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Introduction

The Edmund Niles Huyck Preserve is an area of approximately 470 acres, set aside for scientific study and recreational purposes in 1931, in commemoration of the interests and ideals of Edmund Niles Huyck, a prominent New York industrialist. Since that time the plant life of the Preserve has been kept free from disturbance, other than the clearing of a few paths through the woodlands. Active preservation of this area actually began in 1899 with the acquisition by Mr. Huyck of most of the land immediately surrounding Lake Myosotis. Since the founding of the Preserve, it has been the custom to have one or more resident naturalists present during each growing season. More than fifty papers have resulted from the research done here.

The Preserve is located adjacent to Rensselaerville in Albany Co., New York, on the Helderberg plateau. As indicated by the sketch map (Fig. 1) it is centered about two bodies of water, Lake Myosotis and Lincoln Pond. The vegetation was first studied and mapped by Odum (1934), using strip transects and aerial photos. Odum implied that none of the communities present could be considered as climax, with the possible exception of the more mature hemlock-beech forests. He further prepared an elaborate diagram illustrating successional relationships (Fig. 2) between all the recognized community types. His diagram seems to imply that every community type was simply a successional stage, and that in every edaphic or microclimatic situation a hemlock-hardwood forest would eventually grow.

It seems to the present author that the principal impetus to the construction of such diagrams for an area similar to the Huyck Preserve is the presence of many different aggregations of plants, often showing definite zonation. For example, though Lake Myosotis is an artificial lake, it has recognizable vegetation zones on the mudflats at the upper end. Beginning with the submerged water plants it is easy to work toward the forests, listing the series of community types seen. The addition of arrows then completes our diagram of plant succession. Are we justified though in inserting the arrows? Does zonation alone indicate succession?

Leaving the lake, completion of such a successional diagram becomes more difficult and requires ideas and data from sources

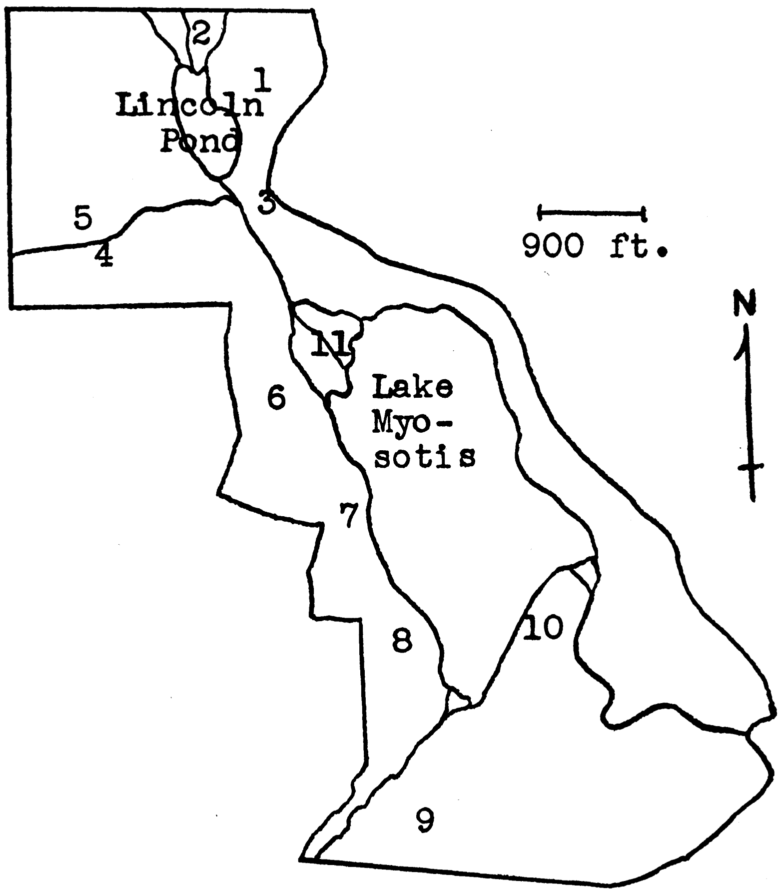

Figure 1. A sketch map of the Edmund Niles Huyck Preserve, showing the approximate locations of the eleven forests studied.

