

## Geological substratum, herbaceous, shrub, and tree vegetation and floristic diversity of mature upland forest sites in northern New Jersey

Donald W. Davidson

*Summary:* Data from forty stands of herbaceous and shrub plants and 29 stands of trees of upland forests in northern New Jersey were used to determine the impact of geological substratum on species diversity of herbaceous, shrub and tree plants. Ten different substrata were studied. The ten geological substrata were Kittatinny Limestone, Martinsburg Shale, Brunswick Shale, Triassic Conglomerate, Basalt, Longwood Shale, Gneiss (Byrum, Pochuck and Losee), High Falls Sandstone, Green Pond Conglomerate and Shawangunk Conglomerate. Greatest diversity was found in herbaceous plants on Gneiss (118 species), Martinsburg Shale (95), High Falls Sandstone (80) and Kittatinny Limestone (82).

Species, which were restricted to specific substrata, are discussed for herbaceous, shrub and tree species. These studies encompass 171 species of herbaceous plants.

For herbs, the ten geological substrata were Kittatinny Limestone (82 species per substratum), Martinsburg Shale (95), Brunswick Shale (18), Triassic Conglomerate (45), Basalt (68), Longwood Shale (25), Gneiss (Byrum, Pochuck and Losee 118), High Falls Sandstone (80), Green Pond Conglomerate (19), and Shawangunk Conglomerate (37).

For shrubs, the ten geological substrata were Kittatinny Limestone (15 species per substratum), Martinsburg Shale (23), Brunswick Shale (6), Triassic Conglomerate (19), Basalt (23), Longwood Shale (10), Gneiss (Byrum, Pochuck and Losee 31), High Falls Sandstone (21), Green Pond Conglomerate (14), and Shawangunk Conglomerate (9). Greatest diversity was over Gneiss. These studies encompass 45 shrub species.

For trees, the ten geological substrata were Kittatinny Limestone (24), Martinsburg Shale (22), Brunswick Formation (11), Triassic/Border Conglomerate (15), Basalt (24), Longwood Shale (12), Gneiss (no data available), High Falls Sandstone (24), Green Pond Conglomerate (11), and Shawangunk Conglomerate (14).

Keywords: geological substrata, trees, shrubs, herbs, upland forest, flora of New Jersey, species diversity

In DAVIDSON (2004a), Table 5 shows 39 taxa restricted to specific substrata or substrata not having restricted species of herbaceous plants. These substrata are:

Kittatinny Limestone	6 species
Basalt	1 species
Longwood Shale	1 species
Gneiss	15 species
High Falls Sandstone	7 species
Shawangunk Conglomerate	2 species
Martinsburg Shale	6 species
Triassic/Border Conglomerate	2 species

Substrata not having restricted species: Green Pond Conglomerate, Brunswick Formation.

In examining the list of 171 herbaceous plants which are shown in DAVIDSON (2004a: tab. 1) the author carefully examined the comments of each species relative to soil and habitat

## D. W. DAVIDSON

specificity of the species in GLEASON & CRONQUIST (1991) and many of these have specific substrate characteristics, such as rocky or sandy, rich soil, rich woods, bogs, and moist habitats (tables 1 & 2), but with the exceptions of *Asplenium trichomanes*, *Camptosorus rhizophyllus*, and *Senecio obovatus*, all growing from calcareous materials, none of the 171 herbaceous taxa can really be said to be identified with particular substrate based on this literature review. These studies of DAVIDSON (2004a), particularly Table 5 (39 species of herbs), do show specificity of herbaceous plants to ten geological substrata in northern New Jersey forests.

Thus, there is specificity of shrubs to ten geological substrata in northern New Jersey. These studies encompassed 45 species of shrubs. Greatest diversity was found in shrub plants on Limestone (31), Basalt (23), Martinsburg Shale (23), and High Falls Sandstone (21).

For trees, the nine geographical substrata were Kittatinny Limestone (24 species), Martinsburg Shale (22 species), Brunswick Shale (31), Triassic Conglomerate (15), Basalt (24), Longwood Shale (12), High Falls Sandstone (24), Green Pond Conglomerate (11), and Shawangunk Conglomerate (14).

