

THE BRYOFLORA OF HAWK MOUNTAIN SANCTUARY, KEMPTON, PENNSYLVANIA¹

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ABSTRACT

Hawk Mountain Sanctuary is part of the Kittatiny Ridge of the Appalachian Mountain range and lies in the northwest corner of Berks County, Pennsylvania. The nearly 1000 ft. elevation gradient on Hawk Mountain allows a variety of topography-dependent habitats for flora and fauna. Although the vascular flora of Hawk Mountain has been documented, the bryoflora has not. In this investigation, the moss and liverwort diversity was examined to establish a baseline for future bryological research. Although collecting encompassed the entire mountain, sampling concentrated on specific sites which reflected the topographic variances. Twenty eight moss and 14 hepatic species comprise the bryoflora of Hawk Mountain, with moss diversity greater in the mid to upper elevations and hepatic diversity greater in the lowlands. Common Pennsylvania mosses such as *Brotherella recurvens* (Mx.) Fl., *Polytrichum ohioense* Ren. & Card. and *Platygyrium repens* (Brid.) BSG are frequent inhabitants, while rarer mosses such as *Anacamptodon splachnoides* (Froel ex Brid.) Brid. and *Leucobryum albidum* (Brid.) Lindb. are locally abundant. *Tetraphis pellucida* Hedw. is of note due to its preference for sandy and peaty soils rather than rotten logs and stumps. Prominent liverwort taxa include the Appalachian endemics *Lophocolea cuspidatum* fo. *alata* (Mitt. ex Larter) Schust. and *Diplophyllum apiculatum* (Evans) Steph.

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INTRODUCTION

Hawk Mountain Sanctuary is a 2400 acre natural area located in the Appalachian Mountains of eastern Pennsylvania. As its name suggests, Hawk Mountain is most notable as a major raptor flyway, but it also presents a variety of topography-dependent habitats for flora and fauna. Although the fauna and vascular plants of Hawk Mountain have been documented (Brett 1991), the moss and liverwort

floras have not. In this investigation, the bryophyte diversity of Hawk Mountain was examined in order to create a baseline useful for future bryological research.

Hawk Mountain is located in Albany Township in the northwest corner of Berks County. It is part of the Kittatiny Ridge, the southernmost of the series of northeast-southwest parallel ridges which comprise the Appalachian Mountains. Geologically, Hawk Mountain is part of the Ridge and Valley Province, bordered to the north by the Pocono Plateau, to the west by the Allegheny Plateau, and to the east by the Piedmont Plateau. The Kittatiny Ridge is largely composed of Martinsburg slates and shales with the ridgetop mainly composed of Tuscarora sandstone (Brett 1991). The soil and rocks of the region are primarily non-calcareous and acidic.

The elevation of the mountain ranges from approximately 600 ft. above sea level in the valley to 1550 ft. near the rocky outcrops of the North Lookout (Brett 1991). This 850 ft. gradient allows for a diverse assemblage of habitats ranging from rocky outcrops, vertical sandstone faces, and wooded slopes to lowland rhododendron groves, rocky streams, and intermittently wet to swampy flats. The vegetation is characterized by a mixed deciduous forest of broadleaved trees dominated by *Quercus prinus* L. (chestnut oak). The high ridgetops are dry, windblown, generally cooler, and exposed to extremes of weather; the soils are sandy, well-drained and often rocky. Habitat disruption on the mountaintop results from the activities of the many visitors who hike to the North and South Lookouts to observe bird migrations. (Over one million visitors have been to the Lookouts since 1934 [Brett 1991]). By comparison, the lowlands present more protected and moister microhabitats than do the open woodlands and rocky outcrops of upper elevations. These differences in substrate conditions, moisture, temperature and light intensity levels restrict the bryophyte distribution and diversity on Hawk Mountain.