other than the vegetation studied. If only the vegetation is observed, our successional diagram will not coincide exactly with standard or classical ones for this region. For example, in one of the older forests of the Preserve one of the three dominants is white pine, which apparently is not reproducing itself. However, we know from other studies in this area that white pine reproduces itself only sporadically, following the opening of the canopy by windfalls, etc. Therefore we can place our arrow in what appears to be a more correct direction. The preparation of these diagrams involves many decisions based upon such evidence. In addition, there are always anomalous communities that must be fitted in as well as possible. For example, it is difficult to place the pure beech copses that have arisen from root sprouting after cutting

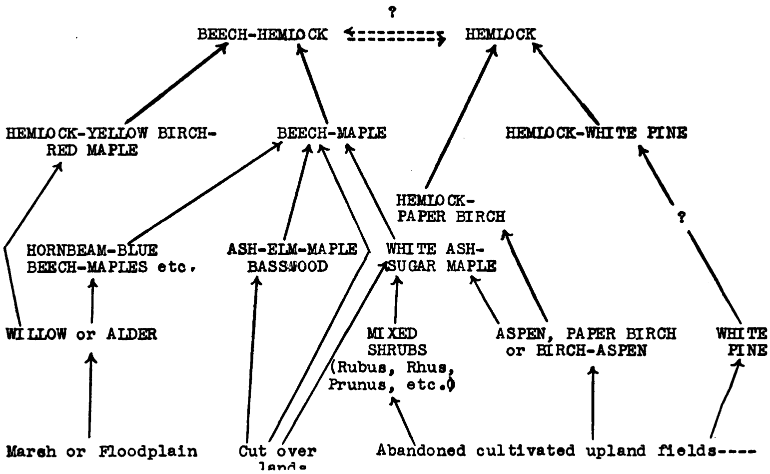

Figure 2. Figure 4 of Odum (1943): "Simplified diagram of successional relations on Edmund Niles Huyck Preserve." Redrawn.

of northern hardwoods. A red oak forest occuring near Lincoln Pond is as old as any of the hemlock-beech stands on the Preserve, but has not a single hemlock and very little beech in it. A great deal of rationalization would be necessary to fit this forest into a monoclimax successional diagram. Odum has wisely omitted it.

During the summer months of 1953, while the author was a research fellow on the Huyck Preserve, eleven different forest stands were sampled, using the random pairs method (Cottam and Curtis 1949). In the selection of stands, an effort was made to find discrete communities. For the most part this effort failed. Often I had the conviction that each step brought me into a different community. As a result, the selection of sampling areas was mostly arbitrary. Where possible, physiographic features, such as streams, or the lake or pond border, were used. Other boundaries were old fields, stands of planted evergreens, and dirt roads. In the case of the unbroken forest on the west side of Lake Myosotis, sampling was done in the north, central, and south portions, the sampling areas being separated by intervals of about 75 yards. As the data to follow will illustrate, the sampled forests were quite different, regardless of the lack of natural boundaries or apparent climatic differences between many of them. Their approximate locations are indicated in Figure 1.

Methods

In 8 of the 11 stands studied a total of 40 points were run; in three of them only 20 were run due to the small size of the stand. The points were established at 10-meter intervals along parallel lines which were 10 to 30 yards apart. At each point the diameters of the random pair of trees were taken and the distance between them measured. In addition, a meter-wide plot was run between the random pair to sample tree reproduction and the frutescent layer. Finally, one-meter square plots were run at even-numbered points to sample the herb layer; in these plots only presence of herbs was noted. In general, these techniques correspond with those originated and in use at the University of Wisconsin. The author's appreciation is expressed to Dr. Richard T. Ward of Beloit College, Wisconsin, for his assistance and advice in the use of these methods.

The order in which the stands are discussed below corresponds to the order in which they were sampled. No attempt has been made to place them in any genetic sequence, as it is felt that sufficient evidence for this is not yet at hand.