Table 1: Specificity of herbaceous plants from 40 stands, in search of any specific substrate requirements and possible herb evolution (GLEASON & CRONQUIST 1991).

<i>Adiantum pedatum</i> L.	Moist woods and stream sides, in circum neutral soil
<i>Aralia racemosa</i> L.	Rich woods
<i>Asarum canadense</i> L.	Rich woods
<i>Asplenium platyneuron</i> (L.) Oakes	Woods, banks and rocks, in circum neutral soil
<i>Asplenium trichomanes</i> L.	On shaded, mostly calcareous rocks
<i>Bromus purgans</i> L.	Rich, moist woods
<i>Camptosorus rhizophyllus</i> (L.) Link.	Mostly on rocks, especially on limestone
<i>Claytonia virginica</i> L.	Rich woods and fields
<i>Collinsonia canadensis</i> L.	Rich woods
<i>Desmodium glutinosum</i> (Muhl.) Wood.	Rich woods
<i>Desmodium nudiflorum</i> (L.) DC.	Rich woods
<i>Medeola virginiana</i> L.	Rich woods
<i>Monotropa uniflora</i> L.	Rich woods
<i>Polygala paucifolia</i> Willd.	Moist, rich woods
<i>Sanguinaria canadensis</i> L.	Rich woods
<i>Senecio obovatus</i> Muhl.	Rich woods and rocky outcrops, especially in calcareous situations
<i>Smilacina racemosa</i> (L.) Desf.	Rich woods
<i>Trientalis borealis</i> Raf.	Rich woods and bogs
<i>Viola pensylvanica</i> Michx.	Rich woods, or sometimes in meadows
<i>Viola pubescens</i> Ait.	Rich woods, or sometimes in meadows
<i>Viola rotundifolia</i> Michx.	Deep, rich, usually coniferous woods

Table 2: Search for specificity of species of New Jersey Shrubs from 40 stands, in search of any specific substrate requirements and possible shrub evolution (GLEASON & CRONQUIST 1991).

<i>Celastrus scandens</i> L.	Rich soil
<i>Cornus alternifolia</i> L.	Rich woods
<i>Lindera benzoin</i> (L.) Blume	Abundant in rich, moist woods
<i>Viburnum rafinesquianum</i> Schultes	Dry, especially calcareous woods

Geological substratum, herbaceous, shrub, and tree vegetation in northern New Jersey

The increase in species represented with increased sampling suggests, that, of all substrata studied, Limestone may support the greatest diversity of tree species. PEARSON (1960a,b) showed 32 tree species occurring in 17 stands on Kittatinny Limestone. DAVIDSON (2004a) was only able to locate three additional stands that PEARSON had not located in 1960.

Lists of trees, shrubs, and herbs were prepared from 106,480 individual taxonomic determinations by D. W. Davidson on plant materials to a great extent in the vegetative state. (DAVIDSON 1973). This figure is considered quite minimal because many of the determinations were evaluated simply by presence of a herb, shrub or tree in the forest.

#### Trees:

The tree species are in general quite deeply rooted, and therefore they would not likely to have speciation taking place rapidly on specific rock types over the last 10,000 years since the last Wisconsin ice age (see DAVIDSON 2005).

#### Shrubs:

The shrubs are less deeply rooted than the trees (DAVIDSON et al. 1989; Davidson: unpublished observations) and therefore speciation on the ten substrata could be determined to be taking place more rapidly on the soils since Wisconsin glaciation (see DAVIDSON 2004b tab. 4).

#### Herbs:

Herbs are shallowly rooted in the forest (DAVIDSON et al. 1989; Davidson: unpublished observations) and therefore speciation could be said to be occurring more rapidly on the soil types with herbs since the last Wisconsin glaciation (see DAVIDSON 2004a tab. 5).

More speciation in herbs and shrubs is hypothesized to have taken place in herbs and shrubs than in trees. There has also been greater specificity in herbs and shrubs on geological substrata than in trees (six).

