VEGETATION DISTRIBUTION ASSOCIATED WITH RIGHT-OF-WAY HABITATS IN NEW YORK[1]

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ABSTRACT.--An analysis was made of vegetation distribution in relation to habitat and forest region on 20 rights-of-way in New York State. A constant group of tree species that included red maple (Acer rubrum L.), red oak (Quercus rubra L.), black cherry (Prunus serotina Ehrh.), white ash (Fraxinus americana L.), and quaking aspen (Populus tremuloides Michx.) was present on mesic habitat areas in all regions. Other species distributions were closely related to habitat and region. Distribution of certain common shrubs, low trees, and herbaceous plants on rights-of-way was closely related to habitat and region, which permitted development of characteristic communities for different habitats within each forest region. A close relationship was found between adjoining forest types and right-of-way plant communities in each region. Maintenance techniques used did not significantly influence the community type that developed or the average cover values of trees, shrubs, or grass. The average cover value of herbaceous plants was significantly higher on broadcast-maintained rights-of-way.

The kind of vegetation on a right-of-way (ROW) is a major factor influencing ROW management and costs. Vegetation includes capable tree species which are those tall-growing trees able to enter the security zone around the conductor. Such trees would interfere with electric transmission and are usually the primary targets of maintenance operations. The density, height, and growth rate of capable trees is commonly used to determine the most practical maintenance method for a section of ROW. Vegetation also includes non-target species that are the low-growing trees, shrubs, herbs, ferns, and grasses which cover the ROW. The species composition and density of non-target communities influences the resistance of the area to invasion by trees; non-target species are also desirable for wildlife food and cover, visual appearance, and other values that must be taken into account in ROW management (Bramble and Byrnes 1974).

A knowledge of what may be expected to develop on ROWs under various habitat conditions is also a valuable aid in long-term management planning. Such planning should be done for short periods of about 10 years, or less, and constantly updated and revised.

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OBJECTIVES

This paper aims to present the results of a case history study of 20 ROWs distributed so as to include 4 major forest regions in New York. Replication of ROW treatments within regions for statistical analysis was not attempted in this phase of a broader study. However, the results of this study will be used to design and implement replicated studies on acceptably similar ROWs in the future.

This paper describes trends in vegetation distribution characteristic of the ROWs studied. This includes distribution of tall-growing trees, low-growing trees and shrubs, and herbaceous vegetation by regions and habitats. Characteristic plant communities are described for moisture regime habitats by regions. Analysis has been made to detect possible effects of ROW treatments on vegetation.

METHODS

Data Collection Techniques

Twenty ROW sites were selected for study from a list of 35 ROWs submitted by cooperating utilities for the New York Power Pool (Asplundh Environmental Services 1977). These sites met criteria set up by the project, were approximately 3.2 kilometers long, and were located in four forest regions in New York. Mesic, hydric, and xeric habitats were selected for detailed study on each site where available. In a few cases, a xeric habitat was lacking.

The four forest regions were taken from the Atlas of Forestry in New York (Stout 1958) and were based on both forest and physiographic regions. These were combined as follows to make up the four regions studied.

Region I. New England Highlands and Mohawk-Hudson
Region II. Appalachian Highlands and Catskill
Region III. Lake Plain
Region IV. Adirondack, Tug Hill, and St. Lawrence-Champlain

The vegetation analysis was carried out on 1/5-acre rectangular plots extending across the ROW and on 1/5-acre circular plots in the adjoining forest. A combined estimate of cover and abundance and of plant grouping was made of each plant species using the system of Braun-Blanquet (1932 and 1964). The cover values used for the cover-abundance symbols have been selected to fit their use in this paper and combine several proposals for such values in the literature (Becking 1957).

Symbol	Cover Value	Description
++	0.1	Occasional
+	1.0	Sparsely present, covering less than 1/20 of the plot area
1	2.5	Plentiful but of small cover value, covering less than 1/20 of the plot area
2	15	Very numerous, covering at least 1/20 of the plot area
3	37.5	Covering 1/4 to 1/2 of the plot area
4	62.5	Covering 1/2 to 3/4 of the plot area
5	87.5	Covering more than 3/4 of the plot area

For grouping:

Symbol	Description
1	Growing one in a place, singly
2	Grouped or tufted
3	In troops, small patches or cushions
4	In small colonies, in extensive patches, or forming carpets
5	In pure populations

Soil characteristics of study sites were obtained by sampling with a soil auger to determine soil series, effective depth, internal drainage, and occurrence of restrictions such as fragipans. Texture and pH were determined by standard field procedures. Soils of ROWs and adjoining forests were mapped for correlation of forest types with ROW communities.

Use of Mesic, Xeric, and Hydric Habitats

In this report, the common ecological terms: mesic, xeric, and hydric were used to indicate characteristic moisture regimes found on ROWs.

Mesic refers to a relatively moist habitat with free drainage and located on a lower slope, a low hilltop, an upland flat, or a level lowland.

Xeric refers to a relatively dry habitat on a ridgetop, middle to upper slope, or plateau top with excessive drainage.

Hydric refers to a relatively wet habitat located in a stream bottom, depression, or level lowland with impeded drainage.

Measurement and Use of Constancy

Constancy is a term used throughout this paper and is defined as the occurrence of a species in stands of a certain plant community.

