Wulfenia **11** (2004): 57–61

Wulfenia

Mitteilungen des
Kärntner Botanikzentrums
Klagenfurt

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

Donald W. Davidson

Summary: Data from forty stands of upland forests in northern New Jersey were used to determine the impact of geological substratum on species diversity of shrub plants. Ten different substrata were studied, with more than three stands available on six of the substrata. Distribution of geological substrata ranged from rich (limestone) to poor (conglomerate). 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 (Byram, Pochuck and Losee 31), High Falls Sandstone (21), Green Pond Conglomerate (14) and Shawangunk Conglomerate (9). Greatest diversity was over Gneiss. Eleven species were restricted to five specific substrata while 5 of the 10 substrates shared species with others. These studies encompass 45 shrub species.

Zusammenfassung: In der vorliegenden Arbeit wird der Einfluss bestimmter Substrate auf das Wachstum von Sträuchern untersucht. Das Untersuchungsgebiet umfasst den gesamten Norden von New Jersey. Zehn verschiedene geologische Substrate und über 45 Strauch-Arten werden hier besprochen.

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

As the paper on herbaceous vegetation (DAVIDSON 2004) pointed out, the full impact of geological substratum on shrub and herb vegetation and floristic diversity of shrubs and herbs, were originally not examined in detail, and therefore, even though the data were collected in 1959–1963, it appears fruitful to further evaluate the role of geological substratum in relation to shrub vegetation and flora. These studies were supported by NSF Grant G-7177, and by the Board of Regents of the University of Wisconsin System. Support for these studies was also provided by Dr. Arthur N. Langford, Dr. Louis F. Ohmann, and Dr. James Montgomery. Sarah Haavik, Margaret E. Nolan, Joseph Znidarsich, Joyce Barnes, Linda Briggs and Sandy Orr assisted in the work at UWS.

Most trees have deep roots that extend downward into the soil profiles of the forests. The herbs are less deeply rooted (DAVIDSON et al., 1989). In addition, most of northern New Jersey is covered by a blanket of glacial debris, through which tree, shrub and herbaceous plants must grow before they come into contact with the rock substrata. Intensive study of the under story vegetation layers was necessary before the impact of the substrata on shrub growth and distribution could be ascertained.

Field methods

The field methods will not be elaborated here (see DAVIDSON 1963), other than to state that the stands were naturally established and had been free from pronounced disturbance for at least 60 years. All stands were upland and well-drained. Nomenclature follows FERNALD (1950).

Results

The 45 species of shrubs identified were delineated on the 10 substrata studied (Table 6). The total number of forest sites, for each substratum type are shown in Table 2. The abbreviations for geological substrata from northern New Jersey are listed in Table 1. The numbers of shrubs, per substratum, were also calculated in Table 3. Wide ranging species are shown in Table 5.

Presence of restricted species to the 10 geological substrata was examined in Table 4, and their specificities are shown.

Discussion

PLATT (1951) showed clear-cut patterns of endemism in the shale barrens of Pennsylvania. These studies as yet have not shown clear-cut patterns of endemism.

The restriction of some of the shrub species (Table 4) to certain of the substrata is possibly of considerable significance. The fact that disturbance had been negligible for at least 60 years makes it possible to conclude that shrub species may have radiated in their present environments following the retreat of the last Wisconsin ice. 11 taxa are restricted to the 10 geological substrata (Table 4). The Gneiss substrate for example suggested the largest number (5) of shrubs restricted to a single substratum.

Table 1: Abbreviations for geological substrata from northern New Jersey.

Lim	Kittatinny Limestone
MS	Martinsburg Shale
BS	Brunswick Shale
TrC	Triassic Conglomerate
Ba	Basalt
LS	Longwood Shale
Gn	Gneiss (Byram, Pochuck and Losee)
HF	High Falls Sandstone
GPC	Green Pond Conglomerate
SC	Shawangunk Conglomerate

Table 2: Total number of forest sites for each substratum.

Kittatinny Limestone	3
Martinsburg Shale	5
Brunswick formation	1
Triassic Conglomerate	1
Basalt	5
Longwood Shale	2
Gneiss	11
High Falls Sandstone	8
Green Pond Conglomerate	3
Shawangunk Conglomerate	1
	40

Table 3: Average number of shrubs per substratum.

Kittatinny Limestone	15
Martinsburg Shale	23
Brunswick Shale	6
Triassic Conglomerate	19
Basalt	23
Longwood Shale	10
Gneiss	31
High Falls Sandstone	21
Green Pond Conglomerate	14
Shawangunk Conglomerate	9

Table 4: Plants restricted to specific substrata, or substrata not having restricted species.

Kittatinny Limestone	*Cornus rugosa* Lam. *Xanthoxylum americanum* Mill.
Martinsburg Shale	*Viburnum lentago* L.
Brunswick Formation	None
Triassic Conglomerate	None
Basalt	*Berberis vulgaris* L.
Longwood Shale	None
Gneiss	*Crataegus macrosperma* Ashe *Crataegus uniflora* Muench. *Leucothoe racemosa* (L.) Gray *Rubus phoenicolasius* Maxim. *Vaccinium corymbosum* L.
High Falls Sandstone	*Pyrus melanocarpa* (Michx.) Willd. *Rhododendron maximum* L.
Green Pond Conglomerate	None
Shawangunk Conglomerate	None

Table 5: Wide-ranging species on substrata, indicating the number of substrata on which these plants occurred.