## Conclusions

The striking features of the western serpentine vegetation (KRUCKEBERG 1954; WALKER 1954; WHITTAKER 1954) were not found in the stands and species here studied in northern New Jersey. Nor were the striking results of BILLINGS (1950) in dry Nevada, shown by the herbaceous flora of the upland forests of northern New Jersey. Northern New Jersey, with more than 10 different geological substrata, has the same type of setting as the Nevada and California sites of BILLINGS (1950), as these are juxtaposed on quite different geological substrata each with a different complement of soil series (as shown by TEDROW 1986). These substrata, as did those of BILLINGS with the altered and unaltered Andesite, provide the opportunity to compare endemic species on these soils and substrata.

## Acknowledgements

Funds were provided by N. S. F. Grant G-7177 and also by the Board of Regents of the University of Wisconsin System through Vice-Chancellor John C. Haugland. U.W.S. Support for these studies was also provided by Dr. Arthur N. Langford, Dr. Louis F. Ohman, Dr. Helen F. Buell, Dr. James Montgomery, Sarah Haavik, Margaret E. Nolan, Joseph Znidarsich, Sandy Orr, Patser Lynch, and Jon Petersburg. A sincere thank you to Dr. Mary Balcer for her ongoing support for the John W. Thomson Herbarium, Joyce Barnes, Linda Briggs, Julian

D. W. DAVIDSON

Opella of the University of Minnesota-Duluth Computer Center and Dr. C. L. Seebeck of the University of Alabama-Tuscaloosa Computer Center.

## References

- BILLINGS, W. D. (1950):** Vegetation and plant growth as affected by chemically altered rocks in the western Great Basin. – *Ecology* **31**(1): 62–74.
- DAVIDSON, D. W. (1973):** Vascular plants of the mature upland forests of northern New Jersey. – *Bulletin of the Torrey Botanical Club* **100**(1): 44–55.
- DAVIDSON, D. W. (2004a):** Geological substratum, herbaceous vegetation and floristic diversity of mature upland forest sites in northern New Jersey. – *Wulfenia* **11**: 45–55.
- DAVIDSON, D. W. (2004b):** Geological substratum, shrub vegetation and floristic diversity of mature upland forest sites in northern New Jersey. – *Wulfenia* **11**: 57–61.
- DAVIDSON, D. W. (2005):** Geological substratum, tree vegetation, and floristic diversity of mature upland forest sites in northern New Jersey. – *Wulfenia* **12**: 87–91.
- DAVIDSON, D. W., KAPUSTKA, L. A. & KOCH, R. G. (1989):** The role of plant root distribution and strength in moderating erosion of red clay in the Lake Superior watershed. – *Transactions of the Wisconsin Academy of Sciences, Arts and Letters* **77**: 51–63.
- GLEASON, H. A. & CRONQUIST, A. (1991):** Manual of vascular plants of northeastern United States and adjacent Canada. – New York: New York Botanical Garden Press.
- KRUCKEBERG, A. R. (1954):** The ecology of serpentine soils. II. Plant species in relation to serpentine soils. – *Ecology* **35**(2): 267–274.
- PEARSON, P. R. (1960a):** New Jersey limestone vegetation. – Ph. D. Thesis. Rutgers University, New Brunswick, New Jersey: Univ. Microfilms, Ann Arbor, Michigan.
- PEARSON, P. R. (1960b):** Upland forests on the Kittatinny Limestone and Franklin Marble of northern New Jersey. – *Bull. N. J. Acad. Sci.* **5**: 3–19.
- TEDROW, J. C. F. (1986):** Soils of New Jersey. – Malabar, Florida: Robert E. Krieger Publishing Company.
- WALKER, R. B. (1954):** The ecology of serpentine soils. I. Factors affecting plant growth on serpentine soils. – *Ecology* **35**(2): 259–266.
- WHITTAKER, R. H. (1954):** The ecology of serpentine soils. III. Plant species in relation to serpentine soils. – *Ecology* **35**(2): 275–288.

Address of the author:

Prof. Dr. Donald W. Davidson  
Department of Biology and Lake Superior Research Institute  
University of Wisconsin-Superior  
Belknap & Catlin PO Box 2000  
Superior, WI 54880-4500  
U.S.A.

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Wulfenia](#)

Jahr/Year: 2005

Band/Volume: [12](#)

Autor(en)/Author(s): Davidson Donald W.

Artikel/Article: [Geological substratum, herbaceous, shrub, and tree vegetation and floristic diversity of mature upland forerest sites in northern New Jersey 93-96](#)