CHAPTER 16-6
BIRD NESTS – PASSERIFORMES, PART 1

TABLE OF CONTENTS

CHAPTER 16-6
BIRD NESTS – PASSERIFORMES, PART 1

Figure 1. Moss nest from the Pacific Northwest, USA. The bryophytes include ***Isothecium*** and ***Neckera***. Photo courtesy of Jerilyn Peck.

Passeriformes: Perching Birds

This is a large order (>5000 species) and comprises most of the birds that use bryophytes in their nests. But then, it also includes more than half the bird species in the world (Wikipedia 2017). The order is distinguished by having three toes pointing forward and one pointing back, permitting these to be perching birds. Passerines also are **altricial** (hatched or born in undeveloped state and requiring care and feeding by parents).

Richardson (1981) reports that a quarter of the bird species breeding in Great Britain use bryophytes in the construction of their nests. Hansell (2000) likewise reports that numerous small to medium-sized bird species use bryophytes.

Large passerine birds tend to build larger nests relative to their body size when compared to small birds (Slagsvold 1989). The depth of the inner nest cup size of these birds does not relate to the size of the bird. Birds that nest off the ground in open nests have a narrow nest cup, but those with a domed nest or which build in a cavity have a broad nest cup. Birds in exposed nests are less likely to survive than those reared in nest cavities (Nice 1937, 1957). There seem to be no data on the success of birds reared in nests made totally of mosses. Mosses and lichens alter the nest cup size, with the inner nest cup being narrower when more are used (Slagsvold 1989). Use of mosses and lichens also depends on season, with those birds nesting early in the breeding season using significantly more mosses and lichens than are used in later nests.

In coniferous forests, bryophytes are often abundant. Several species of birds that breed there build nests exclusively of bryophytes. These include the Winter Wren (see below; Hejl *et al*. 2002), Marbled Murrelet (see Chapter 16-7; Nelson 1997), and Golden-crowned Kinglet (see Chapter 16-7; Ingold & Galati 1997). In addition, Sakai (1988) described a Hammond Flycatcher nest (see below) made with two epiphytic lichens and five bryophytes, including the epiphytic moss ***Isothecium*** sp. (Figure 11) and liverwort, ***Porella navicularis*** (Figure 17).

Tyrannidae – Tyrant Flycatchers

Wolf (2009) found fifteen species of **Tyrannidae** that use bryophytes in their nests in North America:

Contopus sordidulus (Western Wood-Pewee; Figure 2)
Empidonax flaviventris (Yellow-bellied Flycatcher; Figure 4)
Empidonax alnorum (Alder Flycatcher; Figure 5)
Empidonax minimus (Least Flycatcher; Figure 6)
Empidonax difficilis (Pacific-slope Flycatcher; Figure 7-Figure 8)
Empidonax hammondii (Hammond's Flycatcher; Figure 13)
Empidonax occidentalis (Cordilleran Flycatcher; Figure 18)
Sayornis nigricans (Black Phoebe; Figure 19)
Sayornis phoebe (Eastern Phoebe; Figure 20-Figure 21)
Sayornis saya (Say's Phoebe; Figure 26-Figure 27)
Pitangus sulphuratus (Great Kiskadee; Figure 28)
Tyrannus melancholicus (Tropical Kingbird; Figure 31)
Tyrannus couchii (Couch's Kingbird; Figure 32)
Tyrannus forficatus (Scissor-tailed Flycatcher; Figure 33)
Pachyramphus aglaiae (Rose-throated Becard; Figure 37)

Figure 2. ***Contopus sordidulus***, Western Wood Pewee. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Olive-sided Flycatcher (*Contopus cooperi*)

The Olive-sided Flycatchers (***Contopus cooperi***; Figure 3) typically hide their nests in a cluster of needles and twigs at distal ends of horizontal conifer branches (Johnsgard 2009). These may occur anywhere from 5-13 m above the ground. They use twigs, lichens, mosses, and needles to construct a cup ~12-15 cm in diameter.

Figure 3. ***Contopus cooperi***, Olive-sided Flycatcher. Members of this species often include mosses in their nests. Photo by Jerry Oldenettel, through Creative Commons.

Yellow-bellied Flycatcher (*Empidonax flaviventris*)

In the eastern United States, Yellow-bellied Flycatcher (***Empidonax flaviventris***; Figure 4) nests close to mature stands of lowland coniferous forest (Harrison 1975; Hawrot & Niemi 1996). These forests often have a well-developed layer of mosses and these mosses appear to be necessary for the bird's nesting. The Yellow-bellied Flycatcher nests on the ground in a layer of mosses.

Figure 4. ***Empidonax flaviventris***, Yellow-bellied Flycatcher. This species builds nests on a bed of mosses on the ground. Photo by Cephas, through Creative Commons.

Figure 5. ***Empidonax alnorum***, Alder Flycatcher. Members of this species often include mosses in their nests. Photo by Cephas, through Creative Common.

Figure 6. ***Empidonax minimus***, Least Flycatcher. Members of this species often include mosses in their nests. Photo by MDF, through Creative Commons.

Pacific-slope Flycatcher (*Empidonax difficilis*)

The Pacific-slope Flycatcher (***Empidonax difficilis***; Figure 7-Figure 8) typically builds nests on ledges or crevices of canyon walls (Johnsgard 2009). These are often concealed by mosses or ferns. When the nest is built on trees, they are supported from below and from the rear, occurring in a crotch or on a limb that projects far from the main trunk. They contain a variety of materials, frequently including mosses (Figure 8-Figure 9).

Figure 7. ***Empidonax difficilis***, Pacific-slope Flycatcher, a species that uses ***Isothecium*** in their nests in Douglas fir forests of the Pacific Northwest, USA. Photo by Ron Knight, through Creative Commons.

Figure 8. ***Empidonax difficilis***, Pacific-slope Flycatcher mossy nest with eggs. Photo from USFWS, through Creative Commons.

Figure 9. ***Empidonax difficilis***, Pacific-slope Flycatcher, nest with mosses and young bird. Photo by Don Loarie, through Creative Commons.

In the Pacific Northwest, USA, Wolf (2009) found a nest of the Pacific-slope Flycatcher (Figure 8) on a fractured piece of bark on the tree bole of ***Pseudotsuga menziesii*** (Figure 10) at ~4 m above the ground. The bird had woven strands of the moss ***Isothecium*** (Figure 11) into the rim of the nest and decorated the exterior with fragments of the lichen ***Sphaerophorus globosus*** (Figure 12). The ***Isothecium*** had been relocated from elsewhere in the forest understory.

Figure 10. ***Pseudotsuga menziesii*** bark where Pacific-slope Flycatchers (***Empidonax difficilis***) build their nests in crevices. Photo by Walter Siegmund, through Creative Commons

Figure 11. ***Isothecium myosuroides***, representing a genus among those used in nests of the Pacific-slope Flycatcher (***Empidonax difficilis***). Photo by Hermann Schachner, through Creative Commons.

Figure 12. ***Sphaerophorus globosus***, one of the lichen materials used in nests of the Pacific-slope Flycatcher (***Empidonax difficilis***). Photo by Einar Timdal, through Creative Commons.

Hammond's Flycatcher (*Empidonax hammondii*)

The Hammond's Flycatcher (***Empidonax hammondii***; Figure 13) has a nest that is distinctly different from that of the Pacific Slope Flycatcher (***Empidonax difficilis***; Figure 7-Figure 9) (Sakai 1988). The Hammond's Flycatcher nest is taller, more tightly woven, and mimics the surrounding substrate. The outer bowl of the only retrieved nest was made with mostly white scale lichens, mosses ***Dendroalsia abietina*** (Figure 14), ***Homalothecium nuttallii*** (Figure 15), ***Isothecium*** sp. (Figure 11), ***Alsia*** sp. (Figure 16), and the leafy liverwort ***Porella navicularis*** (Figure 17). By comparison, in the 22 Pacific-slope Flycatcher nests, the material was mostly mosses. They often lacked the camouflage effect because they used the same materials on all substrates. The nests were held together with spider webs that were also used to secure the nests to the substrate.