Corylus cornuta Marsh.	8
Gaylussacia baccata (Wang.) K. Koch	10
Hamamelis virginiana L.	9
Lindera benzoin (L.) Blume	7
Rhododendron nudiflorum L.	8
Vaccinium stamineum L.	7
Vaccinium vacillans Torr.	10
Viburnum acerifolium L.	10
Vitis aestivalis Michx.	8

Table 6: Presence of 45 shrub species on ten substrata in upland northern New Jersey mature forest.

Species	**LM**	**MS**	**BS**	**TrC**	**Ba**	**LS**	**GN**	**HFS**	**GPC**	**SC**	**Total**
Acer spicatum Lam.						x	x				2
Berberis thunbergii DC	x			x	x		x	x			5
Berberis vulgaris L.					x						1
Celastrus scandens L.	x	x		x	x		x				5
Cornus alternifolia L.		x		x			x				3
Cornus racemosa Lam.	x	x		x			x				4
Cornus rugosa Lam.	x										1
Corylus americana Walt.		x		x	x				x		4
Corylus cornuta Marsh.	x			x	x	x	x	x	x	x	8
Crataegus macrosperma Ashe							x				1
Crataegus uniflora Muench.							x				1
Diervilla lonicera Mill.								x	x		2
Gaylussacia baccata (Wang.) K. Koch	x	x	x	x	x	x	x	x	x	x	10
Gaylussacia frondosa (L.) T. & G.		x						x			2
Hamamelis virginiana L.	x	x	x	x	x	x	x	x	x		9
Ilex verticillata (L.) Gray		x			x			x	x		4
Kalmia angustifolia L.						x		x	x	x	4
Kalmia latifolia L.					x	x	x	x	x	x	6
Leucothoe racemosa (L.) Gray							x				1
Lindera benzoin (L.) Blume	x	x	x	x	x		x	x			7
Lonicera japonica Thumb.				x	x						2
Pyrus melanocarpa (Michx.) Willd.								x			1
Quercus ilicifolia Wang.								x	x		2
Rhododendron maximum L.								x			1
Rhododendron nudiflorum L.	x	x	x	x	x	x	x	x			8
Rosa carolina L.		x			x		x			x	4
Rubus allegheniensis Porter		x		x	x		x		x	x	6
Rubus idaeus L.		x		x	x		x				4
Rubus occidentalis L.		x					x				2
Rubus phoenicolasius Maxim.							x				1
Smilax herbacea L.		x			x		x				3
Staphylea trifolia L.	x						x				2
Vaccinium angustifolium Ait.				x			x	x			3
Vaccinium atrococcum (Gray). Heller		x					x				2
Vaccinium corymbosum L.							x				1
Vaccinium macrocarpon Ait.							x	x			2
Vaccinium stamineum L.		x		x	x		x	x	x	x	7
Vaccinium vacillans Torr.	x	x	x	x	x	x	x	x	x	x	10
Viburnum acerifolium L.	x	x	x	x	x	x	x	x	x	x	10
Viburnum dentatum L.		x			x						2
Viburnum lentago L.		x									1
Viburnum prunifolium L.	x	x		x	x		x	x			6
Viburnum rafinesquianum Schultes					x		x				2
Vitis aestivalis Michx.	x	x		x	x	x	x	x	x		8
Zanthoxylum americanum Mill.	x										1

In examining the list of 45 shrubs which are found in Table 6, the author carefully examined the comments of each species relative to soil and habitat specificity of the species in GLEASON & CRONQUIST (1991) and many of these have specific substrate characteristics, such as sandy or rocky, rich soil, rich woods, bogs, and moist habitats, but with the exception of *Viburnum rafinesquianum*, which is known from dry, especially calcareous woods, none of the 45 shrub taxa can really be said to be identified with a particular substrate based on this literature review. These studies, particularly Table 4, do show specificity of shrubs in northern New Jersey.

Comparisons of floristics and vegetation from the present to other works is difficult because the 40 stands of shrubs and herbs were strongly homogeneous (Chi-square values). All the boundaries for the 40 stands were selected by the investigator before the vegetation and flora were sampled.

References

DAVIDSON, D. W. (1963): The shrub and herbaceous vegetation of the upland forests of northern New Jersey. – PhD dissertation. – New Brunswick: Rutgers University, Dept. of Botany.

DAVIDSON, D. W. (2004): Geological substratum, herbaceous vegetation and floristic diversity of mature upland forest sites in northern New Jersey. – Wulfenia **11**: 45–55.

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.

FERNALD, M. L. (1950): Gray's manual of botany. 8th Edition. – New York: American Book Company.

GLEASON, H. A. & CRONQUIST, A. (1991): Manual of vascular plants of northeastern United States and adjacent Canada. – New York: New York Botanical Garden press.

PLATT, R. B. (1951): An ecological study of the mid-Appalachian Shale Barrens and of the plants endemic to them. – Ecological Monographs. **21**: 269–300.

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.
E-mail: ddavidso@uwsuper.edu