



Lichens of Selected Vernal Pools in Acadia National Park, Maine



Abstract- Six selected vernal pools in Acadia National Park were surveyed to identify lichen diversity in temporary pool habitats. Sixty-seven species were identified, including seven species never reported for Acadia National Park. The survey represents the first survey of lichens found in vernal pools in Acadia National Park and our findings represent the richness of lichen assemblages to be found in this unique habitat type. Further work is needed to determine how lichen assemblages are distributed across the range of temporary pool habitats found throughout the park and in New England.

Introduction -Vernal pools are limited-duration annual wetlands resulting from seasonal fluxes in precipitation (Cutko and Rawinski 2008). The ephemeral hydro-period associated with vernal pools creates a challenging environment, often contributing to the assembly of unique communities of plants and animals, including many rare and endangered plant species (Barbour et al. 2005; Calhoun & deMaynadier 2008; Deil 2005; Gerhardt & Collinge 2003). Fall through spring precipitation dictates the hydro-period of these seasonal wetlands (Keeley & Zedler 1998; Schneider & Frost 1996; Zedler 2003). In addition to limited water availability, vernal pools also are characterized by low nutrient availability and fluctuating levels of pH, dissolved oxygen and carbon dioxide, and salinity (Keeley & Zedler 1998; Tiner et al. 2002). The lichen community composition in vernal pools is the result of strong ecological selection on species (Kershaw 1985) from fluctuating moisture and large seasonal shifts in thallus saturation (Larson 1979). In Acadia National Park (ANP) on Mount Desert Island, Maine, extensive research has characterized lichen diversity and communities (Bennett et al. 2005; Cleavett et al. 2009; Selva 1994; Sullivan 1996; Wetmore 1984), however these works did not identify vernal pool-associated lichens. The oversight in ANP is similar for North America with only a handful of studies (Björk & Dunwiddie 2004) being reported. Our objectives were to identify lichens found in select ANP vernal pools to learn if these ephemeral pools harbor new or un-reported species for the park and to add to the existing findings about these unique ecological communities.

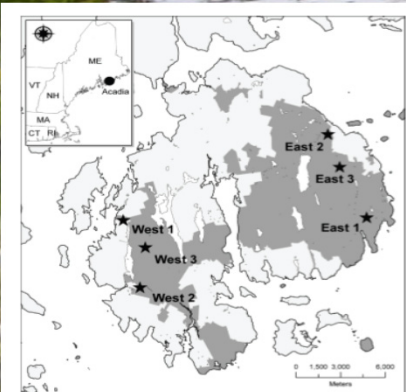
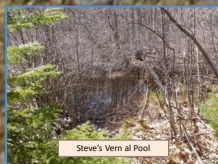


Figure 1. Locations of the six vernal pools selected for study in Acadia National Park, Mount Desert Island, Maine. Pools are labeled by location on the island and pool number and correspond to names given to each pool by Acadia National Park (East 1 = East Otter Creek, East 2 = Steve's, East 3 = Bill's Winterberry, West 1 = Long Pond, West 2 = Western Mountain Fire Road South, and West 3 = Western Mountain Trail). Shaded areas indicate Acadia National Park. Credit: Sarah Nelson.

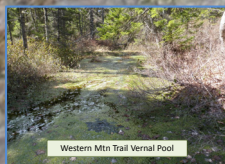
Study Area-Methods. The study sites have been used by other investigators, most recently by Ciccotelli et al. (2011) & Barton et al. (2014), for more than 15 years. All study sites are located in ANP, Mount Desert Island (MDI), with three sites on the east and west side of the island. We re-established five transects (Ciccotelli et al. 2011) at each pool in May 2012, radiating at 72 degree intervals from the deepest part of the pool extending to the spring high water mark of each pool (Ciccotelli et al. 2011). In quadrats located along the transects lichen specimens were collected from hardwoods, conifers, decaying wood, moss, rock and soil substrates to a height not exceeding .5m above spring high water mark (Barton et al. 2014). Lichens were identified using Brodo et al. (2001), Gowan & Brodo (1988), Hinds & Hinds (2007), and Wetmore (2005). Nomenclature follows Esslinger (2013) for lichens and the International Plant Names Index (2013) for plants. Voucher specimens were deposited at the Herbarium of College of the Atlantic (HCOA).



Bill's Winterberry Vernal Pool



Steve's Vernal Pool



Western Mtn Trail Vernal Pool

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Literature Cited.
Please See Separate Printout