Figure 13. ***Empidonax hammondii***, Hammond's Flycatcher. Members of this species often include mosses in their nests. Photo by Pablo Leautaud, through Creative Commons.

Figure 14. ***Dendroalsia abietina***, a nest component of the Hammond's Flycatcher in the Pacific Northwest. Photo by James Maughn, through Creative Commons.

Figure 15. ***Homalothecium nuttallii***, a species used in nests of the Hammond's Flycatcher in the Pacific Northwest. Photo by Doug Murphy, through Creative Commons.

Figure 16. ***Alsia californica***, member of a genus used in nests of the Hammond's Flycatcher in parts of North America. Photo by John Game, through Creative Commons.

Figure 17. ***Porella navicularis***, a leafy liverwort used in nests of the Hammond's Flycatcher in the Pacific Northwest. Photo by Matt Goff <www.sitkanature.org>, with permission.

Figure 18. ***Empidonax occidentalis***, Cordilleran Flycatcher. Members of this species often include mosses in their nests. Photo from Amado Demesa, through Creative Commons.

Figure 19. ***Sayornis nigricans***, Black Phoebe. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Eastern Phoebe (*Sayornis phoebe*)

I picked up my copy of "A Complete Field Guide to Nests in the United States" with eager anticipation. I quickly scanned the keys that depended on nesting location and materials and found several that mentioned mosses or peatlands. As I looked up each appropriate item in the key, I soon discovered only one bird was cited as a bryophyte user, the Eastern Phoebe – ***Sayornis phoebe*** (Figure 20) (Headstromn 1970). The Eastern Phoebe builds a cup-shaped nest (Figure 21) lined with mud and fibrous plant material. It uses mosses as a binding material with mud in the inner cup (Breil & Moyle 1976). It also uses mosses to line the cup. The outermost layer is also covered with moss (Headstromn 1970). Bent (1963) provided interesting bryological information. In a single nest, ***Mnium stellare*** (Figure 22), ***Funaria*** sp. (Figure 23), ***Polytrichum*** sp. (Figure 24), ***Hypnum*** "***cristatum***," and ***Climacium dendroides*** (Figure 25) were used as construction materials.

Figure 20. ***Sayornis phoebe***, Eastern Phoebe, a bird that can be identified by the mosses in its nest. Photo by John Benson, through Creative Commons.

Figure 21. ***Sayornis phoebe***, Eastern Phoebe, nest. Photo by Bernard Goffinet, through Creative Commons.

Figure 22. ***Mnium stellare***, a moss used in the Eastern Phoebe (***Sayornis phoebe***) nests. Photo by Hermann Schachner, through Creative Commons.

Figure 23. ***Funaria hygrometrica*** with immature capsules, a species used in nests of the Eastern Phoebe. Photo by Hermann Schachner, through Creative Commons.

Figure 24. ***Polytrichum commune***, member of a genus used in construction of nests of the Eastern Phoebe. Photo by Hermann Schachner, through Creative Commons.

Figure 25. ***Climacium dendroides***, a moss used in nests of the Eastern Phoebe. Photo by Stan Phillips, through public domain.

Figure 26. ***Sayornis saya***, Say's Phoebe. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 27. ***Sayornis saya***, Say's Phoebe, nest with young. Photo by Tom Grey, with permission.

Figure 28. ***Pitangus sulphuratus***, Great Kiskadee. Members of this species often include mosses in their nests.. Photo by Tom Grey, with permission.

Eastern Kingbird (*Tyrannus tyrannus*)

The Eastern Kingbird (***Tyrannus tyrannus***; Figure 29) of the Great Plains typically lives in forests where the canopy level is uneven, providing high points for observation and foraging (Johnsgard 2009). The female picks the nest site and builds the nest (Figure 30). She places it on outer branches of shrubs or small trees and often incorporates mosses in the construction.

Figure 29. ***Tyrannus tyrannus***, Eastern Kingbird. Members of this species often include mosses in their nests. Photo by MDF, through Creative Commons.

Figure 30. ***Tyrannus tyrannus***, Eastern Kingbird, nest with eggs. Photo by Anc516, through Creative Commons.

Figure 31. ***Tyrannus melancholicus***, Tropical Kingbird. Members of this species often include mosses in their nests.. Photo by Tom Grey, with permission.

Figure 32. ***Tyrannus couchii***, Couch's Kingbird. Members of this species often include mosses in their nests. Photo by Ruben, through Creative Commons.

Figure 33. ***Tyrannus forficatus***, Scissor-tailed Flycatcher. Members of this species often include mosses in their nests.. Photo by Tom Grey, with permission.

Yellow-bellied Chat-tyrant (*Ochthoeca diadema*)

Miller and Greeney (2008) described the nest of the Yellow-bellied Chat-tyrant (***Ochthoeca diadema***; Figure 34). They found a partially domed cup built into a vertical mat of mosses that hung from a horizontal vine. The cup was thick and composed of bryophytes with a sparse lining of feathers. The dome covered only about one-third of the cup. Closer examination revealed that the nest was actually build into the vertical sheet of mosses.

Figure 34. ***Ochthoeca diadema***, Yellow-bellied Chat Tyrant. Members of this species sometimes build their nests into vertical hanging mats of mosses. Photo by Andres Cuervo, through Creative Commons.

Crowned Chat-tyrant (*Ochthoeca frontalis*)

Miller and Greeney (2008) found the Crowned Chat-tyrant (***Ochthoeca frontalis***) where it built its nest into a clump of mosses that was hanging 50 cm below a horizontal tree trunk (Miller & Greeney 2008). This provided good concealment by vegetation on the upper side. The nest was a partial dome made of mosses built into growing mosses and ferns.

Other species, such as Rufous-breasted Chat (***Ochthoeca rufipectoralis***; Figure 35) and Slaty-backed Chat-tyrant (***O. cinnamomeiventris***; Figure 36) also place their mossy cups on ledges (Hilty & Brown 1986; Greeney 2007).

Figure 35. ***Ochthoeca rufipectoralis***, Rufous-breasted Chat Tyrant. Members of this species often include mosses in their nests. Photo by Dick Cook, through Creative Commons.

Figure 36. ***Ochthoeca cinnamomeiventris***. Members of this species place mossy cups on ledges. Photo by Ken-ichi Ueda, through Creative Commons.

Figure 37. ***Pachyramphus aglaiae***, Rose-throated Becard. Members of this species often include mosses in their nests. Photo by Dominic Sherony, through Creative Commons.

Laniidae – Shrikes

Wolf (2009) found two species of **Laniidae** that use bryophytes in their nests in North America:

Lanius ludovicianus (Loggerhead Shrike; Figure 38)
Lanius excubitor (Northern Shrike; Figure 39)

Figure 38. ***Lanius ludovicianus***, Loggerhead Shrike. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 39. ***Lanius excubitor***, Northern Shrike. Members of this species often include mosses in their nests. Photo by Smudge 9000, with permission.

Vireonidae – Typical Vireos

Wolf (2009) found three species of **Corvidae** that use bryophytes in their nests in North America:

Vireo griseus (White-eyed Vireo; Figure 40)
Vireo cassinii (Cassin's Vireo; Figure 41-Figure 42)
Vireo huttoni (Hutton's Vireo; Figure 43)

Figure 40. ***Vireo griseus***, White-eyed Vireo. Members of this species often include bryophytes in their nests. Photo by Andy Reago and Chrissy McClarren, through Creative Commons.

Figure 41. ***Vireo cassinii***, Cassin's Vireo. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 42. ***Vireo cassinii***, Cassin's Vireo, nest with female. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 43. ***Vireo huttoni***, Hutton's Vireo. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Rhipiduridae – Fantails

The Grey Fantail (***Rhipidura albiscapa***) in Tasmania builds a tidy nest of grass, moss sporophytes, bark, other plant fibers, ad spider webs (Lloyd 2013). The webs are used to attach the nest to a branch. The moss sporophytes are used to line the cup of the nest. These nests are built by the males and females in the understorey shrubs and small trees and both birds contribute to feeding.

Figure 44. ***Rhipidura albiscapa*** (Grey Fantail), a species that lines its nest with moss sporophytes. Photo by Patrick Kavanagh, through Creative Commons.