MATERIALS AND METHODS

Although collecting encompassed all regions of the mountain, extensive sampling concentrated upon specific areas selected to reflect the topographical variety of Hawk Mountain. In the lowlands, collecting focused on 1) Kettle Creek, a clean, swift, rocky stream with shaded, peaty

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banks, 2) intermittently wet flats and swamps associated with Kettle Creek, and 3) The River of Rocks, an exposed boulder field which interrupts the lowland forest (Figure 1). The boulders comprising the River of Rocks originated on the South Lookout and slid to the present lowland position during the Wisconsin glaciation (Brett 1991). The intermittently exposed microhabitats of the wooded, midland slopes were sampled along the River of Rocks Trail directly below the North and South Lookouts, while specific upland sites consisted of 1) the windswept, rocky outcrops of the North and South Lookouts, 2) the open woodlands and ridgetops along the Scenic Lookout Trail, and 3) the vertical sandstone faces of The Hall of the Mountain King (Figure 1). Collections are housed in the Darlington Herbarium at West Chester University (DWC).

RESULTS AND DISCUSSION

A total of 42 bryophyte species were identified on Hawk Mountain. Twenty eight moss species representing 17 families, 8 orders and 2 classes of the division Bryophyta and 14 hepatic species representing 9 families and 2 orders of the division Hepatophyta were identified. Ecologically speaking, 9 taxa, designated by "+" in the checklist are strict acidophiles or prefer acid substrates. Nine species, designated by "#" in the checklist are well-known pioneers of disturbed sites (Moul 1952; Schuster 1966, 1967, 1974, 1980, 1992a, 1992b; Crum and Anderson 1981).

Overall, the greatest bryophyte diversity occurs along the River of Rocks Trail on midland slopes, while the least diversity exists in upper elevations, particularly on the North and South Lookouts. Moss diversity is greater in the mid to upper elevations, while lowland habitats support a greater liverwort diversity. Mosses such as *Brotherella recurvans* (Mx.) Fl., *Polytrichum ohioense* Ren. & Card.,

Plagiomnium affine Bland. ex Finck var. *ciliare* C.M., *Platygyrium repens* (Brid.) BSG, *Rhynchostegium serrulatum* (Hedw.) Jaeg. & Saurb., and *Leucobryum albidum* (Brid.) Lindb. are the most abundant over the entire mountain. With the exception of *L. albidum*, these mosses are common throughout Pennsylvania (Porter 1904; Jennings 1951; Moul 1952). Moul (1952) suggested that *L. albidum* is a Coastal Plain species which is confined to the southeastern and southwestern counties of Pennsylvania.

Tetraphis pellucida Hedw. is also common, particularly in the mid to low elevations. However, the substrate preference of *T. pellucida* on Hawk Mountain is of note since, in its circumpolar range, it usually inhabits old, rotting stumps and logs, and only rarely occurs on soil (Lesquereux and James 1884; Crum and Anderson 1981; Kimmerer 1993). Jennings (1951) and Moul (1952) recorded *T. pellucida* from Pennsylvania as occurring on soil and conglomerate rock, pH4, but stated that it grows almost exclusively on rotten wood and humus. On Hawk Mountain, *T. pellucida* was found only on peaty and sandy soils.

One sporadic, albeit interesting inhabitant of Hawk Mountain is *Anacamptodon splachnoides* (Froel ex Brid.) Brid., the "knot-hole moss". As its common name denotes, this moss is typically found on moist, rotten bark in the knotholes of trees. Its existence on Hawk Mountain is noteworthy in that, despite being widespread in eastern North America, *A. splachnoides* is of uncommon occurrence (Lesquereux and James 1884; Jennings 1951; Crum and Anderson 1981). Pursell (1973) regarded *A. splachnoides* as rare or at least infrequently collected in Pennsylvania.

Grimmia apocarpa Hedw. is the sole bryophytic inhabitant of the exposed boulders of the River of Rocks where it exists along with crustose and foliose lichens. This well-known pioneer of exposed rock is fairly common in Pennsylvania at elevations of 50 - 1100 ft. (Moul 1952).

