

**Jockey Hollow: Observations and Hypotheses with reference to
succession in the forest vegetation**

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Major question

Is the vegetation that is here a reflection of natural succession or of the historic landscape or is it greatly modified by planting, introduced species, or changing deer or other herbivore populations?

Corollaries

How are deer affecting the vegetation?

What are the present indications of future changes in the forests, both old stands and younger successional stands?

Are there indications that the patterns of succession have changed over the last 100 years? If so, how and why?

METHODS:

Historical documents, including past superintendant's reports, maps of vegetation and planned plantings, photographs and other more general historical references were scanned for information on past practices.

The vegetation as mapped by Ehrenfeld (1977) was compared to that mapped in the 1930's.

Field work was initiated to characterize the tree vegetation of several stands of different ages and histories. Specific field methods are given below.

Field Methods:

Four forest stands (areas of more or less uniform forest vegetation) were chosen for sampling. These were:

1. ("TW") The stand must north of the Wick Farm. This stand was characterized in 1933 as scattered brush and locust and mapped by Ehrenfeld as White ash-Black locust. It was scheduled for planting in 1933. It slopes gently to the east.
2. (SL") The stand northwest of the intersection of Sugar Loaf and Grand Parade Roads, northwest of the old stone wall and old road just into the forest. This stand was characterized as scattered brush and locust in 1933 and mapped by Ehrenfeld as a pure yellow poplar stand. The part of it that was studied slopes gently to the southeast.

3. ("MK") The northwest slope of Mount Kemble, above Primrose Brook. This was mapped as mixed woods in 1933. Ehrenfeld mapped the lower parts as mixed oak-beech and the upper as mixed oak-black birch and mixed oak. This stand may never have been clear cut (Ehrenfeld 1977). The area that was sampled slopes gently to the northeast.

4. ("RT") The stand in the southeast part of the Park near the radio tower, mapped by Ehrenfeld as white ash-yellow poplar. This was not mapped in 1933. It is essentially level.

Measurements:

Randomly located lines were run through each of the first three stands. To locate these lines, the distance along the forest edge was measured or paced off, and random numbers chosen to indicate starting points. The possible starting points were 25 meters apart. Lines were then run in the direction of the slope, and points marked every 15 - 25 meters, depending on the density of the trees in the stand.

At each point the area around the point was marked off into four quadrants. The species, diameter at 1.4 m (dbh), and distance from the point was recorded for the closest tree in each quadrant. In MK woods the species and distance were also recorded for the nearest sapling in each quadrant. Trees were defined as stems $>$ or $+ 5$ cm dbh, and saplings as < 5 cm dbh and > 2 m tall.

At some points the tree seedlings were described in a 5 m x 5 m square, and one random line was run in TW woods to sample more closely for tree seedlings.

One American ash (Fraxinus americana) tree was cored in TW to determine its age.

In RT the ash trees seemed to be in lines, running WSW. We thus laid out two transects, starting at an ash and going in the direction of the most ash trees, to see if they fell along a transect 3 m wide. These are mapped. Three of these were cored to determine their ages.

RESULTS

The results are given in the tables appended to this report. The species codes used on the data sheets and analyses are also included.

The seedling data sheets also include some discussion.

DISCUSSION

The overall impresssion in the successional stands is that there is very little to no tree reproduction. While there is some seed germination, few of the seedlings seem to survive for a season, and even those that do are very short, and have been eaten off in the past. This does not necessarily mean that the seedlings that do form are all eaten; there are many other possible causes of mortality, such as disease, insect pests, and drought. It does mean, however, that

there is no way at present to predict the future of these forests. Where there are gaps in the canopy caused by the death of old trees there does not appear to be good sapling regeneration to replace the old trees. The saplings or small trees in the gap seem generally to be covered by vines, both native (grape) and non-native (Japanese honeysuckle and Oriental bittersweet), and are not doing well (especially in TW).

The Sugar Loaf stand presents some interesting questions. In at least some parts of it there seem to be dead black locusts (Robinia pseudoacacia) on the ground, especially toward the bottom of the slope. There are also strange pits. Tulip tree (Liriodendron tulipifera, also called yellow poplar) was recommended for planting in 1937 for Pennsylvania and New Jersey. There is little or no mention of this species in the description of the secondary successional stands in 1933. Is it possible that the tulip trees were originally planted, and have spread?