Figure 45. ***Rhipidura albiscapa*** (Grey Fantail) nest and nestlings. Photo by Benjamint444, through Creative Commons.

Monarchidae – Monarch Flycatchers

The Rarotonga Flycatcher (***Pomarea dimidiata***; Figure 46), an endangered species in the Cook Islands of Polynesia, makes a nest entirely from mosses (Figure 46-Figure 47), mostly **Meteoriaceae** (Figure 48) (John Game, Bryonet 22 June 2016).

Figure 46. ***Pomarea dimidiata***, Rarotonga Flycatcher, at mossy nest. Photo by G. McCormack © CINHP <www.cookislands.bishopmuseum.org>, with online permission.

Figure 47. ***Pomarea dimidiata***, Rarotonga Flycatcher, on nest of mosses. Photo by G. McCormack © CINHP <www.cookislands.bishopmuseum.org>, with online permission.

Figure 48. ***Weymouthia mollis***, member of **Meteoraceae** that is common in bird nests. Photo by Clive Shirley, Hidden Forest <www.hiddenforest.co.nz>, with permission.

Myiagra cyanoleuca (Migratory Satin Flycatcher; Figure 49) builds a nest on a dead horizontal branch 5-25 m

above ground (Lloyd 2013). It uses bark strips and moss tightly bound with spider webs, making it neat and well disguised.

Figure 49. ***Myiagra cyanoleuca*** (Satin Flycatcher) male, a species that includes mosses in its nests. Aviceda at English Wikipedia, though Creative Commons.

Corvidae – Jays, Magpies, & Crows

Wolf (2009) found nine species of **Corvidae** that use bryophytes in their nests in North America:

Perisoreus canadensis (Gray Jay; Figure 50)
Cyanocitta stelleri (Steller's Jay; Figure 51)
Cyanocitta cristata (Blue Jay; Figure 52)
Cyanocorax yncas (Green Jay; Figure 53)
Aphelocoma californica (California Scrub-jay; Figure 54)
Gymnorhinus cyanocephalus (Pinyon Jay; Figure 55)
Nucifraga columbiana (Clark's Nutcracker; Figure 56)
Corvus brachyrhynchos (American Crow; Figure 57)
Corvus caurinus (Northwestern Crow; Figure 58)
Corvus corax (Common Raven; Figure 59)

Figure 50. ***Perisoreus canadensis***, Gray Jay. Members of this species often include mosses in their nests. Photo by Walter Siegmund, through Creative Commons.

Figure 51. ***Cyanocitta stelleri***, Steller's Jay. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 52. ***Cyanocitta cristata***, Blue Jay. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 53. ***Cyanocorax yncas***, Green Jay. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 54. ***Aphelocoma californica***, California Scrub-jay. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 55. ***Gymnorhinus cyanocephalus***, Pinyon Jay. Members of this species often include mosses in their nests. Photo by James St. John, through Creative Commons.

Figure 56. ***Nucifraga columbiana***, Clark's Nutcracker. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 57. ***Corvus brachyrhynchos***, American Crow. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 58. ***Corvus caurinus***, Northwestern Crow. Members of this species often include mosses in their nests. Photo by T Greyfox, through Creative Commons.

Common Raven (*Corvus corax*)

The Raven (***Corvus corax***; Figure 59) uses mosses to line its nest (Giannetta 2000).

Figure 59. ***Corvus corax***, Raven. Members of this species often include mosses in their nests. Photo by Dick Daniels, through Creative Commons.

Hirundinidae – Swallows

Wolf (2009) found only two species of **Hirundinidae** that use bryophytes in their nests in North America:

Tachycineta bicolor (Tree Swallow; Figure 60-Figure 61)
Stelgidopteryx serripennis (Northern Rough-winged Swallow; Figure 62)

Tree Swallow (*Tachycineta bicolor*)

Tree Swallows (***Tachycineta bicolor***; Figure 60) are known to construct a basket nest (Figure 61) of sticks with an "upholstery" of moss, grass, and animal fur (Heinrich 2000). Heinrich assumed these to provide insulation and to cushion the eggs.

Figure 60. ***Tachycineta bicolor***, Tree Swallow, male. Members of this species use bryophytes in their treehole nests. Photo by Tom Grey, with permission.

Figure 61. ***Tachycineta bicolor***, tree swallow, in a nest where bryophytes were used. Photo through public domain.

Figure 62. ***Stelgidopteryx serripennis***, Northern Rough-winged Swallow. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Paridae – True Tits

Wesołowski (unpublished data) found that the tits typically gathered moss for their nests in the immediate vicinity of the nest cavity, but they also would travel up to 80 m to gather nesting materials. Wolf (2009) found eight species of **Paridae** that use bryophytes in their nests in North America:

Poecile atricapillus (Black-capped Chickadee; Figure 74)
Poecile gambeli (Mountain Chickadee; Figure 89)
Poecile rufescens (Chestnut-backed Chickadee; Figure 90)
Poecile hudsonicus (Boreal Chickadee; Figure 91)
Poecile cinctus (Gray-headed Chickadee; Figure 92)
Baeolophus inornatus (Oak Titmouse; Figure 93)
Baeolophus ridgwayi (Juniper Titmouse; Figure 94)
Baeolophus bicolor (Tufted Titmouse; Figure 95)

Wesołowski and Wierzcholska (2018) compared the nesting materials used by three species of tit (Figure 63) and demonstrated that they were selective. Furthermore, the selections differed among the species. They avoided the abundant ***Brachythecium rutabulum*** (Figure 64), and ***Plagiothecium nemorale*** (Figure 65) and almost never used ***Anomodon longifolius*** (Figure 66) or ***Brachythecium oedipodium*** (Figure 67). Of the 54 available species, 21 were never used. Most plots associated with the nests had an average of 10.2-11.6 moss species/plot. The liverwort ***Metzgeria furcata*** (Figure 68) was used exclusively by Marsh Tits, and in greater proportion than in the environment. ***Brachythecium salebrosum*** was used only by Blue Tits, who also used large quantities of two forms of ***Hypnum cupressiforme*** (Figure 103). Great Tits under-used ***Hypnum cupressiforme*** forms but used ***Anomodon viticulosus*** (Figure 69), and possibly also ***Pleurozium schreberi*** (Figure 70) in greater proportion than their

availability. Wesołowski and Wierzcholska found no difference in water uptake between used and unused mosses. The Great Tits used mosses (***Anomodon viticulosus***, ***Isothecium alopecuroides*** (Figure 71), ***Pleurozium schreberi***) with stems twice as thick as those used by the Marsh Tits [***Hypnum cupressiforme*** mod. ***filiforme*** (Figure 72), ***Neckera complanata*** (Figure 73)].

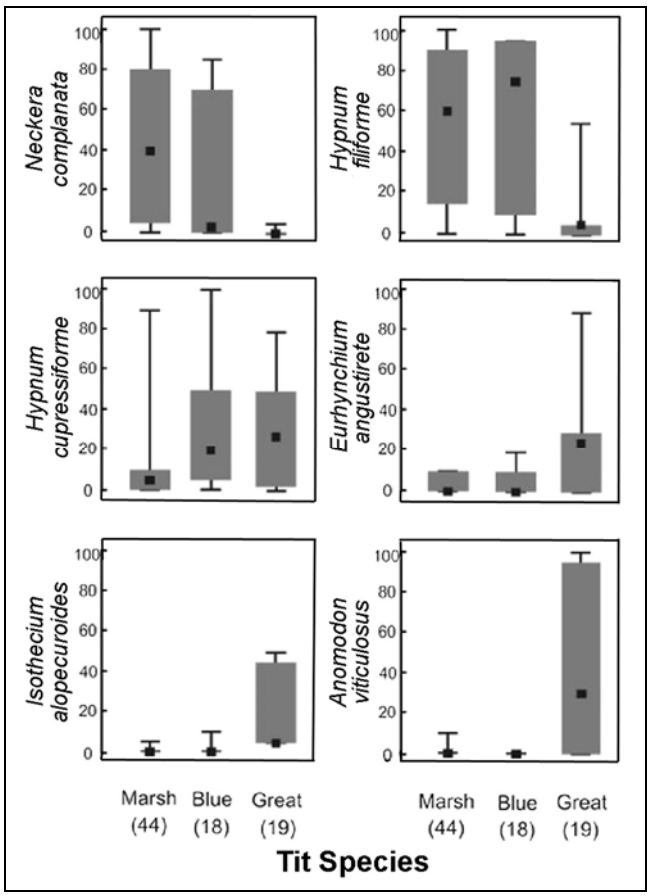

Figure 63. Moss choice in nests of three species of tits in Poland. The percent represents to the percent of volume of mosses in the moss layer of nests that had mosses. Small squares represent the medians, boxes indicate 25-75% quartiles, and whiskers show the ranges. Numbers in parentheses are sample sizes. Modified from Wesołowski & Wierzcholska 2018.

