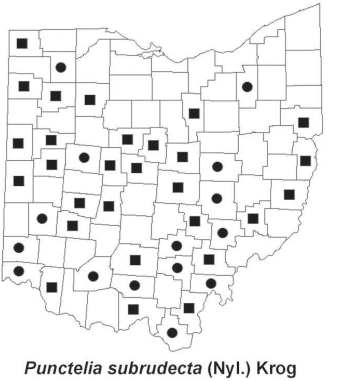
Figure 3. *Hammered Shield Lichen* (Parmelia sulcata), *Vinton County, Ohio, February 2010. The recurved lobe tips that are readily harvestable by hummingbirds and gnatcatchers are apparent. Photo by Ray Showman.*

frequently used on some nests. The latter two species have broader lobes than *Parmelia sulcata*, and the choice of these species may reflect the gnatcatcher's preference for slightly larger lichen pieces. Blue-gray Gnatcatchers tend to heavily armor the exterior of their nests with lichens, whereas hummingbirds tend to plate their nests more sparingly. Gnatcatcher nests might be considered to be *shingled* with lichens (Figure 5), whereas hummingbird nest exteriors could be considered as being *decorated* with lichens (Figure 6). It is unknown whether this preference reflects a need for appropriate camouflage of the nest, the strength of the birds' bills (presumably the stouter bill of gnatcatchers could manipulate larger, tougher pieces of lichen than hummingbirds), or other pressures.

Certain lichens are clearly favored over other readily available species. Selection is almost certainly based on morphological traits of the lichen that enable the birds to harvest them. The lichens used in nest construction are species that can be removed by the tiny bill of a hummingbird or gnatcatcher. Other common twig and branch lichens either have tiny lobes (*Physcia millegrana*) or are tightly appressed and not easily removed (*P. aipolia* and *P. stellaris*; Figure 7). The only published reference we located that mentions specific lichen species utilized in songbird nest construction was Ellison's (1992) monograph of the Blue-gray Gnatcatcher. He cites *Physcia* spp. (Rosette Lichens) as being used, but we found no evidence that any of the nine *Physcia* species

Flavoparmelia caperata **(L.) Hale**

Parmelia sulcata **Taylor**



Punctelia subrudecta **(Nyl.) Krog**

Figure 4. *Ohio distributions of the three lichen species most commonly found in this study. Maps courtesy of the Ohio Moss and Lichen Association: http://www.ohiomosslichen.org*

Nest location, date and additional information	Estimated percent of lichen species on each nest.				
	Parmelia sulcata	*Punctelia* sp.*	*Flavoparmelia caperata*	*Parmotrema* sp.	*Myelochroa aurulenta*
Ruby-throated Hummingbird:					
1. Medina C0., OH. 29 September 2009. Silver maple.	90	5			5
2. Waynesburg, PA. 29 May 1908. American beech.		95	5		
3. Green Co., PA. 04 June 1907.	45	10	45		
4. Licking Co., OH. Dawes Arboretum.	75	20	5		
5. Coshocton Co., OH 19 August 1994	60	10	30		
6. Mahoning Co., OH. 2007	50		50		
7. Delaware Co., OH.	40	10	40	10	
8. Delaware Co., OH.	50		50		
9. Delaware Co., OH	100				
10. Delaware Co., OH	100				
11. Indiana. July 1935.		80	20		
12. Summit Co., OH. November 1985. Maple.	100				
13. Portage Co., OH. 02 July 1944.	100				
14. Athens Co., OH, area.	60		40		

Table 1.

Nest location, date and additional information	Estimated percent of lichen species on each nest.				
	Parmelia sulcata	*Punctelia* sp.*	*Flavoparmelia caperata*	*Parmotrema* sp.	*Myelochroa aurulenta*
Blue-gray Gnatcatcher:					
A. Hancock Co., OH.	100				
B. Licking Co., OH. Dawes Arboretum	45	5	45	5	
C. Licking Co., OH. Granville.	30		30	40	
D. Hancock Co., OH. 20 October 1909.	95	5			
E. Summit Co., OH. 1994.	100				
F. Scioto Co., OH. 2006.		30	60	10	
G. Delaware Co., OH.	5	5	90		
H. Delaware Co., OH	80		20		
I. Summit Co., 2003 or 2004	100				
J. Summit Co., OH area	100				
K. Athens Co., OH, area.	50	50			
L. Athens Co., OH, area.	40	10	50		

Table 1, continued.

found in Ohio were used. The most common of these is *Physcia millegrana*, Mealy Rosette Lichen, which is abundant near typical gnatcatcher and hummingbird nest sites but has quite tiny lobes and is probably unacceptable as nest material.

Lichens are a critical component of Blue-gray Gnatcatcher and Ruby-throated Hummingbird nests. All 26 nests that we obtained for this study had lichens as a co-dominant component, forming an integral part of nest camouflage. Of the 223 macrolichen species known from Ohio (Showman and Flenniken 2004), only a few appear to be acceptable for nest construction. Fortunately, these are common and widespread species. Excessive air pollution can have profound effects on lichen communities. Many species are especially sensitive to high levels of sulfur dioxide (Showman and Flenniken 2004). Prior to passage of the Clean Air Act in 1972, heavily industrialized regions, such as parts of the Ohio River Valley, were virtually lacking in lichens (Showman 1973). Since 1972, there has been a dramatic resurgence of lichens in formerly polluted areas (Showman 1997). The influence of lichen availability on nesting success has not been studied. Two species commonly used in gnatcatcher and hummingbird nests, *Parmelia sulcata* and *Punctelia subrudecta*, are somewhat tolerant of air pollution. Two others, *Flavoparmelia caperata* and *Punctelia rudecta*, are quite sensitive to airborne toxins. Increases in air pollution, especially sulfur dioxide, may have deleterious consequences on the nesting success of Blue-gray Gnatcatchers and Ruby-throated Hummingbirds.

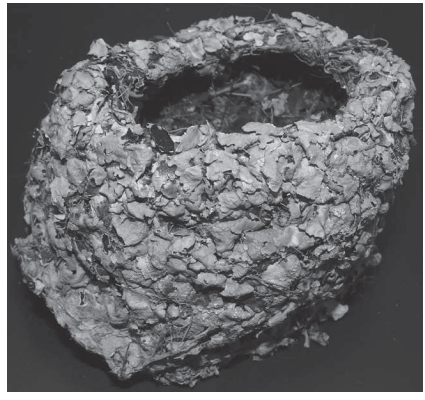


Figure 5. *Blue-gray Gnatcatcher nest showing heavy lichen shingling. Composition:* Flavoparmelia caperata *60%;* Punctelia spp. *30%;* Parmotrema spp. *10%. Nest collected in Scioto County, Ohio in 2006.*

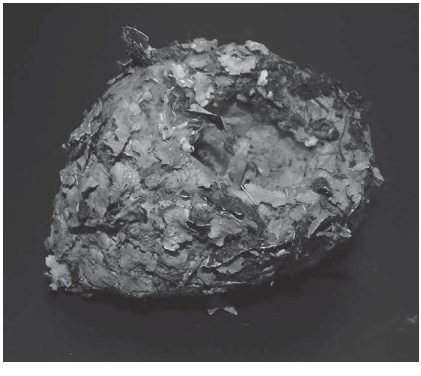


Figure 6. *Ruby-throated Hummingbird nest showing lichen decoration. Composition:* Flavoparmelia caperata *50%;* Parmelia sulcata *50%. Nest collected in Delaware County, Ohio, date unknown.*

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