DESCRIPTIONS OF THE STANDS

Stand One

A summary of the sampling data for this stand is given in Table 1. As the data clearly indicate, hemlock is the sole dominant. The forest is young, immature, and relatively crowded. The medium size of hemlock stems is 12″ DBH. Based on several stump counts, the age of the forest is estimated at about 150 years since clear-cutting. In that time there has apparently been very little disturbance of any kind. This is a single-layered forest, no distinct herbaceous, frutescent or moss layers being present. Average canopy height is about 75 ft. and is relatively uniform, only a few hemlocks raised above the general level. Reproduction is poor of all species; only hemlock and ironwood (*Ostrya*) have many young trees.

The future of this forest is difficult to forecast due in part to its relative youth. With aging we may expect further natural thinning and death of many of the larger trees. In the openings this will create, other species may be able to reproduce, but the dense root growth of hemlock may still prevent this. Beech may increase in importance. In this forest and in Stand No. Two a number of dead beeches, about 18″ in diameter, were seen. This seems to be about the maximum size beech reaches here under present conditions. In addition, it seems to reproduce poorly under hemlocks.

Table 1

A summary of sampling data for the arborescent stratum of Stand One. Forest on a west and northwest-facing slope just northeast of Lincoln Pond. Data from 40 points run July 7, 1953.[1]

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.[2]	No. of Size Classes[3]
Tsuga canadensis[4]	93	85	89	32	4
Fagus grandifolia	15	7	3	7	4
Betula lutea	13	5	4	5	4

[1]In this and the following tables, only trees with a frequency percentage greater than 5% are included.

[2]Reproduction includes stems below 1″ DBH of all woody species present in the 1 m. wide plot between members of the random pair.

[3]Four size classes were recognized: Seedling (1″ - 6′ tall); Sapling (above 6′ tall but below 1″ DBH); Transgressive (1″ - 4″ DBH); and Adult (over 4″ DBH).

[4]All nomenclature is based upon Fernald (1950).

Stand Two

This stand is adjacent to Stand One, separated only by a small stream. However, the first stand grew on a rather steep, northwest-facing slope, and Stand Two occurred on very gently south-sloping land at the upper end of Lincoln Pond. It was apparently of the same age as Stand One, but included more beech, though hemlock was still definitely dominant (Table 2). Again, this was essentially a single-layered forest, no shrub layer at all being present, and only a fragmentary herbaceous layer. The total tree coverage was near 90 per cent, and due to crowding the individual crowns of hemlock and beech were narrow.

Little change in the composition of this forest or in the relative importance of the dominants can be expected. Both dominants seem to have become stabilized and are present in all size (age) classes, from seedlings (or small root sprouts, in the case of beech) to large trees apparently dead of natural causes. With further deepening of the soil in future decades the life span of hemlock should lengthen, which may tend to increase its relative importance.

Table 2

A summary of sampling data for the arborescent stratum of Stand Two. Forest on a gentle south-facing slope just north of Lincoln Pond. Data from 40 points run July 9, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Tsuga canadensis	95	77	78	83	4
Fagus grandifolia	35	23	22	7	4

STAND THREE

This was a small, interesting forest on a steep southwest-facing slope. The data are summarized in Table 3 from twenty points run here. As they reveal, though this forest was of the same approximate size and age as the hemlock forest of Stands One and Two, no hemlock at all was present, and only a small amount of beech. The two dominant species were northern red oak and sugar maple. The oak, however, was reproducing itself very poorly, and the forest may have little stability. There is no evidence of the ingress of hemlock, but both sugar maple and beech may increase in importance in the future.