Figure 64. ***Brachythecium rutabulum***, an abundant moss avoided by tits. Photo by Janice Glime.

Figure 65. ***Plagiothecium nemorale***, an abundant moss that is avoided by tits as a nesting material. Photo by Michael Luth, with permission.

Figure 66. ***Anomodon longifolius***, an abundant moss that is rarely used by tits for their nests. Photo by Hermann Schachner, through Creative Commons.

Figure 67. ***Brachythecium oedipodium***, an abundant moss that is rarely used by tits for their nests. Photo by Michael Luth, with permission.

Figure 68. ***Metzgeria furcata***, a liverwort that often occurs in tit nests, but in small quantity. Photo by Michael Luth, with permission.

Figure 69. ***Anomodon viticulosus***, a preferred moss for nests by Great Tits. Photo by Janice Glime.

Figure 70. ***Pleurozium schreberi***, a preferred moss for nests of Great Tits. Photo by Janice Glime.

Figure 71. ***Isothecium alopecuroides*** with capsules, mosses with thick stems that preferred by Great Tits for nest materials. Photo by David T. Holyoak, with permission.

Figure 72. ***Hypnum cupressiforme*** mod. ***filiforme***, a moss with thin stems and that is used for nest materials by Marsh Tits. Photo by Jan-Peter Frahm, with permission.

Figure 73. ***Neckera complanata***, a moss with thin stems and that is used for nest materials by Marsh Tits. Photo by Michael Lüth, with permission.

But why did these birds travel as much as 80 m to gather some species when unused ones were much closer? When Wesołowski and Wierzcholska (2018) used human

plucking of the mosses used in nests and compared them to plucking of the unused species, they found that the used species yielded larger (heavier) bundles of moss and contained longer shoots than of those mosses that were ignored by the birds. This suggests that there is an energy benefit when using the selected species.

Black-capped Chickadee (*Poecile atricapillus*)

Allen (2017) observed a Black-capped Chickadee (***Poecile atricapillus***; Figure 74) busily gathering dry moss for its nest, then flying to the nestbox. The stream had lots of moss, but the bird ignored these, preferring the dry patch next to the stream. The Robin, on the other hand, preferred the wet moss for its open, mud-lined nest.

Figure 74. ***Poecile atricapillus***, Black-capped Chickadee. Members of this species gather dry mosses near a stream for their nests. Photo by Tattooed Dreamer, through Creative Commons.

Carolina Chickadee (*Poecile carolinensis*)

Erichsen (1919) describes the appearance of "down" on the cinnamon and royal ferns as a signal that the Carolina Chickadee (***Poecile carolinensis***; Figure 75) will begin its nest building (Figure 76). The Carolina Chickadee often begins this nest (Figure 77) by placing a thick mat of green moss (often ***Hypnum***; Figure 78) from the tree trunks into the nesting cavity (Figure 77). This always occurs first, followed by the soft down of the ferns.

Figure 75. ***Poecile carolinensis***, Carolina Chickadee. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 76. ***Poecile carolinensis***, Carolina Chickadee, with nesting materials. Photo by Tom Grey, with permission.

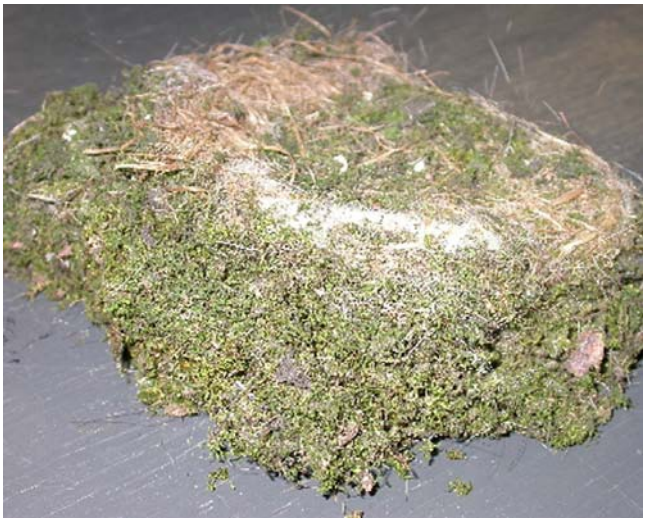

Figure 77. ***Poecile carolinensis***, Carolina Chickadee, nest. Photo courtesy of Diane Lucas.

Figure 78. ***Hypnum imponens***, a common species in a genus used for nests of the Carolina Chickadee. Photo by Janice Glime.

Andreas (2010) observed nests of two Carolina Chickadees (***Poecile carolinensis***; Figure 75). These included ten mosses and two liverworts. The dominant species were the pleurocarpous moss ***Platygyrium repens*** (Figure 79) and the leafy liverwort ***Frullania eboracensis*** (Figure 80) plus a few others, which comprised 55% of the nesting material by volume. In another year, the bryophytes comprised 70.4% of the nest material. The selection of bryophytes was not in proportion to their abundance and all species used were epiphytic on bark. Andreas suggested that they may select ***Frullania eboracensis*** for its chemical properties, possibly protecting them from mites (Figure 113). Only **corticolous** (growing on tree bark) bryophytes were used, with the exception of a single piece of ***Bryoandersonia illecebra*** (Figure 81) in one nest. But even clumps of **acrocarpous** (mostly upright with archegonia and capsules forming at tip of stem) mosses were removed from the tree trunks as tiny tufts for nest usage, including ***Orthotrichum ohioense*** and ***Dicranum montanum*** (Figure 82). Other corticolous bryophytes, including ***Anomodon attenuatus*** (Figure 83), ***Brachythecium laetum*** (Figure 84), ***Clasmatodon parvulus*** (Figure 85), ***Hypnum pallescens*** (Figure 86), and ***Ulota crispa*** (Figure 87), were ignored.

Figure 79. ***Platygyrium repens*** with bulbils, a moss used in nests of Carolina Chickadees. Photo by Hermann Schachner, through Creative Commons.

Figure 80. ***Frullania eboracensis***, a leafy liverwort used in nests of Carolina Chickadees. Photo from Dale A. Zimmerman Herbarium, Western New Mexico University, with permission.

Figure 81. ***Bryoandersonia illecebra***, the only non-epiphytic moss used in a Carolina Chickadee nest. Photo by Bob Klips, with permission.

Figure 82. ***Dicranum montanum***, an acrocarpous moss used in the nest of a Carolina Chickadee. Photo by Hermann Schachner, through Creative Commons.

Figure 83. ***Anomodon attenuatus*** with capsules, an epiphytic moss that was ignored when the Carolina Chickadee built its nest. Photo by Bob Klips, with permission.

Figure 84. ***Brachythecium laetum***, an epiphytic moss that was ignored when the Carolina Chickadee built its nest. Photo by Bob Klips, with permission.

Figure 85. ***Clasmatodon parvulus***, an epiphytic moss that was ignored when a Carolina Chickadee built its nest. Photo by A. Newman, through Creative Commons.

Figure 86. ***Hypnum pallescens***, an epiphytic moss that was ignored when a Carolina Chickadee built its nest. Photo by Michael Lüth, with permission.

Figure 87. ***Ulota crispa***, an epiphytic moss that was ignored when a Carolina Chickadee built its nest. Photo by Michael Lüth, with permission.

In Cashiers, NC, a Carolina Chickadee (***Poecile carolinensis***; Figure 75) used ***Thuidium delicatulum*** (Figure 88) in its nest in an English Boxwood shrub (Annie Martin, Bryonet 1 June 2010).