Lichens in Vernal Pools of Acadia National Park, Maine

* = Rare or occasional in Maine + = newly documented in Acadia National Park

Bryoria furcellata (Fr.) Brodo & D. Hawksw.
Buellia disciformis (Fr.) Mudd
B. erubescens Arnold
Cladonia caespiticia (Pers.) Flörke
C. chlorophaea (Flörke ex Sommerf.) Spreng.
C. coniacraea (Flörke) Spreng.
C. cristatella Tuck.
C. digitata (L.) Hoffm.
C. macilenta Hoffm.
C. maxima (Asah.) Ahti
C. ochrochlora Flörke
C. parasitica (Hoffm.) Hoffm.
C. ramulosa (With.) J. R. Laundon
C. scabriuscula (Delise) Nyl.
C. squamosa Hoffm.
C. stygia (Fr.) Ruoss
Evernia mesomorpha Nyl.
**Everniastrum cataractense* (Degel.) Hale ex Sipman
Flavoparmelia caperata (L.) Hale
+*Fuscidea arboricola* Coppins & Tønsberg
Graphis scripta (L.) Ach.
+*Hypogymnia incurvodes* Rass.
**H. krogiae* Ohlsson
H. physodes (L.) Nyl.
H. tubulosa (Schaer.) Hav.
Imshaugia aleurites (Ach.) S. L. F.Mey.
Julella fallaciosa (Stizenb. e Arnold) R. C. Harris
Lasallia papulosa (Ach.) Llano
Lecanora allophana Nyl.
L. caesiobubella Ach.
L. chlorotera Nyl.
L. cinereofusca H. Magn.
L. hybocarpa (Tuck.) Brodo
L. pulicaris (Pers.) Ach.
L. subrugosa Nyl.
L. symmicta (Ach.) Ach.
L. thysanophora R. C. Harris
Lepraria lobificans Nyl.
+*L. finkii* (de Lesd.) R. C. Harris
Loxospora ochrophaea (Tuck.) R. C. Harris
L. elatina (Flot.) A. Massal.
Melanelia subaurifera (Nyl.) O. Blanco, A. Crespo,
Divakar, Essl., D. Hawksw. & Lumbsch
Mycoblastus affinis (Schäer.) T. Schauer
Ochrolechia arborea (Kreyer) Almb.
Parmelia squarrosa Hale
P. sulcata Taylor
Parmeliopsis hyperopta (Ach.) Arnold
Pertusaria amara (Ach.) Nyl.
P. multipunctoides Dibben
P. ophthalmiza (Nyl.) Nyl.
+*Phaeographis inusta* (Ach.) Müll. Arg.
Platismatia glauca (L.) W. L. Culb. & C. F. Culb.
P. tuckermanii (Oakes) W. L. Culb. & C. F. Culb.
**Pseudevernia cladonia* (Tuck.) Hale & W. L. Culb.
P. consocians (Vain.) Hale & W. L. Culb.
Punctelia rudecta (Ach.) Krog
Pyrrhospora varians (Ach.) R. C. Harris
+*Ropalospora viridis* (Tønsberg) Tønsberg
Tuckermannopsis americana (Sprengel) Hale
Usnea filipendula Stirt.
+**U. flammea* Stirt.
U. hirta (L.) F. H. Wigg.
**U. merrillii* Motyka
U. subgracilis Vain
U. subfloridana Stirt.
U. subrubicunda P. Clerc
Violella fucata (Stirt.) T. Sprib.



Lepraria finkii



Ropalospora viridis

Results. Sixty-seven lichen species were identified from the six vernal pools. Of these 16 were foliose (23.9%), 24 were fruticose (35.8%), 25 were crustose (37.3%), and two were leprose (~3%). *Cladonia*, *Lecanora*, and *Usnea* were the most well-represented genera in the six pools. Fourteen *Cladonia* species were found in the vernal pools compared to seven each of *Lecanora* and *Usnea*. Five species of macrolichens found in the pools are listed as rare or occasional in Maine: *Everniastrum cataractense*, *Hypogymnia krogiae*, *Pseudevernia cladonia*, *Usnea flammea*, *Usnea merrillii* (Hinds & Hinds 2007). Seven lichen species were previously undocumented in ANP: *Fuscidea arboricola*, *Hypogymnia incurvodes*, *Lepraria finkii*, *Phaeographis inusta*, *Ropalospora viridis*, *Usnea flammea*, and *Violella fucata* and six of these were found in only one of the six pools. *Usnea flammea* was the only new record for ANP also listed as uncommon in Maine by Hinds & Hinds (2007). Only three species (~ 4%), *Buellia disciformis*, *Graphis scripta*, and *Hypogymnia physodes* were found in all six pools while twenty-nine species (~ 43%) were found in only one of the six pools.

Unique Vernal Pool Species in ANP

Rare-: *Everniastrum cataractense*, *Hypogymnia krogiae*, *Pseudevernia cladonia*, *Usnea flammea*, *Usnea merrillii* (Hinds & Hinds 2007).

Previously Undocumented- *Fuscidea arboricola*, *Hypogymnia incurvodes*, *Lepraria finkii*, *Phaeographis inusta*, *Ropalospora viridis*, *Usnea flammea*, and *Violella fucata*

Recommendations. 1) Conduct a detailed study examining species differences and zonation along sampling transects in relationship to water depth and hydro-periods from year to year, 2) Conduct further micro-lichen investigations, not only in ANP, but for all National Parks of North America, to continue the discovery of new records as has been recently reported in recent surveys (Barton et al. 2014; Knudsen et al. 2013; Lendemer et al. 2010, 2013; Spribille et al. 2010), 3) Conduct research to determine the presence of zonation among lichens found in the vernal pools, 4) Conduct research to learn if lichens reported in this study represent a lichen community distinct from that of the surrounding forest or are exclusive to pools within different areas of the Park, region, or northeastern North America, and 5) Conduct additional investigations for cyano-lichens that were conspicuously absent in our study, even though common host species and habitats were found in some of the vernal pools studied.

Conclusion. The study of lichen species found in vernal pools will help evaluate how abiotic factors such as fluctuating water regimes, pH, and ionic concentrations may influence community organization. The findings will provide a baseline for research being conducted in similar but stressed environments and be valuable in identifying resource degradation, mitigation efforts, and restoration goals. Recent wetland conservation setbacks (Oscarson & Calhoun 2007; Zedler 2003) have placed approximately one third of the remaining vernal pools in the United States currently unprotected, and while this is a preliminary study of vernal pool lichens, the process and results will be helpful in continuing conservation efforts for all temporary pool environments in northeastern North America. Finally, our study stresses the importance of continuing field surveys even in the 'well-studied' National Parks, with a particular emphasis on specialized habitats that are often under-explored.

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