Table 3

A summary of sampling data for the arborescent stratum of Stand Three. Forest on a southwest-facing slope. Data from 20 points run July 11, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Quercus rubra var. *borealis*	55	30	62	2	3
Acer saccharum	70	42	22	38	4
Tilia americana	15	8	6	1	3
Fagus grandifolia	15	9	5	5	4
Fraxinus americana	15	8	5	13	4
Ostrya virginiana	10	4	1	2	3

STAND FOUR

A somewhat different type of hemlock forest was found on the steep, rocky, northwest-facing slope of the small creek above Trout Pond (Figure 1). Here hemlock was easily dominant but, instead of beech, basswood was the second dominant (Table 4). This forest probably represents the present "climax" on this type of slope. With grading down in the future hemlock may become less important, but the creek is small and slow, the soil well anchored, and conditions should not change materially for many decades. *Fraxinus, Populus, Betula papyrifera,* and possibly *Tilia* may eventually die out, as none of these are reproducing themselves well.

Table 4

A summary of sampling data for the arboresent stratum of Stand Four. Forest on a northwest-facing slope. Data from 20 points run July 13, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Tsuga canadensis	65	48	64	9	4
Tilia americana	25	12	19	3	2
Betula lutea	20	9	4	....	2
Acer saccharum	20	9	3	9	4
Fraxinus americana	15	7	3	4	3
Fagus grandifolia	10	5	4	1	2
Acer pensylvanicum	10	5	1	25	3

Stand Five

On the opposite slope from Stand Four this forest was found. It was very different from the forest across the creek, no hemlock being sampled (Table 5), though a few small trees were seen. Sugar maple was the dominant upper story tree, with Ironwood forming a distinct lower tree layer below it. A few unhealthy basswoods and elms practically completed the tree flora. This was a poor forest growing on thin, eroding soil in a relatively unprotected location (on a southeast-facing slope). Loose boulders, slabs of sandstone, and small cliffs were in evidence. From a long-time view this forest may be considered successional, though at this time there is little sign of what may eventually replace the two present dominants.

Table 5

A summary of sampling data for the aborescent stratum of Stand Five. Forest on a southeast-facing slope. Data from 20 points run July 14, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Acer saccharum	95	65	76	54	4
Ostrya virginiana	45	18	6	3	4
Tilia americana	30	8	4	3	3
Ulmus americana	10	3	13	....	1

STANDS SIX, SEVEN, AND EIGHT

These three forests may be considered together, as they represent three arbitrary subdivisions of the single forest area west of Lake Myosotis. The forest (or forests) west of Lake Myosotis is young and in a state of active change. It presented many appearances in its different parts. It was impossible to delimit closely different forest communities, although there were many present. The three samplings indicate some of the forest diversity. In Stand Six (Table 6) there were three dominants: hemlock, sugar maple, and basswood; in Stand Seven (Table 7) beech and hemlock were dominant; and in Stand Eight, northern red oak was the primary dominant, with sugar maple the second dominant (Table 8). These forests have mostly arisen in the last fifty years, though a few old trees in them were over 100 years old.

Any valid statements as to the ultimate future of these forests must be obtained from known results in similar situations elsewhere, although perhaps their immediate future may be predicted from the data available. In Stand No. Six, red oak, yellow birch, and basswood seem to be dropping out. Hemlock, sugar maple, and beech all are apparently increasing in importance. Both beech and hemlock are reproducing well in Stand Seven, hemlock by scattered, not numerous, seedlings, and beech principally by root or stump sprouts. In addition, sugar maple seems to be reproducing successfully, though most of its numerous seedlings do not survive long. There will probably be little change in the composition of this forest in the near future.

Stand Eight is a young, rather poor forest, compared to Stands Six and Seven, perhaps due to the thin, rocky soil on which it grows. The oak seems to be at about its maximum. Hemlock is coming in, especially near the lake. The ash, here as elsewhere in this region, has many small seedlings, but these seem to die quickly, few transgressives being noted. Basswood is also dying out in this forest. The herbaceous layer here had a total coverage in late summer of perhaps 20 per cent, which was larger than in any forest sampled, except Stand Eleven, probably as a result of the relatively open canopy here.