Figure 88. ***Thuidium delicatulum***, a ground moss used in the nest of a Carolina Chickadee. Photo by Janice Glime.

Figure 89. ***Poecile gambeli***, Mountain Chickadee. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 90. ***Poecile rufescens***, Chestnut-backed Chickadee. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 91. ***Poecile hudsonicus***, Boreal Chickadee. Members of this species often include mosses in their nests. Photo by David Mitchell, through Creative Commons.

Figure 92. ***Poecile cinctus***, Grey-headed Chickadee. Members of this species often include mosses in their nests. Photo by Jargal Lamjav, through Creative Commons.

Figure 93. ***Baeolophus inornatus***, Oak Titmouse, with its nest in the large hole at the bottom left. Members of this species include bryophytes in their nests. Photo by Tom Grey, with permission.

Figure 94. ***Baeolophus ridgwayi***, Juniper Titmouse. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 95. ***Baeolophus bicolor***, Tufted Titmouse. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Varied Tit (*Sittiparus varius*)

The Varied Tit (***Sittiparus varius***; Figure 96) lives in coniferous forests, mixed forests, and bamboo in eastern Japan, Korea, and some parts of northeastern China and extreme southeastern Russia (southern Kurile Islands). It is one of the birds that uses bryophytes for nesting material (Sakai 2007).

Figure 96. ***Sittiparus varius***, Varied Tit. Members of this species often include mosses in their nests. Photo by Alpsdake, through Creative Commons.

Figure 97. ***Parus major***, Great Tit,. Members of this species often include bryophytes in their nests. Photo by Paul Gulliver, through Creative Commons.

Figure 98. ***Parus major***, Great Tit, nest with bryophytes and eggs. Photo by Oh Wei, through Creative Commons.

Blue Tit (*Cyanistes caeruleus*), Great Tit (*Parus major*), and Japanese Tit (*Parus minor*)

The Great Tit (***Parus major***; Figure 97-Figure 98) and the Blue Tit (***Cyanistes caeruleus***; Figure 99-Figure 101) both use mosses to build their nests (Figure 98) (Hribek 1985). Likewise, Gustavo Tomás and Andrew Spink (pers. comm. 2010) have collected mosses from a large number of Blue Tit (***Cyanistes caeruleus***) and Coal Tit (***Periparus ater***; Figure 102) nests in the Netherlands. The most common species in the nest is the locally common ***Hypnum cupressiforme*** (Figure 103). But other locally common species are not common in the nests, suggesting a preference. It appears that different species may be used in different parts of the nest, but so far there is no quantitative analysis available to support this. Figure 108 demonstrates the use of a ***Hypnum*** species (with ***Thuidium***) in the nest of an unknown bird in Pennsylvania, USA.

Figure 99. ***Cyanistes caeruleus***, Eurasian Blue Tit,. Members of this species build their nests with mosses. Photo by Francis C. Franklin, through Creative Commons.

Figure 100. ***Cyanistes caeruleus***, Blue Tit, mossy nest and eggs. Photo by Notts Ex Miner, through Creative Commons.

Figure 101. ***Cyanistes caeruleus***, Blue Tit, nest with moss and nestlings. Photo by Notts Ex Miner, through Creative Commons.

Figure 102. ***Periparus ater***, Coal Tit. Members of this species often include mosses in their nests, preferring ***Hypnum cupressiforme***. Photo by Aviceda, through Creative Commons.

Figure 103. ***Hypnum cupressiforme***, a preferred moss in the nests of Blue Tits and Coal Tits. Photo by Michael Lüth, with permission.

Although the population may use a wide variety of mosses, a few species of bryophytes typically comprise the nest. For example, the Japanese Tit, ***Parus minor***, used 21 species of bryophytes in the nests, but among 91% of the 47 nests, more than 50% of the volume was comprised of only three bryophyte species (Hamao *et al.* 2016). In this case, the preference seems to relate to a potential food source. The Japanese Tits preferred pleurocarpous mosses. In thse nests, seven species of moths emerged from the nesting material and were more frequent in nests with successful fledgine than in failed nests.

Figure 104. ***Parus minor***, Japanese Tit, a species that seems to be selctive in choice of mosses for its nests. Photo by Hyun-tae Kim, through Creative Commons.

In the Czech Republic, Hříbek (1985) found that Blue Tits (Figure 99-Figure 101) used mostly softer species (***Hypnum cupressiforme*** (Figure 103), ***Leptodictyum riparium*** (Figure 105), whereas the Great Tits used mostly the large-stemmed mosses such as ***Calliergonella cuspidata*** (Figure 106) and ***Rhytidiadelphus squarrosus*** (Figure 107).

Figure 105. ***Leptodictyum riparium***, a favorite nesting material of Blue Tits in the Czech Republic, with capsule. Photo by Michael Lüth, with permission.

Figure 106. ***Calliergonella cuspidata***, one of the nesting materials of Great Tits in the Czech Republic. Photo by David T. Holyoak, with permission.

Figure 107. ***Rhytidiadelphus squarrosus***, one of the nesting materials of Great Tits in the Czech Republic. Photo by Michael Lüth, with permission.

Álvarez *et al*. (2013) asserted that the properties and structure of a nest affect breeding performance. This drives the selection of behavior that produces nests characteristic of the species, including the appropriate nesting materials. Where preferred materials are low, birds select alternative materials, often at the cost of reduced breeding success. The researchers set out to support this hypothesis with the Great Tit, a species that has a wide range of habitats, using populations in four different Mediterranean habitats. Interestingly, the clutch size decreased as moss mass increased in the four sites. However, hatching success increased as the moss mass increased in one site. And in all the habitats, the nestling condition was poorer in nests with a greater proportion of sticks and feathers.

Mainwaring *et al*. (2012) reported that the nests of Blue Tits (***Cyanistes caeruleus***) and Great Tits (***Parus major***; Figure 97-Figure 98) in Great Britain consist of a "pad of moss mixed with dry grass and other plant material placed at the base of the nest box" (Figure 109) (Cramp & Perrins 1993; Mainwaring *et al*. 2008; Mainwaring & Hartley 2008, 2009; Britt & Deeming 2011). The nest cup is lined with fine dry grass, hair, wool and feathers. In this case, it appears that the mosses may be used to regulate the temperature and insulate the eggs and young birds. When temperatures increase, the female reduces the amount of lining material.

Figure 108. ***Hypnum*** and ***Thuidium*** in unidentified nest. Photo courtesy of Jeri Peck.

Figure 109. ***Parus major***, Great Tit, with eggs in nest on mosses. Photo by Notts Ex Miner, through Creative Commons.

When Great Tits (***Parus major***; Figure 97) built a second nest in nest boxes after rearing their first brood, they still used mosses in the nest, but there was no lining or inner layer – or any eggs (Slagsvold 1984).

Rydgren *et al*. (2023) compared the mosses used in nests of ***Parus major*** to those available nearby. There was a clear preference for highly branched pleurocarpous species, especially ***Pleurozium schreberi*** (Figure 70), ***Rhytidiadelphus squarrosus*** (Figure 107), and ***Sanionia uncinata*** (Figure 110). They avoid common species that are only sparsely branched. They also used the same species in the same nest boxes in subsequent years. The nesting materials were collected close to the nest, predominantly within 5 m, supporting the hypothesis that collecting nest materials is costly (Figure 111). The researchers suggested that studies are needed to reveal cost of gathering nest materials, to determine the suitability (advantages?) of the materials chosen, and to see if the choices are inherited. It would be interesting to run choice experiments with materials having a variety of properties and to compare nesting materials of the same species in different locations.

Figure 110. ***Sanionia uncinata***, a preferred species for nests of the Great Tit (***Parus major***). Photo by Claire Halpin, with permission.

Figure 111. ***Parus minor*** making nest with branched moss. Photo by Alpsdake, through Creative Commons.

