

# ***HOMALOTHECIELLA SUBCAPILLATA* (HEDW.) BROTH., A NEW MOSS SPECIES TO CANADA FROM OLD BROADLEAVED FORESTS OF NOVA SCOTIA**

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## **ABSTRACT**

We report *Homalotheciella subcapillata* (Hedw.) Broth. for the first time in Nova Scotia, found in the western-most part of the province. Upon examination of a previously reported collection of this species from Saskatchewan, we determined that the previous collection was misidentified and conclude that our collections represent the first records of this species for Canada. The moss was found to grow only on old beech (*Fagus grandifolia* Ehrh.) trees in mature to old growth mixed broadleaved forests. The species has likely been present in Nova Scotia for many decades but was not previously detected due to low search effort. Given the apparent rarity and substrate specificity, the decline of its host tree, and the fact that it is threatened or vulnerable in the USA, we recommend that steps be taken to conserve this species and its habitats in Nova Scotia.

Keywords: arboreal, Brachytheciaceae, bryophyte, epiphyte, moss

## **INTRODUCTION**

*Homalotheciella subcapillata* (Hedw.) Broth. is a rare pleurocarpous moss that is known from forested habitats of eastern North America. It is an eastern North American endemic (Crum & Anderson 1981, Allen 2014), and was formerly known from across much of the American northeast, but appears to have declined from its original extent. It may have become extirpated in New York, Massachusetts, and Vermont, and is considered imperiled in Pennsylvania and

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vulnerable in Tennessee (NatureServe 2022). As recently as 2014, Maine (USA) was thought to be the northern extent of its range (Allen 2014).

*Homalotheciella subcapillata* typically grows on the bark of the lower bole of hardwood trees in old growth deciduous or mixedwood forests. Crum and Anderson (1981) describe it as being associated with oak-hickory forests, but most other authors have been less specific, merely referring to it as being corticolous or epiphytic, and even suggesting that it can be found on substrates from rotting wood to rock (Allen 2014, Bryophyte Editorial Committee 2014).

Southwest Nova Scotia hosts many unique plant assemblages, due to its combination of temperate climate, maritime humidity, and abundance of wetlands (e.g., Keddy and Wisheu 1989), but certain ecosystems and taxa remain understudied. The bryophyte flora of Nova Scotia is thought to be particularly diverse. Recent reports suggest almost 400 moss species are known (Belland 2010), in addition to at least 127 liverwort and 4 hornwort species (Haughian *et al.* 2016). Although the bryophyte flora of Nova Scotia has been comparatively well-studied from a Canadian perspective (Erskine 1968, Erskine 1970, Ireland 1982, Ireland & Bellolio-Trucco 1987, Bagnell *et al.* 1993, Basquill *et al.* 2024), it remains considerably less well-known than that found in many jurisdictions of North America and Europe that have a longer history of both amateur and professional bryological contributions. There remain many geographic, ecological, and taxonomic gaps in the provincial herbarium collections (Haughian 2022). One such ecological gap is mature to old growth hardwood forests that are dominated by American beech (*Fagus grandifolia* Ehrh.), particularly in the southwest of the province. Consequently, we initiated surveys for rare bryophytes in mature to old growth, beech-dominated forests in southwestern Nova Scotia, with an emphasis on those species reported from mature hardwood forests in the Appalachian and Atlantic Coastal Plain regions of the eastern United States.

## METHODS

### Study area

Although still part of the Atlantic Maritime Ecozone (Wiken 1986), Digby County, where this work took place, is warmer than much of Atlantic Canada. The weather station in Yarmouth, approximately 25 km south of the study area, reports mean daily temperatures of

-2.6°C in January and 17.3°C in July, and an average of 1290 mm of precipitation per year, most of which falls as rain (Environment and Climate Change Canada 2022). In western parts of Digby County, the land is low-lying ( $\leq 150$  m above sea level) and gently undulating due to the frequent presence of drumlins within a predominantly till-plain; parent materials are typically slate, schist, or graywacke, and soils are typically gravelly or sandy-loam tills, with small-scale variation based mainly on slope position (Neily *et al.* 2017). Ecologically, most of the area is forested, with well-drained positions dominated by climax forests of Eastern Hemlock (*Tsuga canadensis* (L.) Carrière), Red Spruce (*Picea rubens* Sarg.), American Beech, Sugar Maple (*Acer saccharum* Marsh.), and Yellow Birch (*Betula alleghaniensis* Britton), and lowland forests dominated by Black Spruce (*Picea mariana* (Mill.) Britton, Sterns & Poggenburg), Tamarack (*Larix laricina* (Du Roi) K. Koch), and Red Maple (*Acer rubrum* L.). The primary agent of natural disturbance is infrequent hurricane-caused blowdown (Neily *et al.* 2017).

