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NEW ENGLAND NOTE

TWO FERN SPECIES NEW TO NEW HAMPSHIRE, WITH COMMENTS ON THE GENERATION OF CALCAREOUS-LIKE HABITAT BY BASE-POOR ROCKS

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Incidental to other field investigations, I happened upon small populations of two fern species not previously reported from New Hampshire: *Pellaea atropurpurea* (L.) Link and *Dryopteris filix-mas* (L.) Schott. Both species are typically associated with calcareous habitats, although limestone and marble are nearly absent from New Hampshire bedrock. The presence of these ferns provides examples of how other types of bedrock may accommodate calciphilic taxa, thus increasing the biodiversity of the Granite State.

On September 22, 2003, I located four individuals of *Pellaea atropurpurea* growing in joints on a sparsely vegetated cliff at approximately 550 m elevation on Hart Ledge, Harts Location, Carroll County. The southwest-facing cliff is composed of hornblende syenite, consistent with previous bedrock mapping (Henderson et al. 1977). The cliff was partially shaded by *Acer saccharum* Marshall, *Picea rubens* Sarg., and *Quercus rubra* L. Other taxa observed on the cliff included *Aquilegia canadensis* L., *Cystopteris fragilis* (L.) Bernh., *Poa compressa* L., and *Symphyotrichum cordifolium* (L.) G.L. Nesom. A voucher (*Bailey 03-001*) consisting of a partial frond and a photograph is on deposit at the New England Botanical Club Herbarium (NEBC).

Pellaea atropurpurea is widespread in North America, typically growing on dry calcareous cliffs and rocky slopes, usually of limestone (Flora of North America Committee 1993+). It is considered uncommon (S3) in Vermont, where the known stations closest to Hart Ledge are at Westmore, Orleans County, 90 km to the northwest and Hartford, Windsor County, 100 km to the southwest. It has not been reported from Maine or from Canada

east of the northern extension of the Green Mountains in southwestern Quebec. Thus, this record represents a modest extension in the northeast corner of the fern's range.

On July 16, 2008, I located a population of approximately 50 plants of *Dryopteris filix-mas*. The population was growing in a rocky spring at approximately 970 m elevation at the head of Columbia Brook in Stratford, Coos County. The colony was in a nearly level opening about 50 m^2 with a thick organic-rich A-horizon and abundant cobbles of hornblende syenite. Outcrops of hornblende syenite bedrock were found in the forest on steeper slopes above the spring, and are consistent with bedrock mapping (Hatch 1963). The spring is in an opening within subalpine forest dominated by *Abies balsamea* (L.) Mill., *Betula cordifolia* Regel, and *Picea rubens*. Associated taxa include *Actaea rubra* (Aiton) Willd., *Circaea alpina* L., *Dryopteris campyloptera* (Kunze) Clarkson, *Galium kamtschaticum* Steller *ex* J.A. & J.H. Schultes, *Phegopteris connectilis* (Michx.) Watt, *Ribes lacustre* (Pers.) Poir., *R. triste* Pall., *Solidago macrophylla* Pursh, and *Tiarella cordifolia* L. Specimens (*Bailey 08-020*, *10-008*) are deposited at the Pringle Herbarium (VT) and Hodgdon Herbarium (NHA).

Typical *Dryopteris filix-mas* habitat in northeastern North America has been described as dense woods and talus slopes on limestone (Flora of North America Committee 1993+). The nearest known populations are 95 km southwest in Groton, Caledonia County, Vermont (Gilman 1999) and 70 km northeast in Bowmantown, Oxford County, Maine (*Rooney and McMahon 76426* MAINE). It is considered threatened (S2) in Vermont and endangered (S1) in Maine.

Perhaps not coincidentally, both of these populations of calciphilic fern species were found in habitat developed in hornblende syenite bedrock. This felsic, intrusive igneous rock is found in several locations as part of the White Mountain magma series in central and northern New Hampshire (Lyons et al. 1997). Elsewhere, this bedrock supports other calciphilic ferns. For example, *Woodsia glabella* R. Br. *ex* Richardson and *Cryptogramma stelleri* (S.G. Gmel.) Prantl occur on cliffs in Northumberland, Coos County, and *Dryopteris goldiana* (Hook. *ex* Goldie) A. Gray and associated rich mesic hardwood communities occur in Northumberland, Coos County (Bowman and Bailey 2007) and Albany, Carroll County. There is also an extensive rich mesic hardwood community downslope of the Hart Ledge site. However,

this lithology typically has low calcium content (Billings and Wilson 1964) and has not been reported to contain carbonate minerals such as calcite and dolomite, the presence of which is generally responsible for development of calcareous habitats.

Comparison of topographic and bedrock maps shows that hornblende syenite in the White Mountains tends to form upland knobs and ridges, attesting to its resistance to erosion. Mineral components that are highly resistant to chemical weathering are quartz (~10% composition) and perthite (~80% composition), a potassium-sodium feldspar. The remaining 10% mineral composition is hornblende and pyroxenes, calcium-bearing silicate minerals that are more susceptible to chemical weathering (Hatch 1963; Henderson et al. 1977). Areas underlain by hornblende syenite are typically punctuated by cliffs displaying closely spaced joints or fractures that intersect in multiple directions. This creates the potential for a ''plumbing system'' that transports water through the bedrock and creates the opportunity for extensive frost wedging, resulting in abundant talus slopes beneath the cliffs. This fractured-rock groundwater system also provides a medium for water-rock interaction. High dissolved calcium concentrations and secondary calcite deposits in joints (Bowman and Bailey 2007) suggest that, although the host rock is relatively calcium-poor and resistant to chemical weathering, long flow paths or residence time of water in the rock are sufficient to result in mineralized groundwater, with discharge that creates a habitat resembling that found on calcareous rocks such as limestone or marble.

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