The Corsican Blue Tit (***Cyanistes caeruleus ogliastrae***; Figure 112) includes 1-5 aromatic herbs in its nest (Lambrechts & Dos Santos 2000). Herbs are included in a number of kinds of bird nests, and researchers have suggested that they may serve an anti-parasite function (Figure 113) (Wimberger 1984; Bucher 1988; Cowie & Hinsley 1988; Clark 1991; Banbura *et al.* 1995). Using an herb removal experiment when the young hatched, these researchers found that the parents brought fresh aromatic greens to the nest. They proposed the Potpourri hypothesis that included at least seven functional causes for materials used in the nests. When the Blue Tits breed in cavities, they use predominately mosses, but also include other materials, including fresh herbaceous leaves. They suggested that mosses may optimize the microclimate in the nest cavity. The aromatic herbs are likely to serve an anti-parasitic function.

Figure 112. ***Cyanistes caeruleus ogliastrae***, Corsican Blue Tit. Members of this species often include mosses in their nests. Photo by Valter Jacinto, through Creative Commons.

Figure 113. ***Cyanistes caeruleus***, Eurasian Blue Tit, with mite infestation causing balding. Photo by Michael Palmer, through Creative Commons.

Ground Tit (*Pseudopodoces humilis*)

Ground Tit, also known as Hume's Jay, (***Pseudopodoces humilis***; Figure 114) has been considered the smallest member of the Jay and Crow family (Lipske 2004). But more recently it appears that it should be classified in the **Paridae** with the Chickadees. These birds are common in forests and woody suburbs of Europe and North America, but it appears that their ancestors lived on the dry, treeless Tibetan plateau. They nest in cavities where they build nests of grasses and mosses. Like Jays, they rarely fly, but they do not run like the Jays; rather, they hop.

Figure 114. ***Pseudopodoces humilis***, Ground Tit. Members of this species build nests of grasses and mosses. Photo by David Blank, through Creative Commons.

Pipridae – Manakins, Piprites

Black-capped Piprites (*Piprites pileata*)

Only one example in this family has emerged. The Black-capped Piprites (***Piprites pileata***; Figure 115) builds a spherical nest made of mosses (Cocckle *et al*. 2008).

Figure 115. ***Piprites pileata***, Black-capped Piprites. Members of this species often build their nests of mosses. Photo by Bruno Lima, through Creative Commons.

Aegithalidae – Long-tailed Tits

Wolf (2009) found one species of **Aegithalidae** whose members use bryophytes in their nests (Figure 116) in North America: ***Psaltriparus minimus*** (Bushtit; Figure 117).

Figure 116. ***Psaltriparus minimus***, Bushtit, at mossy nest. Photo by Walter Siegmund, through Creative Commons.

Figure 117. ***Psaltriparus minimus***, Bushtit, pulling on nest materials. Photo by Mikul, through Creative Commons.

Long-Tailed Tit (*Aegithalos caudatus*)

The Long-tailed Tit (***Aegithalos caudatus***; Figure 118-Figure 119) has been separated from other tits and has different feeding and nesting (Figure 120) habits from them. These are not seed-eaters, eating mostly insects from bark crevices and buds. The families stay together, so that a flock will contain only related birds. Relatives that have lost their family members will join the flock. Nests may be tended by 1-8 adults. The female sits on the eggs and the male brings the food. Once the dozen or more babies hatch, helper adults gather food to feed them.

Figure 118. ***Aegithalos caudatus***, Long-tailed Tit, a species whose members build nests with mosses. Photo by drplokta, through Creative Commons.

Figure 119. ***Aegithalos caudatus***, Long-tailed Tit juvenile. Photo by Charles J. Sharp, through Creative Commons.

Figure 120. ***Aegithalos caudatus***, Long-tailed Tit, building her nest in a hedgerow. Photo by Gail Hampshire, through Creative Commons.

The nests are bag-shaped and woven from mosses, bound with spider webs (Burton 1996). The birds cover the outside of the nest with lichens, sometimes substituting plastic and newspaper in areas of human habitation. This nest is insulated on the inside with feathers. The tits may accumulate ~1130 km of travel to gather nest materials. Hansell (2002) reported a nest with 5000-6000 pieces of material, including short-leaved mosses and cocoons intertangled, creating a Velcro effect with a few hundred sprigs of mosses.

Sittidae – Nuthatches

Wolf (2009) found two species of **Sittidae** that use bryophytes in their nests in North America:

Sitta carolinensis (White-Breasted Nuthatch; Figure 121)
Sitta pygmaea (Pygmy Nuthatch; Figure 123)

Figure 121. ***Sitta carolinensis***, White-breasted Nuthatch. Members of this species often include bryophytes in their nests. Photo by Tom Grey, with permission.

Red-Breasted Nuthatch (*Sitta canadensis*)

The Red-breasted Nuthatch (***Sitta canadensis***; Figure 122) builds its nest in tree holes, generally about 2.5 cm in diameter (Heinrich 2009; Moss Musings 2017). Inside the hole it lines the nest with mosses, down, and fibers. In fact, its nest can be recognized from those of woodpeckers because they never line their nests.

Figure 122. ***Sitta canadensis***, Red-breasted Nuthatch, outside the mossy nest in the treehole. Photo by Cephas, through Creative Commons.

Figure 123. ***Sitta pygmaea***, Pygmy Nuthatch, at tree hole. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission

Certhiidae – Holarctic Treecreepers

Wolf (2009) found one species of **Certhidae** whose members use bryophytes in their nests in North America: ***Certhia americana*** (Brown Creeper; Figure 124-Figure 125).

Figure 124. ***Certhia americana***, Brown Creeper, with a beak full of dinner. Photo by Alan and Elaine Wilson, through Creative Commons.

Figure 125. ***Certhia americana***, Brown Creeper, a bird that uses mosses to construct its nests. Photo by Badjoby, through Creative Commons.

Troglodytidae – Wrens

Wolf (2009) found five species of **Troglodytidae** that use bryophytes in their nests in North America:

Salpinctes obsoletus (Rock Wren; Figure 126)
Catherpes mexicanus (Canyon Wren; Figure 127)
Thryothorus ludovicianus (Carolina Wren; Figure 128-Figure 129)
Thryomanes bewickii (Bewick's Wren; Figure 130)
Troglodytes pacificus (Pacific Winter Wren; Figure 133-Figure 135)

Figure 126. ***Salpinctes obsoletus***, Rock Wren. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Figure 127. ***Catherpes mexicanus***, Canyon Wren. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Carolina Wren (*Thryothorus ludovicianus*)

The tiny Carolina Wren (***Thryothorus ludovicianus***; Figure 128) is revered in places like Virginia because of its penchant for eating lots of insects (Harrison 2003). They nest mostly in nooks and crannies, so nest boxes are especially suitable for them. Their nests (Figure 129) often contain mosses, along with leaves, twigs, rootlets, weed stalks, and even cast-off snake skins. Both males and females are the nest builders, but it is she who lines the nest with feathers, hair, fine grass, and moss. These prolific breeders will typically lay a second set of eggs as soon as the young birds leave the nest and may even have a third set.

Figure 128. ***Thryothorus ludovicianus***, Carolina Wren. Members of this species often include mosses in their nests and nest linings. Photo by Ken Thomas, through public domain.

Figure 129. ***Thryothorus ludovicianus***, Carolina Wren, nest with a considerable proportion of mosses, and nestlings. Photo by Marvin, through Creative Commons.

Figure 130. ***Thryomanes bewickii***, Bewick's Wren. Members of this species often include mosses in their nests. Photo by Tom Grey, with permission.

Pacific Wren (*Troglodytes pacificus*) and Winter Wren (*T. hiemalis*)

The Winter Wren has been divided into two species, the Pacific Wren (***Troglodytes pacificus***; Figure 131) and the Winter Wren (***Troglodytes hiemalis***; Figure 132), the eastern species (Toews & Irwin 2008). Where their breeding ranges overlapped, the two species were distinguishable by their songs and lack of cross mating. This evidence was supported by DNA analysis.

Figure 131. ***Troglodytes pacificus***, Pacific Wren. Members of this species often include mosses in their nests. Photo by Tom Talbott, through Creative Commons.