Table 6

A summary of sampling data for the aborescent stratum of Stand Six. Forest on a north-facing slope. Data from 40 points run July 16, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Acer saccharum	68	31	17	51	4
Tsuga canadensis	43	17	20	9	4
Tilia americana	35	12	19	4	4
Fraxinus americana	33	13	11	6	4
Fagus grandifolia	28	10	12	4	4
Ostrya virginiana	33	10	4	3	4
Quercus rubra var. *borealis*	13	3	10	1	2
Betula lutea	15	5	5	4	4

Table 7

A summary of sampling data for the arborescent stratum of Stand Seven. Forest on a northeast-facing slope. Data from 40 points run July 22, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Fagus grandifolia	45	25	25	10	4
Acer saccharum	60	27	13	53	4
Tsuga canadensis	38	14	23	1	4
Tilia americana	35	11	17	3	4
Fraxinus americana	25	9	16	20	4
Ostrya virginiana	23	8	3	5	4

Table 8

A summary of sampling data for the arborescent stratum of Stand Eight. Forest on an east-facing slope. Data from 40 points run July 27, 1953.

Species	Above 1″ Frequency %	DBH % Density	% Basal Area	Reprod. %	No. of Size Classes
Quercus rubra var. *borealis*	38	21	50	0.5	2
Acer saccharum	65	35	18	65	4
Fraxinus americana	33	13	13	6	4
Tilia americana	25	12	10	5	4
Ostrya virginiana	15	8	2	6	4
Fagus grandifolia	10	7	4	1	4

STAND NINE

This forest was unusual in being the only white pine stand on the Preserve or in its immediate vicinity. Actually there were three dominants: hemlock, beech, and white pine (Table 9). Both the hemlock and beech and two subdominants, ash and sugar maple, were reproducing well and occurred in all size classes. Few seedlings of white pine were seen. However, its habit of infrequent seeding following windfalls is well known. White pine is , in all probability, a permanent part of this forest, barring cutting by man. There is little evidence here, therefore, of any material change in this forest in the near future. The data give no evidence that it is not "climax".

Table 9

A summary of sampling data for the arborescent stratum of Stand Nine. Forest on relatively level land. Data from 40 points run July 30, 1953.

Species	Above 1" Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Tsuga canadensis	48	25	44	2	4
Fagus grandifolia	45	24	19	7	4
Pinus Strobus	25	11	22	2	4
Acer saccharum	33	15	7	42	4
Fraxinus americana	25	14	4	5	4
Betula papyrifera	8	3	2	....	1

STAND TEN

On the upland at the southwest corner of Lake Myosotis was a much disturbed forest stand. An old cottage stood in one part of it, and a narrow road had been cut through. The data (Table 10) represent an average statistical view of this heterogeneous forest. What its future will be is extremely difficult to say. It is now weedy and partially open in many spots. Of the three principal dominants, sugar maple, beech, and northern red oak, the oak seems likely to disappear first, as the canopy becomes more nearly complete. Either sugar maple or hemlock may then become more important.

STAND ELEVEN

The last forest sampled grew on the floodplain at the upper end of Lake Myosotis and differed considerably in percentage composition of dominants from the other ten stands. Ash and American elm were the co-dominants (Table 11) with several

Table 10

A summary of sampling data for the arborescent stratum of Stand Ten. Forest on relatively level upland. Data from 40 points run August 4, 1953.

Species	Above 1" Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Fagus grandifolia	60	40	28	8	4
Quercus rubra var. *borealis*	30	12	31	3	3
Acer saccharum	50	25	19	34	4
Acer rubrum	13	6	10	5	4
Tsuga canadensis	10	4	8	0.5	4
Fraxinus americana	15	9	2	10	4

other trees of some importance. Most of the trees were quite small with occasional very large elms, none of which were sampled. The canopy was ragged and quite open in many spots. Herb coverage was much higher than elsewhere, averaging perhaps 70-75 per cent through the forest, as opposed to a tree coverage of about 65 per cent. A shrub layer, dominated by *Prunus virginiana,* was also evident.

The future of this forest, like most floodplain forests, is difficult to predict. One of the dominants (ash) is reproducing well, but the other (elm) is not and may be losing importance. The basin is filling in slowly, especially on the west side, and here sugar maple and ironwood were more important. The conclusion that there will be no major change in the composition of this forest for a long time to come is probably justified. Any such change must follow a major physiographic change.