To determine constancy, each stand was examined by means of 1 plot, 1/5 acre in area, so placed as to get a normal combination of species for that stand. Constancy was calculated as a percent by dividing the number of plots on which a species occurred by the total number of plots examined. Ordinarily, a species constancy of 80 to 100 percent is considered "constantly present" and 60 to 80 percent is "mostly present."

While species with a constancy of 60 percent or over are usually grouped together as species of the highest constancy, this does not eliminate the use of characteristic species of special affinity for a community but of low constancy. It is the combination of characteristic and highly constant species which actually makes up the complete combination of species which identify a plant community.

RESULTS

Distribution of Capable Trees on ROWs

Some important trends in distribution by habitat and region were exhibited by tall-growing tree species capable of interfering with electric transmission (capable trees). The distribution of these species has been grouped into six categories for convenience and reference. (Table 1).

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In the first category, characteristic species of northern hardwood types, namely beech (Fagus grandifolia Ehrh.), yellow birch (Betula lutea Michx. f.), and sugar maple (Acer saccharum Marsh.), were found to be only sparsely distributed on ROWs in general. These species were of low constancy of 50 percent or less in all regions, except for yellow birch which had a 100 percent constancy on xeric habitats in Region II. The cover value of beech was only 2.5 percent or less, sugar maple 15 percent or less, and yellow birch mostly 15 percent or less in all regions.

The characteristic trees of oak forest types found on ROWs, namely white oak (Quercus alba L.), chestnut oak (Quercus prinus L.), and hickory (Carya sp. Nutt.) were restricted to Regions I, II, and III. On mesic habitats they were mostly present on ROWs only in Region I; on xeric habitats all were common on ROWs in Regions I and II, with white oak highly constant in Region III.

An interesting and somewhat unexpected trend was found in the distribution of species associated with both northern hardwoods and oak types on ROWs. Red maple, red oak, black cherry, and white ash formed an important group on mesic sites in all regions (Table 1). These species were also present on xeric habitats in Regions I and II, and in Region III with the exception of red maple; only red oak appeared in Region IV. On hydric sites red maple, black cherry, and white ash occurred in all regions, while red oak was only found in Region I. On the other hand, sweet birch (Betula lenta L.) was found only on mesic and xeric habitats in Regions I and II. White pine (Pinus strobus L.) and hemlock were present on xeric habitats in Region IV.

The following pioneer species are highlighted (Table 1) for the purpose of emphasis. Quaking aspen was the most prominent and was present in all regions on all habitat areas. Large-toothed aspen (Populus grandidentata Michx.) was present only on mesic and xeric habitats. Pin cherry (Prunus pensylvanica L. f.) was present on mesic habitats in all regions and was highly constant on xeric habitats in Region IV. White birch (Betula papyrifera Marsh.) was absent in Region I. Gray birch (Betula populifolia Marsh.) had an irregular distribution, although it was mostly present on xeric habitats in Regions I and IV and on hydric habitats in Region IV. Sassafras (Sassafras albidum (Nutt.) Ness) and flowering dogwood (Cornus florida L.) were also somewhat irregular in distribution. They were mostly present on mesic habitats in Region I and were highly constant on xeric habitats in Region III. Northern conifers were present only on hydric habitats in Regions III and IV.

It should be noted that because capable trees have been controlled for a number of years on the 20 ROWs to insure reliable transmission of electric power, the distribution of trees on these established ROWs does not necessarily reflect species composition of regional forest types as closely as would occur naturally without such control. Thus, while species present on ROWs are usually related to the adjoining forest types, only those resistant to control and capable of establishment under the shrub and herb competition on ROWs were present in significant numbers.

Distribution of Shrubs and Low-growing Trees on ROWs

The distribution of common shrubs and low-growing trees on ROWs in New York represent a selection from 86 species that were found on ROWs (Table 2).

Three highly constant shrubs or low trees were selected as characteristic of habitats with which they were associated. Of these, blackberry (Rubus sp. L.) was found to be a characteristic and constant shrub of mesic habitats in all regions. Although it had a wide distribution over various habitats, it was most constant and/or of greatest cover value on mesic habitats. Similarly, blueberry (Vaccinium sp. L.)