The liverwort flora is typified by ubiquitous taxa such

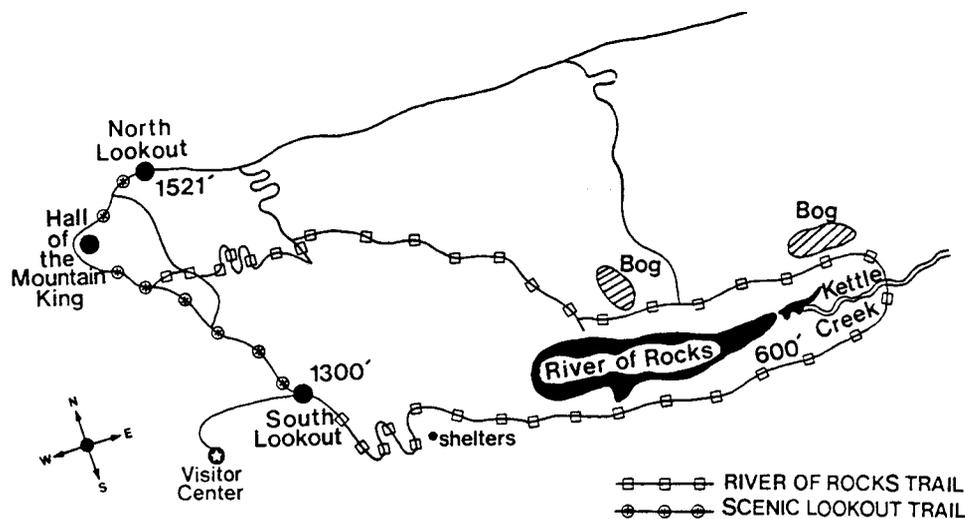


FIGURE 1. Map of Hawk Mountain showing major localities, trails, and elevations.

as *Lophocolea heterophylla* (Schrad.) Dum. and *Odontoschisma prostratum* (Sw.) Trev. Although these are common eastern North American taxa, *O. prostratum* is restricted to unglaciated regions (Schuster 1974). Hawk Mountain represents such a locale, as during the Wisconsin glaciation the ultimate front of the continental ice sheet was approximately 45 miles to the north on the Pocono Plateau (Brett 1991).

Of the 14 hepatic species found on the mountain, 8 are virtually exclusive to lowland habitats. These include common taxa such as *Nowellia curvifolia* (Dicks.) Mitt., *Scapania nemorosa* (L.) Dum., *Kurzia sylvatica* (Evans) Grolle, and the only simple thalloid liverwort found on the mountain, *Pallavicinia lyellii* (Hook.) Carruth. The less common taxon, *Cephaloziella hampeana* (Nees) Schiffn. inhabits the shaded banks of Kettle Creek. Although *C. hampeana* is reportedly widespread in eastern North America, it is rare south of New York and its range extends southward only in the Appalachian Mountains (Schuster 1980).

Prolific populations of *Frullania eboracensis* Gott., *F. tamarisci* (L.) Dum. subsp. *asagrayana* (Mont.) Hatt., *Ptilidium pulcherrimum* (Web.) Hampe and the distinctly Appalachian taxa of *Lophocolea cuspidatum* fo. *alata* (Mitt. ex Larter) Schust. and *Diplophyllum apiculatum* (Evans) Steph. are common in the mid to upper elevations of Hawk Mountain. According to Schuster (1980), *L. cuspidatum* fo. *alata* is exclusive to the Appalachian Mountains of the Ridge and Valley Province, being absent in the Coastal Plain and the Piedmont. *Diplophyllum apiculatum* is an acidophile with a wide light tolerance which forms extensive mats on both sandstone and peaty soils and is particularly abundant in The Hall of the Mountain King. This taxon is an endemic of the temperate, deciduous forests of eastern North America and is very likely of Appalachian origin (Schuster 1974).

CHECKLIST OF THE MOSSES AND LIVERWORTS OF HAWK MOUNTAIN, BERKS COUNTY, PENNSYLVANIA

(Taxa are arranged alphabetically within the respective divisions. Moss nomenclature follows that of Crum and Anderson [1981]). Liverwort nomenclature follows that of Stotler and Crandall-Stotler [1977].)