Site selection focused on well-drained stands of old growth mixed deciduous forest that had a beech component, based on the experience of the authors as a result of over two decades of surveying epiphytic lichens and mosses in this region, and as confirmed by driving down approximately 646 kilometers of forest roads while visually assessing canopy composition. Once potential sites were identified (30 in total), surveyors inspected them on foot, following the intelligent meander approach (Mueller-Dombois & Ellenberg 1974). Key habitat features that observers were searching for included the presence of either large or gnarled and stunted beech trees, with abundant coverage by bryophytes on the lower bole, a dense forest canopy (70-90% crown closure), and little to no obvious evidence of recent human disturbance.

Loans of three *Homalotheciella subcapillata* specimens from other herbaria were acquired for comparison purposes. Both field collected and herbarium specimens were examined using light microscopy and regionally appropriate taxonomic keys (Crum & Anderson 1981, Allen 2014, Bryophyte Editorial Committee 2014). Nomenclature follows the most recent published treatments (Bryophyte Editorial Committee 2014).

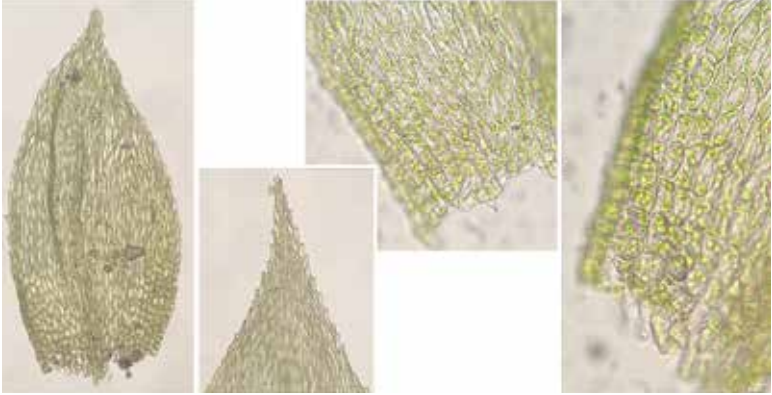
## RESULTS

All three of the loaned herbarium specimens of *Homalotheciella subcapillata* were determined to be species other than the target. The two specimens from the United States were both determined to be *Pylaisia selwynii* Kindb., on the basis of branch tips that were consistently curved away from the substrate; leaf apices that were gradually attenuate, rather than abruptly apiculate; the apparent lack of a visible costa, and the large alar regions bearing upwards of 20 short quadrate cells in 6-10 rows, as compared with only 6-12 cells in 2-5 rows for *H. subcapillata*.

The single Canadian specimen previously identified as *Homalotheciella subcapillata* was from the base of a trembling aspen tree (*Populus tremuloides*) in Saskatchewan, well outside of the range of the species in North America. This specimen was examined, and its identity revised to be *Brachytheciastrum collinum* (Schleicher ex Müller Hal.) Ignatov & Huttunen on the basis of the following:

Colony forming a dense mat to turf (~ 0.5 cm thick) of yellow-green, interwoven shoots, with at least the distal most half of plants erect to ascending; shoots 1-3 cm long, by 0.6-0.9 mm wide (stems to 0.2 mm wide); irregularly branched and often julaceous, with leaves closely imbricate, and shoot tips often falcate; stem leaves ovate-deltoid, approximately 1.0 mm long by 0.5 mm wide, with tips acute to short-acuminate, margins serrulate to serrate throughout, and alar regions with 2-4 rows of small, quadrate or subquadrate alar cells, extending 8-12 cells up the margins; leaf costa single, well-demarcated, and 0.4-0.6 the length of the leaf, with the dorsal surface somewhat prorate; branch leaves similar to stem leaves, but more narrowly deltoid; perichaetial leaves narrowly deltoid at base, acuminate-lanceolate at tip, to 3 mm long by 0.6 mm wide.