The Pacific Wren (***Troglodytes pacificus***; Figure 131) breeds in the coiferous forests of the Pacific Northwest and constructs a nest almost entirely of mosses (Hejl *et al*. 2002). These wrens protect their nests with a dome and small side entrance (Heinrich 2009). The winter wren places green mosses and small evergreen twigs on the outside. Some birds place their nests in hanging mosses near the ground, but more commonly they place them on tip-up mounds formed by roots of fallen trees.

The Pacific Wren builds a round nest of grass, moss, lichens, or leaves that it stuffs into a hole in a wall, crack in a rock, corner of a building, or tree trunk, but can also put it in bushes or overhanging boughs (Wikipedia 2010).

Eastern Winter Wren (*Troglodytes hiemalis*)

Piers (1897) reported two Winter Wren (***Troglodytes hiemalis***; Figure 132) nests in Nova Scotia, Canada, built in moss that was constantly saturated by water trickling from the bank above. Piers suspected that the second nest was a later one built by the same pair as the first.

Figure 132. ***Troglodytes hiemalis***, Winter Wren. Members of this species often include mosses in their nests. Photo by Paul Stein, through Creative Commons.

Figure 134. ***Troglodytes troglodytes***, Eurasian Wren, feeding young in nest of mosses and other materials. Photo by Sonja Kübelbeck, through Creative Commons.

Eurasian Wren (*Troglodytes troglodytes*)

Nests of the Eurasian Wren (***Troglodytes troglodytes***; Figure 133) can make its nest almost entirely of bryophytes (Figure 134). The Japanese variety (***Troglodytes troglodytes fumigatus***) likewise uses mosses (Figure 135).

Figure 133. ***Troglodytes troglodytes***, Eurasian Wren, a bryophyte nest builder. Photo by Dibyendu Ash, through Creative Commons.

Figure 135. ***Troglodytes troglodytes fumigatus***, Japanese Winter Wren, shown here gathering mosses for its nest. Photo by Alpsdake, through Creative Commons.

Cinclidae – Dippers

Wolf (2009) found one species of **Cinclidae** whose members use bryophytes in their nests in North America: ***Cinclus mexicanus*** (American Dipper; Figure 136-Figure 137), also known as the Water Ouzel.

Figure 136. ***Cinclus mexicanus***, American Dipper, on mosses on the streambank. Photo by Stephen Shunk, through Creative Commons.

Figure 137. ***Cinclus mexicanus***, American Dipper, gathering moss for its nest. Photo by Frank D. Lospalluto, through Creative Commons.

The American Dipper (Figure 136-Figure 137) is the only aquatic songbird in North America (Rosentreter 2014). It is a year-round resident, maintaining its streamside territorial defense year-round. It is known for its diving ability, down to nearly 7 m below the surface, and lives along unpolluted streams with riffles, cascades, and waterfalls. It makes a ball-shaped nest with a side entrance, placed on a cliff face, in a crevice, or under a bridge abutment, positions that help it to avoid predators. The outer shell of this nest is moss with its inner chamber made of pine needles. It uses stream mosses that it dives to obtain, hence they are dripping wet. These are woven into the nest, still wet, and as they dry they tighten the weave and help to affix the nest to its vertical substrate.

I have seen the nest of an American Dipper (Figure 136-Figure 137) in Colorado with the busy expectant mother diving into the water to collect ***Platyhypnidium riparioides*** (Figure 138) for the construction. The nest (Figure 139), wedged under the cliff behind a waterfall, appeared to be made entirely of mosses. Dan Norris (Bryonet 22 November 1995) reports that this bird is indeed selective, using mosses with a different frequency from that found in their habitat.

Figure 138. ***Platyhypnidium riparioides***, a common moss used in nests of the American Dipper (***Cinclus mexicanus***). Photo by Stan Phillips, through public domain.

Figure 139. ***Cinclus mexicanus***, American Dipper, nest of ***Hygrohypnum*** and ***Hygroamblystegium***. Photo by Janice Glime.

Terry McIntosh (Bryonet 2 June 2010) identified mosses in Dipper (***Cinclus mexicanus***; Figure 136-Figure 137) nests from northern Idaho. To his surprise, he found only one species, ***Scouleria marginata*** (Figure 140), a somewhat rare moss, despite the much greater abundance of ***S. aquatica*** (Figure 141). He attributed this selection to the stronger plants of ***S. marginata***. By contrast, Ellen Anderson (Bryonet 2 June 1010) found 30 moss species and 5 liverwort species (plus a few unknowns) in 7 dipper nests in the area around Juneau, Alaska, USA. Most of the nests had only traces of mosses, but nevertheless had quite a few species, numbering 1, 7, 10, 11, 13, 14, and 16 (plus 5 unknowns).

Figure 140. ***Scouleria marginata***, a common component of the American Dipper nests. Photo by Martin Hutten, with permission.

Figure 141. ***Scouleria aquatica***, a common moss that is ignored as nesting material for the American Dipper when ***S. marginata*** is present. Photo by Matt Goff, with permission.

Roger Rosentreter (pers. comm. 20 January 2014) observed numerous American Dipper (***Cinclus mexicanus***; Figure 136-Figure 137) nests on the Payette River, Idaho, USA, reaching up to 2 nests per kilometer. In this case, the nests were composed primarily of the aquatic moss ***Scouleria aquatica*** (Figure 141), an abundant moss in the river.

Brown Dipper (*Cinclus pallasii*)

The Brown Dipper, also known as the Pallas Dipper, (***Cinclus pallasii***; Figure 142), is an Asian dipper that uses mosses in its nests (Nishimura *et al*. 1980).

Figure 142. ***Cinclus pallasii pallasii***, Brown Dipper, a bird that uses aquatic bryophytes in its nests Photo by Alpsdake, through Creative Commons.

Summary

The Passeriformes is the largest order of birds and contains the majority of birds that use bryophytes in their nests. Nevertheless, they seem to be a small proportion of the total species in the order.

In this first part, the members using bryophytes include Tyrant Flycatchers, shrikes, Vireos, Jays and Crows, Swallows, Tits, Piprites, Nuthatches, and Wrens. Among these, the American Dipper is an aquatic bird that often dives for mosses to build its nest. Their selective choices may be energy savings by being able to gather larger bryophyte materials, providing nest-inhabiting food organisms, and in some cases possibly providing more constant moisture.

Acknowledgments

Thank you to Brian Dykstra for sending me the wonderful thesis on birds and epiphytes by Adrian Wolf, as well as other references and personal observations. David Dumond shared the references he got from Bryonet. Many photographers have provided permission or put their images in Creative Commons, for which I am deeply appreciative. Thank you to Tom Grey and Janet Marr for a critical reading of the manuscript. And thank you to

Bernard Goffinet for his continued support in sending me images and interesting publications.

Literature Cited

Allen, Janet. 2017. Stewardship Garden. Birds Raising Young. Accessed 14 June 2017 at <hg.cny@verizon.net>.

Álvarez, E., Belda, E. J., Verdejo, J., and Barba, E. 2013. Variation in Great Tit nest mass and composition and its breeding consequences: A comparative study in four Mediterranean habitats. Avian Biol. Res. 6(1): 39-46.

Andreas, B. K. 2010. Use of bryophytes by Carolina Chickadees (*Poecile carolinensis*) in nest construction. Evansia 27: 23-29.

Banbura, J., Blondel, J., Wilde-Lambrechts, H. De, and Perret, P. 1995. Why do female Blue Tits (*Parus caeruleus*) bring fresh plants to their nests? J. Ornithol. 136: 217-221.

Bent, A. C. 1953. Life histories of North American wood warblers. Part i. U.S. Natl. Mus. Bull. 203.

Breil, D. A. and Moyle, S. M. 1976. Bryophytes used in construction of bird nests. Bryologist 79: 95-98.

Britt, J. and Deeming, D. C. 2011. First-egg date and air temperature affect nest construction in Blue Tits *Cyanistes caeruleus* but not in Great Tits *Parus major*. Bird Study 58: 78-89.

Bucher, E. H. 1988. Do birds use biological control against nest parasites? Parasitol. Today 4: 1-3.

Burton, R. 1996. Long-tailed Tits**.** The Garden 121: 89.

Clark, L. 1991. The nest protection hypothesis: The adaptive use of plant secondary compounds by European Starlings. In: Loye, J. E. and Zuk, M. (eds.), Bird-Parasite Interactions – Ecology, Evolution and Behaviour. Oxford University Press, Oxford, pp. 205-221.