Table 1

Distribution of trees on ROWs in New York by habitat and region

Species	Mesic Habitat Region				Xeric Habitat Region				Hydric Habitat Region			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
	Constancy* %				Constancy %				Constancy %			
Characteristic Northern Hardwoods												
Beech	0	50	0	17	0	50	0	0	20	0	0	17
Yellow birch	40	50	0	33	20	100	0	0	20	0	0	17
Sugar maple	20	0	0	17	0	0	50	0	0	0	0	0
Associated Species												
Red maple	100	100	80	66	100	100	0	0	80	50	60	66
Red oak	80	75	40	50	100	100	100	50	20	0	0	0
Black cherry	60	50	80	66	40	50	50	0	20	25	60	50
White ash	60	50	80	33	60	50	50	0	60	25	60	50
Basswood	20	0	0	17	0	0	0	0	0	0	0	0
American elm	0	25	80	0	20	0	0	0	60	0	80	0
White pine	20	25	0	23	20	0	0	100	20	0	0	0
Hemlock	0	0	0	17	0	0	0	50	20	0	0	0
Sweet birch	60	75	0	0	40	100	0	0	0	25	0	0
Characteristic Oak-Type Species												
White oak	80	0	20	0	40	100	100	0	0	0	20	0
Chestnut oak	60	0	0	0	60	50	0	0	0	0	0	0
Hickory	80	50	20	0	60	50	0	0	0	0	0	0
Pitch pine	0	0	0	0	20	0	0	0	0	0	0	0
Chestnut	0	20	0	0	0	0	0	0	0	0	0	0
Black oak	0	0	0	0	0	0	50	0	0	0	0	0
Black walnut	0	0	0	0	0	0	0	0	0	0	0	17
Pioneer Species												
Quaking aspen	40	75	60	66	40	100	50	50	20	50	60	50
Largetoothed aspen	20	25	20	17	20	50	50	0	0	0	0	0
Pin cherry	20	50	40	66	20	0	0	100	0	25	0	50
White birch	0	25	0	23	0	50	0	0	0	0	0	0
Sassafras	60	0	20	0	20	0	100	0	20	0	0	0
Flowering dogwood	60	0	20	33	40	0	100	0	40	0	0	17
Gray birch	40	25	0	33	60	50	0	100	0	0	0	66
Serviceberry	0	50	0	33	0	0	0	0	0	25	0	17
Black locust	0	0	20	0	0	0	0	0	0	0	40	0
Cottonwood	0	0	20	17	0	0	0	0	0	0	0	0
Red cedar	0	0	0	17	20	0	0	0	0	0	0	0
Alternate-leaved dogwood	0	0	0	17	0	0	0	0	0	0	0	0
Yellow Poplar	0	0	0	0	20	0	0	0	20	0	0	0
Northern Conifers and Hardwoods												
Balsam fir	0	0	0	0	0	0	0	0	0	0	0	17
Red spruce	0	0	0	0	0	0	0	0	0	0	0	50
Northern white cedar	0	0	0	0	0	0	0	0	0	0	20	0
Black ash	0	0	0	0	0	0	0	0	0	0	20	0
Miscellaneous Species												
Scotch pine	0	25	0	33	0	0	50	0	0	0	0	0
Red Pine	0	25	0	0	0	0	0	0	0	0	0	0
Apple	0	25	0	0	0	0	0	0	0	0	0	0

* Constancy - See under Methods

Table 2

Distribution of Shrubs and Low-growing Trees on ROWs in New York by Habitat and Region

Species	Mesic Habitat								Xeric Habitat								Hydric Habitat							
	Region I		Region II		Region III		Region IV		Region I		Region II		Region III		Region IV		Region I		Region II		Region III		Region IV	
	Con*	Cov**	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov
Characteristic:																								
Blackberry	100	13.9	100	8.4	60	8.2	100	32.3	40	3.2	100	1.8	100	31.3	100	8.8	60	3.7	25	0.6	20	0.5	83	3.7
Blueberry	60	0.9	0.3				33	0.6	60	11	100	0.5	100	1.8	100	1.8	40	0.7	--	--	--	--	33	0.3
Huckleberry	40	3.2	--	--	--	--	--	--	40	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Willow	60	0.6	25	0.6	--	--	50	2.8	40	0.2	--	--	--	--	--	--	100	18.9	50	10	100	11.7	100	16.3
Differential:																								
Mapleleaf viburnum	100	1.3	25	3.8	--	--	--	--	20	0.5	--	--	--	--	--	--	--	--	25	0.3	--	--	--	--
Witchhazel	60	0.9	75	1.5	--	--	17	0.4	80	1.1	--	--	--	--	--	--	40	0.4	25	0.3	--	--	--	--
Staghorn Sumac	40	3.5	25	0.3	100	28.2	0.2	0.2	40	8.0	--	--	50	1.3	--	--	20	3.0	25	0.3	60	0.6	--	--
Spiraea	60	0.6	50	4.4	--	--	100	7.8	60	0.9	50	0.5	--	--	50	7.5	80	9.5	50	0.9	--	--	100	14.1
Sweetfern	--	--	25	3.8	--	--	--	--	80	8.8	100	8.8	--	--	--	--	--	--	--	--	--	--	--	--
Arrow-wood	--	--	25	15.6	60	10.7	0.2	0.2	20	3.0	50	0.5	100	1.8	--	--	20	0.5	25	9.4	60	8.2	--	--
Red osier dogwood	--	--	--	--	--	--	17	0.2	--	--	--	--	--	--	--	--	20	0.5	--	--	100	16.2	33	0.8
Beaked hazelnut	40	0.7	25	3.8	--	--	--	--	20	0.2	50	1.3	--	--	50	1.3	--	--	--	--	--	--	17	2.5
Companion:																								
Alder	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	12.5	25	0.6	20	0.2	66	0.9
Buttonbush	--	--	25	0.3	40	0.2	--	--	20	0.2	--	--	--	--	--	--	20	0.2	50	0.9	20	0.5	66	--
Dewberry	40	0.7	25	15.6	40	10.5	17	6.3	60	1.2	50	1.3	100	26.3	--	--	--	--	25	3.8	--	--	33	0.8
Elderberry	--	--	25	0.3	--	--	17	0.2	--	--	--	--	--	--	--	--	60	7.9	25	0.6	40	6.0	33	0.6
Gray dogwood	40	7.7	25	0.3	60	16.0	17	0.2	20	3.0	--	--	--	--	--	--	40	10.5	25	0.3	60	11.0	--	--
Hawthorn	--	--	75	4.3	40	4.4	17	0.2	40	0.2	--	--	50	0.5	50	1.3	--	--	--	--	20	0.2	--	--
Raspberry	20	3.2	50	13.1	--	--	33	10.6	20	0.2	50	1.3	50	0.2	50	0.5	--	--	50	0.5	--	--	33	2.9
Virginia Creeper	20	0.2	--	--	20	0.2	--	--	20	0.5	--	--	--	--	--	--	40	0.2	25	0.6	20	0.2	17	0.4
Choke-cherry	--	--	--	--	20	0.2	50	6.6	--	--	--	--	--	--	50	7.5	--	--	--	--	--	--	17	2.5
Bittersweet	20	3.0	--	--	40	0.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Grape	40	3.2	--	--	40	3.2	--	--	20	0.5	--	--	50	0.5	--	--	20	3.0	--	--	40	3.2	--	--
Ground juniper	--	--	--	--	--	--	--	--	40	0.7	--	--	--	--	50	18.8	20	0.2	--	--	--	--	17	0.4
Mountain laurel	--	--	25	3.8	--	--	--	--	40	3.5	50	7.5	--	--	--	--	--	--	--	--	--	--	--	--
Nannyberry	--	--	--	--	--	--	--	--	20	0.2	--	--	50	0.2	--	--	20	0.2	--	--	20	0.5	--	--
New Jersey Tea	40	4.0	--	--	--	--	--	--	20	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Poison Ivy	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	0.5	--	--	33	2.9
Occasional:																								
57 species not listed																								