The first specimen of *Homalotheciella subcapillata* was discovered in Nova Scotia in a mature hardwood forest of Digby County, Nova Scotia, in April, 2021. This area is part of the Clare Ecodistrict of the Southwest Ecoregion (Neily *et al.* 2017). The forest was dominated by sugar maple (*Acer saccharum*) and American beech (*Fagus americana*). Other tree species included red maple, yellow birch, and white ash. The species was detected on the lowest 3 m of the bole of a mature American Beech, which was approx. 20 cm diameter at 1.3 m from the ground.



**Fig 1** Leaves of *Brachytheciastrum collinum*, formerly considered to be the first record of *Homalotheciella subcapillata* in Canada, emphasizing overall leaf shape (a), leaf apex (b), and alar regions (c and d).

The colony had the following properties: Colony forming loose to dense, patchy mats with a yellowish-tinged, medium green colour, with shiny appearance (Fig 2); habit decumbent, with the first 2/3 of a shoot appressed against the bole and tending to grow in a downwards trajectory, and the last 1/3 becoming erect-pendulous, and giving an overall shingle-like appearance to the colony; primary shoots approx. 1.9 mm wide (stems approx. 0.2 mm) and to 2.7 cm long, branching pinnate to subpinnate, branches approximately 1.1 mm wide by 8 mm long; stem cortical cells small and thick-walled; stem and branch leaves erect-spreading, slightly imbricate to crowded but never julaceous, with a mean size of 1.2 mm long by 0.75 mm wide, ovate-elliptical in shape, with a long-apiculate apex (Fig 3); costa ending slightly above the mid-leaf to slightly below the apiculus; leaf margins serrulate; leaf lamina smooth (not plicate); leaf cells to 6 x longer than wide; alar regions with 3-5 rows of small, quadrate alar cells, extending 10-13 cells up the margins; sporophytes and reproductive features absent (colonies sterile).

After our first discovery of *H. subcapillata* in Nova Scotia, twelve more occupied trees were found within 30 km of the original (Fig 4), also on beech and in mature to old growth mixed hardwood forests (Table 1). All forests were well drained and they tended to be dominated by sugar maple, beech, and yellow birch (Table 1). Three of these occurrences were published online via the iNaturalist platform



**Fig 2** Habit of *Homalotheciella subcapillata* in-situ on American Beech trees in Digby County, Nova Scotia.



**Fig 3** Stem leaves shown under  $100\times$  magnification (a-c), alar region of stem leaf shown at  $100\times$  magnification, and transverse section of mature stem shown at  $400\times$  magnification.

(Ueda *et al.* 2017), including the first record, whereas others had voucher specimens collected that were donated to the E.C. Smith Herbarium at Acadia University.

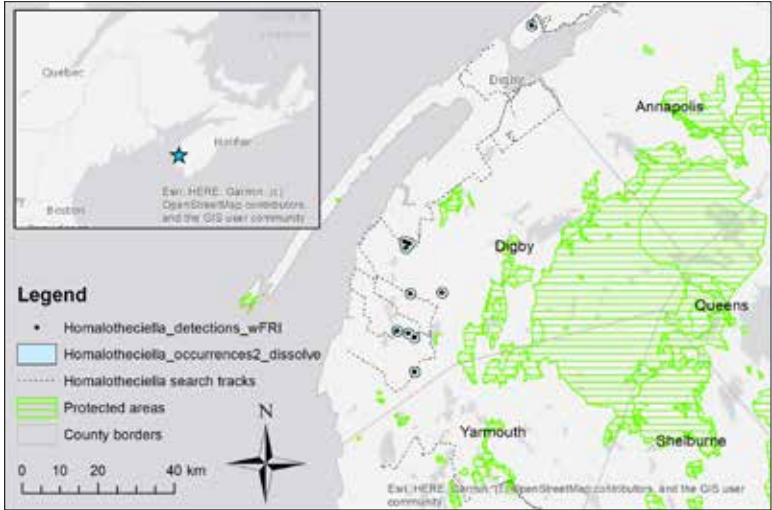


Fig 4 Distribution of detections, occurrences, and search tracks for *Homalotheciella subcapillata* in western Nova Scotia.