DIVISION BRYOPHYTA (mosses)

1. *Anacamptodon splachnoides* (Froel ex Brid.) Brid. - Rare, sheltered in knotholes on underside of fallen tree; *Bartholomew-Began* 290.
- #2. *Atrichum angustatum* (Brid.) BSG - Common on soil in open woodlands; *Bartholomew-Began* 304.
3. *Brachythecium curtum* (Lindb.) Limpr. Common on thin soil over rock in open woodlands; *Bartholomew-Began* 342.
4. *Brotherella recurvans* (Mx.) Fl. - Common on moist soil in shaded sites; *Bartholomew-Began* 298, 319, 329.
5. *Bryum argenteum* Hedw. - Common at edges and between bricks of walkways near the visitor center; *Bartholomew-Began* 341.
6. *Bryum caespiticium* Hedw. - Abundant on sterile soils in disturbed sites and in crevices of rocky outcrops; *Bartholomew-Began* 347, 348, 351.
- + #7. *Dicranella heteromalla* (Hedw.) Schimp. - Occasional on bark at tree bases, locally associated with *Ptilidium pulcherrimum*, on thin soil over rock, sandy soil along woodland trails and on shaded banks in open woodlands; *Bartholomew-Began* 284, 303.

- +8. *Dicranum scoparium* Hedw. - Common on soil in open woods, often associated with *Leucobryum albidum* and *Thuidium delicatulum*; *Bartholomew-Began* 266, 293.
- #9. *Ditrichum pusillum* (Hedw.) Hampe - Rare, on bare, sandy soil over sandstone blocks and at bases of vertical sandstone cliffs in The Hall of the Mountain King; *Bartholomew-Began* 310, 317.
10. *Fontinalis darlicarlica* BSG - Abundant, attached to rocks and submerged in swiftly flowing water; *Bartholomew-Began* 277.
11. *Fontinalis novae-angliae* Sull. - Abundant, attached to various substrates and submerged in shallow-flowing water; *Bartholomew-Began* 273.
12. *Funaria flavicans* Mx. - Common on sterile soils in exposed, disturbed sites; *Bartholomew-Began* 346.
- #13. *Grimmia apocarpa* Hedw. - Occasional on dry, exposed boulders; *Bartholomew-Began* 270.
14. *Hypnum curvifolium* Hedw. - Common on thin soil over rock in moist, shaded woodland sites; *Bartholomew-Began* 289.
- +15. *Isopterygium elegans* (Brid.) Lindb. - Rare on sandy soil in crevices of sandstone cliffs; *Bartholomew-Began* 307.
16. *Isopterygium tenerum* (Sw.) Mitt. - Rare on sandy soil at bases of rocks in very sheltered woodland sites; *Bartholomew-Began* 295.
17. *Leucobryum albidum* (Brid.) Lindb. - Abundant, on soil along trails and in open woodlands, locally associated with *Dicranum scoparium*, *Thuidium delicatulum* and *Polytrichum ohioense*, occasional on moist logs, locally intermixed with *Lophocolea heterophylla*, *Ptilidium pulcherrimum* and *Ulota* sp., and on sandstone cliffs; *Bartholomew-Began* 263, 267, 294, 307.
18. *Orthotrichum ohioense* Sull. & Lesq. ex Aust. - Common on bark of trees usually near flowing water; *Bartholomew-Began* 299.
19. *Plagiomnium affine* Bland. ex Finck var. *ciliare* C.M. - Abundant on moist to wet soil in shaded locations, often along stream banks and under leaf litter in woodlands; *Bartholomew-Began* 268, 287, 301.
20. *Plagiomnium cuspidatum* Hedw. - Common on moist, peaty soil in shaded locations; *Bartholomew-Began* 344.
- #21. *Platygyrium repens* (Brid.) BSG - Abundant on bark at tree bases and on logs; *Bartholomew-Began* 262, 272, 320, 359.
22. *Pleurozium schreberi* (Brid.) Mitt. - Common and locally abundant on thin soil over rock in open woodlands; *Bartholomew-Began* 240.
23. *Polytrichum ohioense* Ren. & Card. - Common and locally abundant on moist humus and sandy soils along trails and in open woodlands; *Bartholomew-Began* 280, 311, 321.
24. *Rhynchostegium serrulatum* (Hedw.) Jaeg. & Saurb. - Abundant on moist, shaded, peaty soil, on wood, and in crevices of sandstone cliffs; *Bartholomew-Began* 274, 275, 278, 279, 292.
25. *Sphagnum compactum* DC ex Lam. & DC - Common and locally abundant on soil in wet to boggy lowland flats and near ponds; *Bartholomew-Began* 339.
- +26. *Tetraphis pellucida* Hedw. - Abundant on shaded, moist, peaty or sandy soils along stream banks and in sheltered woodland sites; *Bartholomew-Began* 300, 323, 324, 325, 330, 332, 333, 335.
- +27. *Thuidium delicatulum* (Hedw.) BSG - Common and locally abundant on moist, shaded soil near stream banks; *Bartholomew-Began* 331.
- +28. *Ulota hutchinsiae* (Sm.) Hamm. - Occasional, but locally abundant on acidic, noncalcareous rocks in somewhat exposed areas of open woodlands; *Bartholomew-Began* 286.