* Constancy - see under Methods

** Cover Value - see under Methods

(plus huckleberry [Gaylussacia sp. H.B.K.] where it occurred) was found to be most characteristic of xeric habitats in all regions. Willow (Salix sp. L.) was found to be characteristic as a low tree or shrub on hydric habitats in all regions.

A second group of seven shrubs was selected as typical of habitats only in certain regions. When these were combined with either blackberry, blueberry, or willow, they formed a combination of shrubs that characterized a specific habitat. For example, blueberry/sweet-fern (Comptonia peregrina [L.] Coult.) was a characteristic shrub combination on xeric sites in Regions I and II. Other combinations will be described in a following section.

Distribution of Herbaceous Vegetation on ROWs

The distribution of herbaceous vegetation on ROWs was related to habitat and region (Table 3). Herbaceous is used to include other nonwoody plants such as ferns, grasses, mosses, etc., as well as herbs. Those selected were from some 289 species found on ROWs (Table 3).

Goldenrod (Solidago sp. L.) and aster (Aster sp. L.) were selected as characteristic species on mesic habitats in all regions. Most commonly, these species were highly constant as genera and/or of high cover value on ROWs and could be recognized in all seasons of the year, a valuable asset for use in ROW management.

Bracken (Pteridum aquilinum [L.] Kuhn) was characteristic and of high cover value on xeric habitats in all regions. It was also highly constant on mesic habitats in Region IV. Sensitive fern (Onoclea sensibilis L.) and cat-tail (Typha latifolia L.) were characteristic of hydric habitats in all regions.

These five characteristic species have been combined with shrubs and low trees to produce a characteristic species combination for each habitat and region (Table 4). This will be described in the following section.

Synthesis of Plant Communities

A ROW plant community, as used in this paper, is a typical combination of common and characteristic species which can be recognized in the field during most seasons of the year. Such herbaceous plants as goldenrods, asters, bracken, sensitive fern, and cat-tail fit this requirement and have been used to delineate ROW communities. Also used have been low trees, such as shrubby willow, and various common shrubs. Common and characteristic combinations of plants have been found to be closely related to habitat moisture conditions, and other site factors that relate to mesic, xeric, and hydric habitats.

It is important to realize that combinations of species have been used rather than single indicator species. This is because very few plants are exclusive to a certain ROW habitat. The characteristic species used were either "selective," i.e., are found most frequently in a certain community and rarely in other communities; or "preferential," i.e., present in several communities more or less abundantly, but predominantly or with better vitality in one certain community (Braun-Blanquet 1932).

Characteristic Plant Communities of ROWs

Different and recognizable ROW plant communities were characteristic of mesic, xeric, and hydric habitats in all regions (Table 4).