## DISCUSSION

As is clearly visible from the more elliptical leaf shape and the shorter apiculus, and as is apparent from the differences in growth habit, the previously purported first record for *Homalotheciella subcapillata* in Canada is actually a specimen of *Brachytheciastrum collinum*. Consequently, we regard our specimen, now in the Nova Scotia Museum of Natural History herbarium, as the first record of *H. subcapillata* in Canada.

It is difficult to say whether this occurrence represents a new colonization from places where the species is less rare (e.g., the southeastern United States), or a residual population from pre-industrial times, but we believe that the latter scenario is more likely for several reasons. First, several other bryophyte and lichen species in Nova Scotia have seen apparent population size increases in recent years due to expanded search effort, but had been known to occur in the province for several decades and have actually shown declines in abundance at repeatedly visited sites (e.g., *Pannaria lurida*: Maass 1986, COSEWIC 2016). Consequently, an increased number of occurrences for such taxa in Nova Scotia can contradict apparent population trends, particularly for under-studied ecosystems and taxa. Second, although

**Table 1** Characteristics of forest stands within which *Homalotheciella subcapitata* was detected. Stand structure, canopy composition, and basal area traits were all determined from provincial forest inventory data, which are interpreted from aerial photography (Province of Nova Scotia 2017). Depth to water table was based on the provincial wet areas mapping model (Province of Nova Scotia 2007).

Site name	Longitude	Latitude	Aerial photo year	Structure		Percent of canopy								Basal area (m <sup>2</sup> /ha)		Stand size (ha)	Estimated depth to water table (cm)
				Estimated crown closure	Estimated canopy height	<i>Abies balsamea</i>	<i>Acer rubrum</i>	<i>Acer saccharum</i>	<i>Betula alleghaniensis</i>	<i>Betula papyrifera</i>	<i>Fagus grandifolia</i>	<i>Picea rubens</i>	<i>Pinus strobus</i>	Softwood	Hardwood		
Hs1	-65.981	44.126	2010	75	12	20	30		40	10			7	16	8.66	532.50	
Hs2	-65.982	44.184	2010	65	16		10	50	10	30			0	22	2.69	423.75	
Hs3	-65.997	44.343	2011	65	15			40	20	20	20		7	16	12.41	101.00	
Hs4	-66.002	44.336	2011	60	16			30	40	20	10		3	18	1.30	253.50	
Hs5	-65.997	44.191	2010	65	19			50	20	30			0	25	16.97	1152.00	
Hs6	-65.997	44.191	2010	65	19			50	20	30			0	25	16.97	1152.00	
Hs7	-65.994	44.343	2011	65	15			40	20	20	20		7	16	12.41	573.25	
Hs8	-66.006	44.346	2011	70	14			40	30	20	10		4	19	3.98	568.50	
Hs9	-65.992	44.258	2011	90	7		20	40	20	20			0	15	4.46	1032.25	
Hs10	-65.917	44.260	2011	70	14	10	40				30	20	21	8	3.74	112.50	
Hs11	-66.023	44.195	2010	35	15		20	20		60			0	11	9.33	466.75	
Hs12	-66.002	44.336	2011	60	16			30	40	20	10		3	18	1.30	229.00	
Hs13	-66.002	44.335	2011	60	16			30	40	20	10		3	18	1.30	260.25	
Hs14	-65.706	44.710	2012	80	12	20	30		40	10			4	19	11.78	1067.50	

the first record of this species was from a mature forest in a private woodlot, this stand had been minimally managed (selective harvesting for firewood) for several decades, and the majority of stands this species was subsequently found within (Table 1) were old or old growth forests that had likely existed before the widespread use of industrial forest harvesting. Consequently, the species' habitats have likely been intact and minimally managed for at least several decades, and probably for close to a century. Third, the nearest source colony from which propagules could come outside of Nova Scotia is Maine, USA, over 100 km away across the Gulf of Maine, and the species is neither abundant nor common in most of its eastern North American range, so viable propagules are unlikely to reach Nova Scotia in large quantities on a regular basis. Finally, the species occurred in just under half of sites that appeared to have suitable host trees and were inspected on foot, and sites that were considered worth inspecting



were few and far between, suggesting that dispersal or establishment may be somewhat limited.