Cocckle, K., Maders, C., Santo, G. Di, and Bodrati, A. 2008. The Black-capped Piprites *Piprites pileata* builds a spherical moss nest. Cotinga 29: 166-168.

Cowie, R. J. and Hinsley, S. A. 1988. Timing of return with green vegetation by nesting Blue Tits *Parus caeruleus*. Ibis 130: 553-559.

Cramp, S. and Perrins, C. M. 1993. The birds of the Western Palearctic. Vol. 7. Flycatchers to shrikes. Oxford University Press, Oxford.

Erichsen, W. J. 1919. Some summer birds of Liberty County, Georgia. Auk 36: 380-393.

Giannetta, J. 2000. Arctic Birds. Accessed July 2004 at <http://www.crosswinds.net/~jgiannet/arctic/Abirds.html>.

Greeney, H. F. 2007. Observations on the nesting biology and natural history of Slaty-backed Chat-tyrant *Ochthoeca cinnamomeiventris* with a description of nestling growth and plumage development. Bol. Soc. Antioqueña Ornitol. 17: 10–16.

Hamao, S., Higuchi, M., Jinbo U., Maeto K., and Furuki, K. 2016. Interaction among birds, mosses and insects in birds nests. Japan J. Ornithol. 65: 37-42.

Hansell, M. 2000. Bird Nests and Construction Behaviour. Cambridge University Press, Cambridge.

Hansell, M. 2002. Disassembly Required. Nat. Hist. 111(4): 96.

Harrison, G. H. 2003. Southern charmer. Birder's World 17(2): 48-51.

Harrison, H. H. 1975. A Field Guide to Birds' Nests in the United States East of the Mississippi River. Houghton Mifflin Co., Boston.

Hawrot, R. Y. and Niemi, G. J. 1996. Effects of edge type and patch shape on avian communities in a mixed conifer-hardwood forest. Auk 113: 586-598.

Heinrich, B. 2000. The artistry of birds' nests. Audubon 102(5): 24-31.

Heinrich, Bernd. 2009. Which Bird Made That Nest? Northern Woodlands. Accessed 2 August 2014 at <http://northernwoodlands.org/articles/article/which-bird-made-that-nest/>.

Hejl, S. J., Holmes, J. A., and Kroodsma, D. 2002 Winter Wren: *Troglodytes troglodytes*. In: Poole, A. and Gill, F. (eds.). The birds of North America, No. 623. American Ornithologists' Union, Washington, DC.

Hilty, S. L. and Brown, B. 1986. A Guide to the Birds of Colombia. Princeton University Press, Princeton, NJ.

Hřibek, M. 1985. The use species of moss (Bryophyta sp.) in the building of nests the Great Tits (*Parus major* L., 1758) and Blue Tit (*Parus caeruleus* L., 1758). Zprávy Moravského Ornitologického Sdruženi 43: 39-45.

Ingold, J. L. and Galati, R. 1997. Golden-crowned Kinglet (*Regulus satrapa*). In: Poole, A. and Gill, F. (eds.). The Birds of North America, no. 301. Academy of Natural Sciences. Philadelphia, and American Ornithologists' Union, Washington, D. C.

Johnsgard, Paul. A. 2009. Birds of the Great Plains: Family Tyrannidae (Tyrant Flycatchers). Accessed 14 May at <http://digitalcommons.unl.edu/bioscibirdsgreatplains/38/>.

Lambrechts, M. M. and Dos Santos, A. 2000. Aromatic herbs in Corsican Blue Tit nests: The "potpourri" hypothesis. Acta Oecol. 21: 175-178.

Lipske, M. 2004. Smithsonian ornithologist corrects century-old mystery of Tibetan bird. Inside Smithsonian Research 3: 8-9.

Lloyd, Sarah. 2013. Bugs, Birds, Bettongs & Bush. Conserving Habitats For Tasmania's Native Animals. Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania, <https://dpipwe.tas.gov.au/Documents/Kit10.pdf>.

Mainwaring, M. C. and Hartley, I. R. 2008. Seasonal adjustments in nest cup lining in Blue Tits *Cyanistes caeruleus*. Ardea 96: 278-282.

Mainwaring, M. C. and Hartley, I. R. 2009. Experimental evidence for state-dependent nest weight in the Blue Tit, *Cyanistes caeruleus*. Behav. Proc. 81: 144-146.

Mainwaring, M. C., Benskin, C. M. H., and Hartley, I. R. 2008. The weight of female-built nests correlates with female but not male quality in the Blue Tit *Cyanistes caeruleus*. Acta Ornithol. 43: 43-48.

Mainwaring, M. C., Hartley, I. R., Bearhop, S., Brulez, K., Feu, C. R. du, Murphy, G., Plummer, K. E., Webber, S. L., Reynolds, S. J., and Deeming, D. C. 2012. Latitudinal variation in Blue Tit and Great Tit nest characteristics indicates environmental adjustment. J. Biogeogr. 39: 1669-1677.

Miller, E. T. and Greeney, H. F. 2008. Clarifying the nest architecture of the *Silvicultrix* clade of *Ochthoeca* chat-tyrants (Tyrannidae). Ornitol. Neotrop. 19: 361-370.

Moss Musings, accessed 13 May 2017 at <http://moss-musings.blogspot.com/2011/02/birds-and-mosses-collection-of-sorts.html>.

Nelson, S. K. 1997. Marbled Murrelet (*Brachyramphus marmoratus*). In: Poole, A. and Gill, F. (eds.). The Birds of North America, no. 276. Academy of Natural Sciences. Philadelphia, and American Ornithologists' Union, Washington, D. C.

Nice, M. M. 1937. Selections from "Study in the life history of the song sparrow l." Trans. Linn. Soc. NY, 4: 57-83.

Nice, M. M. 1957. Nesting success in altricial birds. Auk 74: 305-321.

Nishimura, N., Higuchi, M., and Une, K. 1980. Bryophytes as materials of the nest of a songbird, Pallas's Dipper (*Cinclus pallasii hondoensis*). Hikobia 8: 350-354.

Piers, H. 1897. Notes on Nova Scotian zoology. II. Proc. Trans. Nova Scotian Inst. Sci. 10: 255-267.

Richardson, D. H. S. 1981. The Biology of Mosses. John Wiley & Sons, New York.

Rosentreter, R. 2014. American Dipper nests are no gingerbread house. Botany 2014 Abstract Book, 26-30 July 2014, Boise, Idaho.

Rydgren, K., Indreeide, B., Slagsvold, T., and Lampe, H. M. 2023. Nest building in titmice Paridae: Selectivity in bryophyte use. Ecol. Evol. 2023: 13:e9852. <https://doi.org/10.1002/ece3.9852>.

Sakai, H. F. 1988. Breeding biology and behavior of Hammond's and Western Flycatchers in northwestern California. Western Birds 19: 49-60.

Sakai, N. 2007. Bryophytes as material for the nests of *Parus varius varius*. Bryol. Res. 9: 150-151.

Slagsvold, T. 1984. Clutch size variation of birds in relation to nest predation: On the cost of reproduction. J. Anim. Ecol. 53: 945-953.

Slagsvold, T. 1989. On the evolution of clutch size and nest size in passerine birds. Oecologia 79: 300-305.

Toews, D. P. and Irwin, D. E. 2008. Cryptic speciation in a Holarctic passerine revealed by genetic and bioacoustic analyses. Molec. Ecol. 17: 2691-2705.

Wikipedia. 2010. Pacific Wren. Updated 28 October 2010. Accessed 25 April 2011 at <http://en.wikipedia.org/wiki/Pacific_Wren>.

Wikipedia. 2017. Passerine. Last updated 2 July 2017. Accessed 3 July 2017 at <https://en.wikipedia.org/wiki/Passerine>.

Wimberger, P. H. 1984. The use of green plant material in bird nests to avoid ectoparasites. Auk 101: 615-618.

Wolf, A. L. 2009. Bird use of epiphyte resources in an old-growth coniferous forest of the Pacific Northwest. Master's Thesis, Evergreen State College, WA, USA