Table 3

Distribution of Herbaceous plants on ROWs in New York by habitat and region

Species	Mesic Habitat								Xeric Habitat								Hydric Habitat							
	Region								Region								Region							
	I		II		III		IV		I		II		III		IV		I		II		III		IV	
	Con	Cov**	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov	Con	Cov
Characteristic:																								
Goldenrod	100	8.6	100	17.5	100	16.5	100	12.9	100	4.7	100	8.0	100	1.8	100	2.5	20	0.2	50	13.1	100	23.5	100	12.5
Aster	100	8.6	75	8.1	80	4.5	100	10.6	60	0.9	50	7.5	100	1.0	50	1.3	--	--	25	0.6	100	4.4	83	16.3
Bracken	20	3.0	25	0.3	--	--	100	24.2	60	8.5	100	1.8	100	26.3	100	2.7	--	--	--	--	--	--	--	--
Sensitive fern	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	20.4	100	5.6	100	26.5	83	23.9
Cat-tail	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	80	7.0	50	7.5	40	8.0	33	7.9
Mixed grass	100	14.2	100	50.0	100	36.0	100	30.8	100	19.5	100	37.5	100	8.6	100	26.3	100	12.0	50	4.0	--	--	83	17.7
Differential:																								
Broomsedge	--	--	--	--	--	--	--	--	60	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hawkweed	--	--	--	--	--	--	--	--	20	0.5	100	1.8	100	1.8	--	--	--	--	--	--	--	--	--	--
Horsetail	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	3.7	50	13.1	100	35.5	66	23.1
Interrupted fern	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	3.4	50	0.3	--	--	--	--
Jack-in-the-pulpit	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	0.9	--	--	20	0.2	--	--
Jewelweed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	0.9	--	--	80	18.5	17	2.5
Nightshade	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	4.0	--	--
Pearly everlasting	--	--	--	--	--	--	--	--	60	0.6	100	8.8	50	0.5	--	--	--	--	--	--	--	--	--	--
Reindeer moss	--	--	--	--	--	--	--	--	20	0.2	--	--	50	0.5	100	8.0	--	--	--	--	--	--	--	--
Sedge	60	3.7	50	10.0	--	--	83	3.9	40	3.5	100	1.8	--	--	50	1.3	20	3.0	50	8.8	100	43.0	100	32.1
Sphagnum moss	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	8.2	25	9.4	--	--	--	--
Trout lily	--	--	75	35.0	20	0.2	66	23.8	--	--	--	--	--	--	50	18.8	--	--	50	25.0	--	--	50	5.4
Violet	80	1.1	50	0.6	--	--	33	0.3	40	3.2	--	--	--	--	--	--	20	0.5	50	4.4	20	0.5	--	--
Water purslane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	4.0	--	--	--	--	--	--
Whorled loosestrife	80	1.1	25	3.8	--	--	17	0.2	60	0.9	100	20.0	--	--	--	--	--	--	25	0.3	--	--	--	--
Wild geranium	--	--	--	--	60	0.9	17	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Wild lettuce	60	8.2	--	--	--	--	--	--	60	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Companion:																								
Hayscented fern	60	16.0	50	15.9	--	--	33	0.6	60	3.7	50	18.6	--	--	--	--	20	0.2	25	3.0	--	--	--	--
Cinquefoil	100	7.2	75	7.5	60	0.9	33	2.9	80	8.5	100	1.8	100	1.8	17	0.5	20	3.0	50	4.4	--	--	--	--
Haircap moss	60	15.5	75	16.9	--	--	83	17.7	80	25.5	100	8.8	50	0.5	33	20.0	--	--	25	0.6	--	--	--	--
Poverty grass	60	6.5	--	--	20	0.5	17	6.3	40	10.5	50	1.3	50	7.5	100	15.0	--	--	--	--	--	--	--	--
Queen Anne's lace	--	--	--	--	--	--	--	--	20	0.5	--	--	100	1.8	--	--	--	--	--	--	--	--	--	--
Sheepsorrel	--	--	60	1.9	80	8.7	50	3.1	20	0.5	50	0.5	100	8.8	--	--	--	--	--	--	--	--	--	--
Spring beauty	--	--	50	4.4	--	--	50	0.8	--	--	--	--	--	--	--	--	--	--	50	4.4	--	--	--	--
Strawberry	20	0.2	60	7.8	100	15.0	83	7.4	20	3.0	100	1.8	100	2.5	50	1.3	--	--	50	0.6	40	3.2	66	3.3
Wild lily-of-the-valley	20	0.2	50	9.6	--	--	66	17.3	40	15.5	--	--	50	0.5	--	--	--	--	--	--	--	--	50	0.8
Yarrow	--	--	20	1.3	80	2.0	50	1.0	20	0.5	--	--	100	1.8	50	1.3	--	--	25	0.3	20	3.0	--	--
Occasional:																								

255 species not listed

* Constancy - see under Methods

** Cover Value - see under Methods

Table 4

Correlation of characteristic plant communities in 4 forest regions with habitat, forest type, soil and topographic conditions

Habitat & Region	Plant Community Shrub / Herbaceous	Forest Type Adjoining the ROWS	ROW Soil & Topographic Conditions
Mesic			
I	Blackberry-Viburnum / Goldenrod-Aster	Oak-Hickory	Free drainage Lower slope
II	Blackberry-Witch Hazel / Goldenrod-Aster	Hemlock-N. Hardwoods	Free drainage-lower slope & level lowland
III	Blackberry-Sumac / Goldenrod-Aster	N. Hardwoods	Free drainage-lower slope & lowland flat
IV	Blackberry-Spiraea / Goldenrod-Aster	N. Hardwoods & Conifer-N. Hardwoods	Free drainage-lower slope & upland flat
Xeric			
I	Blueberry-Sweetfern / Goldenrod-Bracken	Chestnut Oak & Oak-Hickory	Excessive drainage-Upper slope & hilltop
II	Blueberry-Sweetfern / Goldenrod-Bracken	Oak-N. Hardwoods	Excessive drainage-Ridgetop
III	Blueberry-Dewberry / Goldenrod-Bracken	Oak-N. Hardwoods	Excessive drainage-Upper flat
IV	Blueberry-Chokecherry / Goldenrod-Bracken	White Pine-N. Hardwoods	Excessive drainage-Middle slope & plateau top
Hydric			
I	Willow-Spiraea / Sensitive Fern-Cattail	Hemlock-Yellow Birch & Elm-Red Maple	Impeded drainage-Bottom & depression
II	Willow-Spiraea / Sensitive Fern-Cattail	Hemlock-Yellow Birch Hemlock-N. Hardwoods Elm-Red Maple	Impeded drainage-Bottom & depression
III	Willow-Red Osier / Sensitive Fern-Cattail	Elm-Red Maple	Impeded drainage-Bottom & depression
IV	Willow-Spiraea / Sensitive Fern-Cattail	Elm-Red Maple Spruce-Fir N. Hardwoods	Impeded drainage-Bottom & depression