Table 11

A summary of sampling data for the arborescent stratum of Stand Eleven. Forest on level ground. Data from 40 points run August 12, 1953.

Species	Above 1" Frequency %	DBH % Density	% Basal Area	% Reprod.	No. of Size Classes
Fraxinus americana	73	32	36	13	4
Ulmus americana	50	20	30	0.5	4
Acer Saccharum	43	18	12	18	4
Tilia americana	18	15	11	2	4
Juglans cinerea	10	3	10	....	2
Carpinus caroliniana var. *virginiana*	15	6	1	8	4
Prunus virginiana	8	5	....	35	3

Discussion

Eleven forest stands were sampled on a 500-acre private preserve in eastern New York state. Together, these forest stands composed the native forest vegetation of the Edmund Niles Huyck Preserve in Albany County, New York. Summaries of sampling data have been presented for each individual stand; in Table 12 the eleven stands have been compared by the preparation of "DFD indices" for the species in each stand. These indices are obtained by adding the percentage values for density, frequency, and basal area ("dominance") for the species. The percentage values for frequency have been computed by adding the frequencies of each sampled tree in each stand and then dividing each by the total. The DFD indices give a fairly reliable indication of relative species importance in each stand.

The data and descriptions given for each individual stand should make clear some of the difficulties attendant to the preparation of successional diagrams. Table 12, however, may help indicate how easy it might be to prepare a successional diagram, providing one or more assumptions are made first. If we assume that beech-hemlock is the final climax, we may then arrange the stands in order of increasing percentages of hemlock and beech. Should we assume further that white pine is a member of the future climax we must change our arrangement somewhat. However, until we have more definite, concrete evidence that all successional lines lead to a certain type of vegetation, we are not in any sense justified in making these assumptions.

There are very few major differences in the histories or present situations of the eleven forests sampled. They are in the same region, subject to the same general climate. Therefore they should be moving inexorably toward the same "climatic climax." If this is true, then why have they diverged so far at the very start?

Because every local climatic-edaphic situation, as long as it exists, will best support a slightly different community type. Because, when each area was colonized or re-colonized, different species were available in different quantity and quality. Definition of a floristrically defined "regional" climax in the area in which the present studies were made seems to the present author very impractical. It can never be achieved completely, due to the constant changing of the physiognomy and climatic patterns of the earth.

Table 12
DFD (Density-Frequency-Dominance) indices for species found in each of the eleven stands sampled.

Species	Stand 1	2	3	4	5	6	7	8	9	10	11	Total DFD
Tsuga canadensis	249	228		146		53	53	5	95	17		846
Acer saccharum			104	23	188	72	64	85	39	70	49	694
Fagus grandifolia	22	72	21	16	5	32	69	16	67	100		420
Fraxinus americana			21	17	6	36	35	42	31	19	100	307
Quercus rubra var. *borealis*			122			18	3	89		58		290
Tilia americana			21	43	27	44	43	34			34	246
Ostrya virginiana			11	5	47	26	21	18		3	2	133
Ulmus americana					21		5				72	98
Betula lutea	22			24		16	5	3				70
Pinus Strobus									47			47
Acer pensylvanicum				13	6				4	5		28
Juglans cinerea								8			17	25
Acer rubrum										23		23
Betula papyrifera				7					9	5		21
Carpinus caroliniana var. *virginiana*									4		14	18
Prunus serotina	7										3	10
Populus grandidentata				6					4			10
Prunus virginiana											9	9
Carya ovata						3						3
Salix sp.							2					2

Summary

Eleven forest areas were studied on the Edmund Niles Huyck Preserve in Albany County, New York, during the summer of 1953. Summaries of sampling data, obtained by the use of the random pairs method, are given. In spite of closely similar land use histories, physiographic situations, and local climates, each of the eleven forests is seen to be distinct from the others. In the absence of long-range studies of plant succession, it is concluded that evidence for the arrangement of these eleven forests into any sort of successional scheme is presently inadvisable.

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