DIVISION HEPATOPHYTA (liverworts)

29. *Calypogeia muelleriana* (Schiffn.) K. Mull. subsp. *muelleriana* - Occasional on moist, peaty soil along stream banks in sheltered, lowland habitats, locally associated with *Tetraphis pellucida*; *Bartholomew-Began* 327.
30. *Cephaloziella hampeana* (Nees) Schiffn. - Occasional on wet soil along lowland streams, intermixed with *Odontoschisma prostratum*; *Bartholomew-Began* 338.
- +31. *Diplophyllum apiculatum* (Evans) Steph. - Abundant in crevices of sandstone cliffs and on peaty to sandy soil banks in The Hall of the Mountain King, often associated with *Leucobryum albidum* and *Rhynchostegium serrulatum*; *Bartholomew-Began* 312, 313, 315, 316.

- #32. *Frullania eboracensis* Gott. - Abundant on the bark of trees and corticate logs in open woodlands; *Bartholomew-Began* 269, 282, 283.
33. *Frullania tamarisci* (L.) Dum. subsp. *asagrayana* (Mont.) Hatt. - Common on acidic rocks; *Bartholomew-Began* 288.
- + 34. *Kurzia sylvatica* (Evans) Grolle - Rare on moist, peaty soil in sheltered lowland habitats along streams, locally associated with *Calypogeia muelleriana*, *Tetraphis pellucida*, and *Cephaloziella hampeana*; *Bartholomew-Began* 327.
35. *Lophocolea cuspidata* fo. *alata* (Mitt. ex Larter) Schust. - Occasional, but locally abundant on moist humus at tree bases; *Bartholomew-Began* 360, 361.
- #36. *Lophocolea heterophylla* (Schrad.) Dum. - Abundant, on various organic substrates such as moist, peaty soil, decorticate logs, and bark at tree bases, also on loose sandstone in crevices of the vertical walls of The Hall of the Mountain King; *Bartholomew-Began* 271, 291, 297, 308, 309, 345.
- + #37. *Nowellia curvifolia* (Dicks.) Mitt. - Occasional, limited to moist, decorticate logs in lowland sites, associated with *Lophocolea heterophylla*; *Bartholomew-Began* 322.
38. *Odontoschisma prostratum* (Sw.) Trev. - Abundant, on moist soil along streams, locally associated with *Tetraphis pellucida* and *Cephaloziella hampeana*, on moist, noncalcareous rocks, on bark at tree bases, and in somewhat exposed sites at bases of vertical sandstone cliffs; *Bartholomew-Began* 285, 296, 302, 314, 337.
- + 39. *Pallavicinia lyellii* (Hook.) Carruth. - Common on wet, shaded soil along lowland streams; *Bartholomew-Began* 334, 336.
40. *Ptilidium ciliare* (L.) Hampe - Occasional, but locally abundant at mid to upper elevations on rock in somewhat protected sites; *Bartholomew-Began* 353.
- #41. *Ptilidium pulcherrimum* (Web.) Hampe - Abundant at mid to upper elevations on decaying logs, locally associated with *Leucobryum albidum*, *Lophocolea heterophylla*, *Dicranella heteromalla* and *Rhynchostegium serrulatum*, also occasional on vertical rock walls; *Bartholomew-Began* 275, 281, 318, 358.
42. *Scapania nemorosa* (L.) Dum. - Common on soil over rocks at edges of streams; *Bartholomew-Began* 265.

+ acidophiles, #pioneers.

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