The evidence for planting on RT is weak. The trees do not line up. Unfortunately, this area was not one that was mapped in 1933. The trees in the lines, however, generally are double- or triple-trunked, and these and the ash in TW are all about 50 years old at about 1 m, suggesting at least that these may have originated in the 1930's. Some pictures from Jockey Hollow in the 1930's indicate that some forests may have been coppiced, and these may have arisen by the abandonment of this practice about this time. More trees need to be cored to test the age. Tulip trees should also be cored, and possible mapped.

RECOMMENDATIONS FOR FURTHER STUDY

1. Permanent plots should be set up for monitoring vegetational change in these forests. For best comparison among the plots, it might be best to sample three stands of different ages on similar slopes, for example SL, TW, and the old growth forest in the extreme west of the part, on the ridge northwest of Mt. Kemble. Each stand should be sampled with a minimum of 5 plots, at least 20 m x 20 m.
2. The fate of seedlings and the input of seedlings each year should be studied both in the permanent plots and in carefully designed exclosures. The exclosures should test for herbivory by rabbits, deer and other possible herbivores (e.g., mice). Seedlings should be marked and re-observed as often as possible during the growing season (at least every two weeks), to determine what happens to them. This would have to be carried out over several years, probably 10 or more to yield representative results. Over an 18 year period, I have observed that there was one period of 3 years when oak seedlings from a large Quercus velutina were very common, while during the rest of the period oak seedlings were very rare. Many of those that became established in this three year period are now flourishing. Only in this last summer have tulip tree seedlings been common, but they are very common this year. These are anecdotal observations, in a suburban setting, but they suggest that these species not only have mast years, but also that there are only occasional years when the

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seeds actually germinate and become established. The interactions of these unusual years and the weather in those years may have major effects on establishment of saplings. Long-term studies are necessary to test this hypothesis.

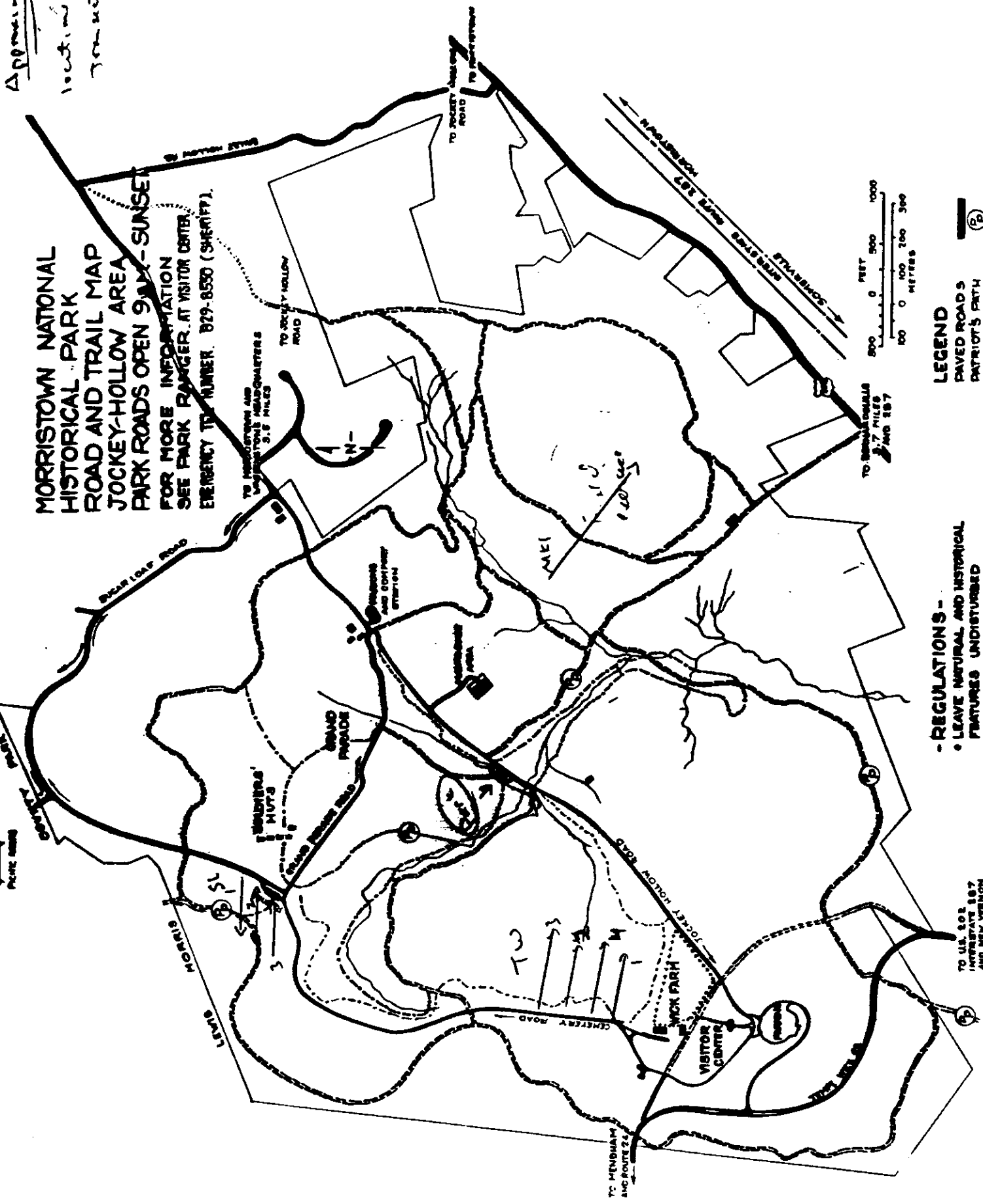
In conclusion:

1. There exists the strong possibility that succession as it is occurring today at Jockey Hollow is strongly affected by introduced species (e.g., black locust, introduced vines and possible herbaceous species such as Microstegium vimineum, introduced pests such as gypsy moths) and grazing pressure. These are only hypotheses to be tested at this point, however.
2. While it is hard to question that deer grazing is severely affecting shrub and small tree growth, other herbivores and other factors may also be playing an important role in restricting tree reproduction. There are some saplings surviving in Mount Kemble, so why not in the younger successional forests? Differences in physical characteristics, such as shade and soil moisture need to be considered as well as biotic interactions.
3. There is indication that the successional trends have changed, at least over the last 50 years. There were no stands described as yellow poplar or tulip in 1933, but these are common now. In the general region, succession was to gray birch (Betula populifolia) or red cedar (Juniperus virginiana) (NJ. State Geologists Report, 1900). While these species are found dead or dying in several of the successional stands, they are not commonly dominant, or even alive, in those stands that originated in the 1930's or were young then. The spread of the non-native black locust plus plantings by the CCC may have changed the patterns. According to the pictures the CCC planted in brushy areas, clearing out what native regeneration there was.

Approximate
location of
town under

MORRISTOWN NATIONAL HISTORICAL PARK ROAD AND TRAIL MAP JOCKEY-HOLLOW AREA PARK ROADS OPEN 9 AM - SUNSET

FOR MORE INFORMATION
SEE PARK RANGER AT VISITOR CENTER
EMERGENCY TELEPHONE NUMBER 829-8530 (SHERIFF)



- LEGEND**
- PAVED ROADS
 - PATRIOT'S PATH
 - FOOT TRAIL ONLY
 - FIRE TRAIL

- REGULATIONS-**
- LEAVE NATURAL AND HISTORICAL FEATURES UNDISTURBED
 - NO FIRES
 - PETS MUST BE CAGED IN THE PARK

TO US 501
INTERSTATE 557
AND NEW VERNON
NEAREST GAS STATION
ON ROUTE 24

Jockey Hollow, Seedling Data, 6/89
Tempe Wick woods

18 5m x 5m plots were scanned for seedling and small tree reproduction. These plots were located in the southeast quadrant of all points for transects 1 and 2. Any saplings within about 10-15 meters of the point were noted also.

<u>Tr/pt</u>	<u>species</u>	<u>#</u>	<u>comments</u>	<u>saplings</u>
1/1	robpse	1	root sucker, this year's growth	none
1/2	none			none
1/3	none			none
1/4	none			none
1/5	acerub	1	small, first year	none
1/6	none			none
1/7	none		one fraame in another quadrant	none
1/8	pru(avi?)	>1	1st year	none
1/9	none			none
1/10	pru(avi?)	>1		none
1/11	lirtul	1	1st yr	none
	pru(avi?)	>1	small	
	fraame	1	small	
1/12	pru(avi?)	>1	small	none
1/13	pru(avi)	>>1	small	none
	fraame	>1	1st yr.	
	que(vel?)	1	small	
1/14	pru(avi?)	>1	small	none
	robpse	1	root sucker, this year's growth	
2/1	lirtul	>1	root suckers at base of tree	none
	fraame	>1	"	
	robpse	1	outside plot, this year's growth	
2/2	fraame	>1	probably suckers	none
	robpse	1	outside plot, this year's growth	
2/3	none			none
2/4	ailalt	>1	suckers, small	none
	robpse	1	woody, previously grazed	
2/5	fraame	1	first year	none
	robpse	1	sucker, this year's growth	
2/6	ailalt	1	appears to be a seedling	none
2/7	ailalt	>1	seedlings (large tree nearby)	none
	robpse	>1	suckers, this year's growth	
2/8	none			none

There is apparently practically no tree reproduction surviving to greater than about 2 cm tall from year to year, and very little at that height. There was no tree reproduction from this size to the smallest "trees", those greater than or equal to 5 cm dbh.