A combination of blackberry, goldenrod, and aster was characteristic of mesic habitats in all regions (Table 5). Between regions, differential species such as maple-leaved viburnum (Viburnum acerifolium L.) in Region I, witch-hazel (Hamamelis virginiana L.) in Region II, staghorn sumac (Rhus typhina L.) in Region III, and spiraea (Spiraea sp. L.) in Region IV served to differentiate between mesic communities for those regions.

A combination of blueberry, goldenrod, and bracken was characteristic of xeric habitats in all regions (Table 5). Differential species such as sweet-fern in Regions I and II, dewberry (Rubus sp. L.) in Region III and choke-cherry (Prunus virginiana L.) in Region IV serve to differentiate between xeric habitats in the four regions.

A combination of willow, sensitive fern, and cat-tail was characteristic of hydric habitats in all regions. Differential species such as spiraea in Region I, II and IV, and red osier (Cornus stolonifera Michx.) in Region III, serve to differentiate between hydric communities in the four regions.

Although characteristic plant communities could be recognized on ROWs on mesic, xeric, and hydric habitat areas, mixtures of these communities are commonly encountered in the field and must be recognized for what they are. This is particularly true of ROW areas between adjoining habitats (ecotones). It also occurs where a habitat is neither truly mesic nor xeric but represents an intermediate moisture regime such as might be called "dry mesic."

The community concept is still useful, however, since it is not difficult, when the different communities are known, to recognize a specific mix. For example, the ecotone between mesic and xeric habitats in a certain region may be recognized as different from an ecotone between mesic and hydric habitats, owing to the different combinations of species in each ecotone.

Successional Trends on ROWs in New York

While a plant community characterized by blackberry, goldenrod, and aster, along with certain shrubs, has been described for managed ROW mesic habitats in New York (Table 4), the trend in development of vegetation toward and away from this sort of community can only be surmised from other studies reported in the literature.

In an important contribution on development of vegetation in New York, Bray (1930) describes vegetation development on an abandoned field in central New York (Region III) over a period of some 20 years. The initial stages of field weeds such as hawkweeds (Hieracium sp. L.), ox-eye daisy (Chrysanthemum leucanthemum L.), goldenrod, and grasses are invaded by red raspberry (Rubus sp. L.) and blackberry, the latter becoming dominant. Sumac gradually invades the blackberry stage with gradual appearance of white pine and pin cherry. As the hardwoods of nearby forests invade, vegetation of the shrub-herb stage is overtopped and eliminated. Development of the forest stage, however, is hindered by berry pickers who habitually break down and cut seedling hardwood and white pine.

In a more applicable case on a mesic ROW habitat in Region IV included in this study, data had been taken on ROW vegetation in 1951 after maintenance by hand-cutting for 9 years. On this 1951 cover map, blackberry and spiraea were dominant shrubs, and goldenrod was a dominant herb. Grass sod and bracken were prominent in some areas.

Table 5

Composition of characteristic plant communities

SHRUBS

Characteristic Species

Mesic Habitat	Xeric Habitat	Hydric Habitat
Blackberry (I-IV) *	Blueberry (I-IV)	Willow (I-IV)
	Huckleberry (I)	
	Sweet-fern (I & II)	

Differential and Highly Constant Companion Species

Mesic Habitat	Xeric Habitat	Hydric Habitat
Maple-leaved Viburnum (I)	Dewberry (II & III)	Spiraea (I & IV)
Hawthorn (II)	Nannyberry (I & III)	Gray Dogwood (III)
Witch-hazel (I & II)	Witch-hazel (I)	Elderberry (I)
Bittersweet (I & II)	Ground Juniper (I & IV)	Alder (IV)
Staghorn Sumac (III)	Spiraea (I)	Buttonbush (IV)
Gray Dogwood (III)	Choke-cherry (IV)	Red Osier (III)
Elderberry (II & IV)	Blackberry (II, III, IV)	Blackberry (I)
Spiraea (I * IV)	Arrow-wood (III)	Arrow-wood (III)
Blueberry (I)		
Arrow-wood (III)		
Willow (I)		

HERBACEOUS

Characteristic Species

Mesic Habitat	Xeric Habitat	Hydric Habitat
Goldenrod (I-IV)	Goldenrod (I-IV)	Sensitive Fern (I-IV)
Aster (I-IV)	Bracken (I-IV)	Cat-tail (I-IV)