American Beech is thus far the only tree known to be a substrate for *Homalotheciella subcapillata* in Nova Scotia. This tree has been recently re-classified from “apparently secure” (S4) to “may be at risk / apparently secure” (S3S4), according to NatureServe subnational ranks. This change is primarily due to the rapid expansion of beech leaf-miner beetles (Sweeney & Johns 2016) and subsequent dieback of beech forest throughout the province. Mature, healthy beech forests have already become a rarity as a result of the widespread prevalence of beech canker disease in the province (Houston 1994). Furthermore, as a result of extensive land clearing and forest harvesting, mature to old growth hardwood forests in Nova Scotia are thought to have been severely reduced in extent, relative to their pre-colonial prevalence (Loo & Ives 2003). This combination of a rare or threatened habitat with apparently high substrate specificity and restriction to the extreme western part of the province, suggest that *Homalotheciella subcapillata* may be a species at risk in Nova Scotia and Canada. Conserving and promoting the recovery of old hardwood forests with beech components in the extreme western part of Nova Scotia should be a priority to ensure this species’ persistence. Additional survey work is also needed, to further test the apparent range restriction and rarity of *H. subcapillata* throughout the western part of the province.

#### **Specimens examined:**

*Homalotheciella subcapillata* (Hedw.) Broth. Canada: Nova Scotia:

Digby County: south of Big Pine Lake. April 13, 2021. Neily, Thomas H. #3266 (NSPM N023.021-063210P).

*Brachytheciastrum collinum* (Schleich. ex Müll. Hal.) Ignatov & Huttunen (revised from *Homalotheciella subcapillata* (Hedw.) Broth). CANADA, Saskatchewan, east of Saskatoon. 51.827°N, 105.586°W, September 2, 2012. Batten, Ryan #354 (UBC B236645).

*Pylaisia selwynii* Kindberg (revised from *Homalotheciella subcapillata* (Hedw.) Broth). U.S.A.: Missouri: Shannon County: Rocky Creek Falls. September 23, 1990. Allen, Bruce #9855 (UBC B133542).

*Pylaisia selwynii* Kindberg (revised from *Homalotheciella subcapillata* (Hedw.) Broth). U.S.A.: West Virginia: Upshur County:

Buckhannon Road. September 12, 1940. Phinney, H.K. (UBC B163819).

### LITERATURE CITED:

- Allen, B.** (2014). Maine Mosses (Volume 2): *Drumondiaceae-Polytrichaceae*. New York Botanical Garden Press, New York, NY, USA.
- Bagnell, B.A., Clayden, S.R. & Ireland, R.R.** (1993). Notes on New Brunswick and Nova Scotia mosses. *Bryologist* 96: 439-442.
- Basquill, S., Neily, T.H. & Haughian, S.R.** (2024). The genus *Sphagnum* in Nova Scotia: an annotated checklist of species with notes on their ecology, distribution, and conservation status. *Northeastern Naturalist* in review.
- Belland, R.J.** (2010). Mosses (Bryophyta) of the Atlantic Maritime Ecozone. In: Assessment of Species Diversity in the Atlantic Maritime Ecozone. (eds.) McAlpine, D.F. & Smith, I.M. (p.179-196) National Research Council of Canada, Ottawa, ON.
- Bryophyte Editorial Committee.** (2014). Flora of North America, north of Mexico Volume 28: Bryophyta - Mosses, part 2 (R. H. Zander, P. M. Eckel, T. T. McIntosh, M. R. Crosby, C. Delgadillo M., K. Gandhi, R. E. Magill, L. R. Stark, & D. H. Vitt, Eds.). Oxford University Press, New York, NY, USA.
- COSEWIC.** (2016). COSEWIC assessment and status report on the Wrinkled Shingle Lichen, *Pannaria lurida*, in Canada. Environment Canada, Ottawa, ON.
- Crum, H.A. & Anderson, L.** (1981). Mosses of Eastern North America. Columbia University Press, New York, NY, USA.
- Environment and Climate Change Canada.** (2022). Canadian Climate Normals 1991-2020 Data: Yarmouth Environment and Climate Change Canada Ottawa, ON.  
[climate.weather.gc.ca/climate\\_normals/results\\_1991\\_2020\\_e.html?searchtype=stnprov&lstprovince=ns&txtcentrallatmin=0&txtcentrallatsec=0&txtcentrallongmin=0&txtcentrallongsec=0&stnid=51000000&disback=0](https://climate.weather.gc.ca/climate_normals/results_1991_2020_e.html?searchtype=stnprov&lstprovince=ns&txtcentrallatmin=0&txtcentrallatsec=0&txtcentrallongmin=0&txtcentrallongsec=0&stnid=51000000&disback=0)
- Erskine, J.S.** (1968). An Introductory Moss Flora of Nova Scotia. Nova Scotia Museum, Halifax, NS.
- Erskine, J.S.** (1970). The Hepatics or Liverworts of Nova Scotia. Nova Scotia Museum, Halifax, NS.
- Haughian, S.R.** (2022). Collection assessment and strategic plan for the Herbarium of the Nova Scotia Museum, 2021-2025. Nova Scotia Museum, Halifax, NS.
- Haughian, S.R., Bagnell, B.A., Daley, E., Frego, K.A., Smith, L. & Clayden, S.R.** (2016). A checklist of the Marchantiophyta and Anthocerotophyta of New Brunswick, Canada. *Northeastern Naturalist* 23: 1-35.
- Houston, D.R.** (1994). Major new tree disease epidemics: beech bark disease. *Annual Review of Phytopathology* 32: 75-87.