To test the number of small "seedlings" a little better, because they were easily hidden by the Microstegium vimineum, I laid out two random transects in the same area and counted seedlings in 4 1 meter quadrats on alternating sides of the line at 15 m intervals, carefully combing the grass for hidden seedlings. (see sketch for arrangement of quadrats). There were a total of 31 quadrats (at one point I forgot to do the fourth quadrat).

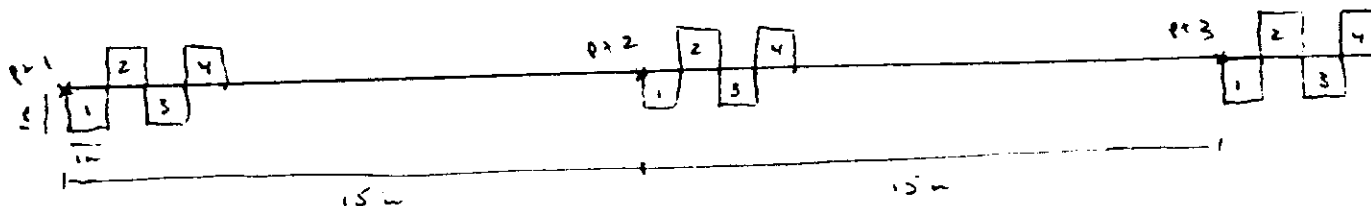
Twenty four of the quadrats (77%) had no seedlings. Results of the other seven quadrats are given below.

<u>tr/pt/quad</u>	<u>species</u>	<u>age</u>	<u>#</u>	<u>comments</u>
1/1/3	fraame	2yr	1	
1/1/4	pruser	2yr	1	
2/1/2	robpse	1yr	1	sprout
2/1/3	robpse	1yr	3	sprouts
	robpse	>1yr	1	sprout
2/1/4	robpse	1yr	3	sprout from old log
2/3/1	fraame	1yr	1	
2/4/4/	pruser	1yr	1	canopy of <u>Prunus serotina</u> .

There were three other first year black cherry seedlings that I thought at the time were shrub seedlings, so the total black cherry seedlings was probably 5 for the 31 quadrats.

It seems thus that the observations from the 5 x 5 m plots were fairly accurate, except for the possible problem of identifying the cherry seedlings to species. There is simply no tree reproduction getting a good start. While there is some germination, the seedlings are apparently not surviving until the next season. This one short observation period cannot tell anything about germination from year to year, but it can indicate clearly that seedlings that may have germinated in previous years have not survived, nor are the locust sprouts surviving until next season, except in a very few cases.

Recommendation: Initiate a study of seedling survival. Mark plots and seedlings, and track them at least month by month to find out what happens to them: when they disappear, and if possible, what causes them to disappear. Browsing is the most obvious problem, but it could just as well be disease or insect damage. If it is browsing, it is important to find out what the browsers are - deer, rabbits, mice?



Jockey Hollow, Seedling Data, 6/89
 Sugar Loaf woods (see map)

9 5m x 5m plots were scanned for seedling and small tree reproduction. These plots were located in the southeast quadrant of every other point for transects 1 and 2 and at one point of transect 3. Any saplings within about 10-15 meters of the point were noted also.

<u>Tr/pt</u>	<u>species</u>	<u>#</u>	<u>comments</u>	<u>saplings</u>
SL1/2	fraame	>1	>1 yr	none
	lirtul	1	first year	
SL1/4	lirtul	1	>1 yr	none
SL1/6	lirtul	>>1	first year	none
	lirtul	>1	>1 yr	
SL1/8	none			1 faggra
SL2/2	lirtul	>1	first year	none
	lirtul	>1	>1 yr	
SL2/4	lirtul	>1	first year	none
SL2/6	lirtul	>1	first year	none
	lirtul	>1	basal sprouts	
SL2/8	fraame	1	>1 yr	
	acerub	1	>1 yr	1 acerub
	lirtul	1	first year	
	lirtul	>1	basal sprouts, eaten back	
SL3/3	lirtul	>1	first year	1 robpse

It seems that tulip tree has the potential to reproduce here, but clearly there has been little successful reproduction in the recent past. Tulip seedlings are also numerous in the older forest on Mount Kemble, though older seedlings are rare, and there were no tulip tree saplings in the sample and none observed in general. A casual observation is that there have not been many tulip seedlings in the recent past in this general region, but that this year is a good one for tulip seedlings (this is based on casual observations near a tulip tree in Mt. Tabor, about 10 miles north of Jockey Hollow).