Differential and Highly Constant Companion Species

Mesic Habitat	Xeric Habitat	Hydric Habitat
Violet (I)	Broomsedge (I)	Horsetail (I, III, IV)
Wild Lily-of-the-Valley (IV)	Pearly Everlasting (I & II)	Interrupted Fern (I)
Trout-lily (III & IV)	Hawkweed (II & III)	Jack-in-the-pulpit (I)
Wild Geranium (III)	Queen Anne's Lace (III)	Jewelweed (I & III)
Whorled Loosestrife (I)	Reindeer Moss (IV)	Sedge (III & IV)
Wild Lettuce (I)	Whorled Loosestrife (I & II)	Sphagnum (I)
Hay-scented Fern (I)	Wild Lettuce (I)	Water Purslane (I)
Cinquefoil (I, II, III)	Hay-scented Fern (I)	Strawberry (IV)
Poverty-Grass (I)	Poverty-Grass (IV)	
Sheep-sorrel (II & III)	Sheep-sorrel (III)	
Strawberry (II, III, IV)	Strawberry (II & III)	
Sedge (I & IV)	Sedge (II)	
Yarrow (III)	Yarrow (III)	
Haircap Moss (I,II, IV)	Haircap Moss (I & II)	
Bracken (IV)		

Some 25 years later in 1976, after 5 herbicide treatments had been applied which included both broadcast and selective sprays, the characteristic plant community on the mesic habitat was still Blackberry-Spiraea/Goldenrod-Aster. Bracken was still prominent, and mixed grass remained as a major plant cover.

This is one of the few cases where persistence of a plant community on a ROW has been adequately documented over such a long period. It appears, therefore, that the Blackberry-Spiraea/Goldenrod-Aster community can persist for at least 25 years on a sprayed ROW in New York State.

In a recent study of biomass production of successional plant communities in three abandoned hayfields in central New York (border of Region III and Regions I and II), an interesting similarity can be detected between mesic plant communities of ROWs and a 36-year-old field studied (Mellinger and McNaughton 1975). The successional stage recognized at 36 years was described as a shrub-dominated community; it was composed of gray dogwood (Cornus racemosa Lam.) as the highest net producer, seconded by goldenrods and asters. Although the field had not been invaded by blackberry or other characteristic mesic shrubs of ROWs, it could be said to resemble an incomplete stand of a Blackberry-Sumac/Goldenrod-Aster community typical of Region III. In this area, gray dogwood is a highly constant companion species. The other shrubs which occurred sparsely in the hayfield were choke-cherry and grape (Vitis sp. L.). They are also found on ROWs in Region III as companion species of low constancy. Owing to the nature of the research, the authors could not objectively delimit definable stages by species composition and growth form, even though recognizable biomass differences were reported for dominant species given for each of the three ages of fields studied. The development of vegetation was described as continuous from a grass stage through a perennial herb stage to the shrub stage.

Relationship of ROW Plant Communities to the Adjoining Forest Types

A close relationship was found between adjoining forest types and ROW plant communities in each region (Table 4).

In Region I, an Oak-Hickory forest type adjoined the Blackberry-Viburnum/Goldenrod-Aster community on the ROW; Chestnut-Oak adjoined the Blueberry-Huckleberry-Sweet-fern/Goldenrod-Bracken ROW community; a Hemlock-Yellow Birch or Elm (Ulmus sp. L.)-Red Maple type adjoined the Willow-Spiraea/Sensitive Fern-Cat-tail community.

In Region II, a Hemlock-Northern Hardwoods or Northern Hardwoods forest type adjoined the Blackberry-Witch-hazel/Goldenrod-Aster community; an Oak-Northern Hardwoods type adjoined the Blueberry-Sweet-fern/Goldenrod-Bracken community; a Hemlock-Yellow Birch, Hemlock-Northern Hardwoods, or Elm-Red Maple adjoined the Willow-Spiraea/Sensitive Fern-Cat-tail community.

In Region III, a Northern Hardwoods type adjoined the Blackberry-Sumac/Goldenrod-Aster community; an Oak-Northern Hardwoods type adjoined the Blueberry-Dewberry/Goldenrod-Bracken community; an Elm-Red Maple adjoined the Willow-Red Osier/Sensitive Fern-Cat-tail community.

In Region IV, a Northern Hardwoods, Conifer-Northern Hardwoods, or Aspen-Birch type adjoined the Blackberry-Spiraea/Goldenrod-Aster community; a White Pine-Northern Hardwoods or Aspen-Birch adjoined the Blueberry-Choke-Cherry/Goldenrod-Bracken community; a Spruce (Picea sp. Dietr.)-Fir (Abies sp. Mill.), Elm-Red Maple, or Northern Hardwoods type adjoined the Willow-Spiraea/Sensitive Fern-Cat-tail community.

A notable uniformity of plant communities between regions was found in that a combination of blackberry, goldenrod, and aster occurred on all mesic habitats. While a blueberry, goldenrod, and bracken combination occurred on all xeric sites, a low willow, sensitive fern, cat-tail combination occurred on all hydric sites. These combinations were adjoined by mesic, hydric, and xeric forest types, respectively.