- Ireland, R.R.** (1982). Moss Flora of the Maritime Provinces. National Museums of Canada, Ottawa, ON.
- Ireland, R.R. & Bellolio-Trucco, G.** (1987). Illustrated Guide to Some Hornworts, Liverworts and Mosses of Eastern Canada. National Museums of Canada, Ottawa, ON.
- Keddy, P.A. & Wisheu, I.C.** (1989). Ecology, biogeography, and conservation of coastal plain plants: some general principles from the study of Nova Scotian wetlands. *Rhodora* 91: 72-94.
- Loo, J.A. & Ives, N.** (2003). The Acadian forest: historical condition and human impacts. *Forestry Chronicle* 79: 462-474.
- Maass, W.S.G.** (1986). *Pannaria lurida* in Atlantic Canada. *Proceedings of the Nova Scotian Institute of Science* 36: 131-135.
- Mueller-Dombois, D. & Ellenberg, H.** (1974). Community Sampling: the relevé method. In: Aims and Methods of Vegetation Ecology. p. 45-66. John Wiley & Sons, Inc., Toronto, ON.
- NatureServe.** (2022). NatureServe Explorer: *Homalotheciella subcapillata*. [explorer.natureserve.org/taxon/element\\_global.2.126387/homalotheciella\\_subcapillata](https://explorer.natureserve.org/taxon/element_global.2.126387/homalotheciella_subcapillata)
- Neily, P., Basquill, S., Quigley, E. & Keys, K.** (2017). Ecological Land Classification for Nova Scotia. Province of Nova Scotia, Truro, NS, Canada.
- Province of Nova Scotia.** (2017). Forest Inventory - Current Forest Data Department of Natural Resources Truro, NS. [nsgisw.novascotia.ca/arcgis/rest/services/for/for\\_forest\\_ut83/maps/server](https://nsgisw.novascotia.ca/arcgis/rest/services/for/for_forest_ut83/maps/server)
- Province of Nova Scotia.** (2007). Nova Scotia Wet Areas Province of Nova Scotia Truro, NS. [www.novascotia.ca/natr/forestry/gis/wamdownload.asp](http://www.novascotia.ca/natr/forestry/gis/wamdownload.asp)
- Sweeney, J.D. & Johns, R.C.** (2016). Beech Leaf-mining Weevil. Ottawa, ON.
- Ueda, K., Belmonte, J., Shepard, A., Leary, P. & Loarie, S.** (2017). iNaturalist San Francisco, CA, USA. [www.inaturalist.org](http://www.inaturalist.org)
- Wiken, E.B.** (1986). Terrestrial Ecozones of Canada. Hull, Quebec, QC.