A Seed Source for ROWs

An interesting insight as to why blackberry has been found abundantly on ROWs is given by Graber and Thompson (1978), from their study of seeds in the forest floor of beech-birch-maple stands in New Hampshire. Viable seeds of blackberry were found in four stands varying in age from 5 to 95 years. These seeds were deposited annually in amounts between 6,000 to 7,000 per hectare. The authors also estimated the maximum age of viable Rubus seeds to be 50 to 100 years.

Pin cherry was another common ROW species whose seed was found in the forest floor in abundance in young stands of beech-birch-maple. Pin cherry has shown high constancy and relatively high cover value on mesic and xeric habitats in Region IV where beech-birch-maple are common in forest stands.

Correlation of Characteristic Plant Communities with Habitat Factors

Differences in plant communities were closely correlated with the habitat factors of soil drainage and topographic location in all regions. Mesic habitats typically had free drainage and were located on lower slopes, level lowlands, upland flat areas and low, rounded hilltops. Xeric habitats were typically excessively drained and occurred on upper slopes, ridgetops, upperflats, and tops of plateaus. Hydric habitats typically had impeded drainage and were located in stream bottoms, or depressed areas.

Soil texture and percent slope were variable within each of the three habitats and no distinct relationship between these factors and habitat could be established.

Although pH values for the three habitats overlapped somewhat, the pH of hydric sites was generally higher than mesic or xeric sites and were over 6.0 for a number of hydric sites, a value seldom reached by most other habitats. This nearly neutral pH should have an effect on species of plants that can thrive in hydric habitats.

DISCUSSION

Application to ROW Management

The consistent relationship of characteristic plant communities and common tree species to habitats within regions could be used as an important aid to ROW management. The type of vegetation to be expected on managed ROW could be predicted for various habitats in each region, and the effects of management measured against such predictions. Use of characteristic communities would also greatly simplify description of vegetation on ROWs in making reports to the Public Service Commission. Normal changes expected in plant cover could aid in long-term management planning, just as normal stocking of trees and volume growth do for forest management.

A specific example of use of vegetation development in ROW planning would be planned development of plant communities resistant to invasion. In this connection,

goldenrods and asters are special non-target plants to favor in ROW management. There is reliable evidence from research that these plants not only compete strongly with tree seedlings on ROWs for water and nutrients, but also have the ability to inhibit invasion by trees through production of phytochemicals which inhibit seed germination and seedling development (Fisher 1976, Horsley 1977). From other research studies, goldenrods rate high in resistance to tree invasion on ROWs (Bramble and Byrnes 1976).

On the 20 ROWs studied in New York, both goldenrods and asters were characteristic species that were abundant on ROWs, particularly those maintained by ground broadcast and aerial techniques. The average cover value of goldenrods on broadcast-maintained ROWs was 15.8 and for asters 13.1, while on selectively-maintained ROWs, the average cover value for goldenrods was 11.9 and for asters, 4.0.

Goldenrods and asters are also desirable for other reasons than resistance to tree invasion. They add a great deal to natural beauty during the summer months when their colorful flowers are present. They are also used for food by white-tailed deer, wild turkey, grouse, small mammals, and songbirds. Tall goldenrods furnish cover for deer while feeding on ROWs.

Effects of ROW Management on Vegetation

In spite of wide differences in brush control treatments that had been applied to the 20 ROWs studied, characteristic plant communities could be delineated which were strongly related to habitat and region. Evidently the natural processes of community development in response to habitat factors were stronger than differences in treatment.

This lack of any clear relationship between treatment and characteristic plant communities on the 20 ROWs does not mean, however, that repeated broadcast sprays could not produce a plant cover different from that produced by repeated selective sprays, or not affect certain sensitive species. It means simply that the characteristic type of plant community found on those 20 ROWs could not be related to the type of maintenance commonly used. This is an important fact which opens to questions many preconceived notions that should be tested by further research.

In Table 6, vegetation on selectively maintained ROWs has been compared with ROWs maintained by broadcast techniques. The ROWs were separated on the basis of the last 2 treatments prior to 1976. For the selective ROWs, any previous broadcast spray must have been done at least 15 years prior to 1976.

When the average cover value of 3 major life forms are compared, there is no significant difference at the 5 percent level between shrub cover to selective and broadcast-maintained ROWs (Table 6). This appears to be contrary to the conditions reported on selected ROWs over the United States (Carvell and Johnston 1978), but is caused by the abundance of species of Rubus which were dominant shrubs on mesic habitats on the 20 ROWs where they had an average cover value of 31.0 on broadcast-maintained ROWs and only 11.9 on selective ROWs. This means, of course, that the remainder of the shrub cover was made up of other species which therefore must have been more abundant on selective ROWs. Herbaceous cover value was significantly higher on broadcast-maintained ROWs than on selective-maintained ROWs; while grass cover was not significantly different. Cover value for capable trees was higher on selective ROWs than on broadcast-maintained ROWs, but not significantly different at the 5 percent level.

Table 6

Comparison of Cover Values of Mesic Habitats on ROWs Maintained by Selective Techniques with ROWs Maintained by Broadcast Techniques

Maintenance Technique	No. ROWs	Average Cover Value			
		Trees	Shrubs	Herbaceous Herbs	Herbaceous Grass
Selective	11	52.7	44.6	39.2	20.5
Broadcast	9	42.1	47.8	85.6*	24.2

* Significantly different at the 0.05 level.

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