Tree Species Codes and Common Names

Acer negundo	AC ⁶ NEG	Boxelder
Acer rubrum	AC ⁶ RUB	Red Maple
Acer saccharinum	AC ⁶ SAN	Silver Maple
Acer saccharum	AC ⁶ SAC	Sugar Maple
Ailanthus altissima	AILALT	Tree-of-Heaven
Betula lenta	BETLEN	Sweet or Black Birch
Betula lutea	BETLUT	Yellow Birch
Broussonetia papyrifera	BROPAP	Paper-mulberry
Carya glabra	CARGLA	Pignut Hickory
Carya laciniata	CARLAC	Big Shellbark Hickory
Carya ovata	CAROVA	Shagbark Hickory
Carya tomentosa	CARTOM	Mockernut Hickory
Castanea dentata	CASDEN	American Chestnut
Celtis occidentalis	CELOCC	Hackberry
Fagus grandifolia	FAGGRA	American Beech
Fraxinus americana	FRAAME	White Ash
Fraxinus nigra	FRANIG	Black Ash
Fraxinus pennsylvanica	FRAPEN	Green Ash
Juglans cinerea	JUGCIN	Butternut
Juglans nigra	JUGNIG	Black Walnut
Juniperus virginiana	JUNVIR	Red Cedar
Liriodendron tulipifera	LIRTUL	Tulip or Yellow Poplar
Morus alba	MORALB	White Mulberry
Nyssa sylvatica	NYSSYL	Black Gum
Pinus rigida	PINRIG	Pitch Pine
Pinus strobus	PINSTR	White Pine
Pinus virginiana	PINVIR	Virginia Pine
Platanus occidentalis	PLAOCC	Sycamore
Populus grandidentata	POPGRA	Big-toothed Aspen
Prunus avium	PRUAVI	Sweet Cherry
Prunus serotina	PRUSER	Black Cherry
Quercus alba	QUEALB	White Oak
Quercus bicolor	QUEBIC	Swamp White Oak
Quercus coccinea	QUECOC	Scarlet Oak
Quercus palustris	QUEPAL	Pin Oak
Quercus prinus	QUEPRI	Chestnut Oak
Quercus rubra	QUERUB	Red Oak
Quercus velutina	QUEVEL	Black Oak
Robinia pseudoacacia	ROBPSE	Black Locust
Salix nigra	SALNIG	Black Willow
Sassafras albidum	SASALB	Sassafras
Tilia americana	TILAME	Basswood
Tsuga canadensis	TSUCAN	Hemlock
Ulmus americana	ULMAME	American Elm

Shrub and Small Tree Species Codes and Common Names

<i>Alnus rugosa</i>	ALNRUG	Speckled Alder
<i>Alnus serrulata</i>	ALNSER	Smooth Alder
<i>Amelanchier canadense</i>	AMECAN	Shadbush
<i>Asimina triloba</i>	ASITRI	Pawpaw
<i>Berberis thunbergii</i>	BERTHU	Barberry
<i>Carpinus caroliniana</i>	CRPCAR	Ironwood, Blue Beech
<i>Celastrus orbiculatus</i>	CLAORB	Oriental Bittersweet
<i>Cephalanthus occidentalis</i>	CEPOCC	Buttonbush
<i>Cercis canadensis</i>	CERCAN	Redbud
<i>Clethra alnifolia</i>	CLEALN	Sweet Pepperbush
<i>Cornus amomum</i>	CORAMO	
<i>Cornus florida</i>	CORFLO	Flowering Dogwood
<i>Corylus americana</i>	CORAME	Hazelnut
<i>Eleagnus umbellata</i>	ELEUMB	
<i>Euonymus americanus</i>	EUOAME	Strawberry Bush
<i>Gaylussacia baccata</i>	GAYBAC	Huckleberry
<i>Hamamelis virginiana</i>	HAMVIR	Witchhazel
<i>Ilex verticillata</i>	ILEVER	Winterberry
<i>Kalmia latifolia</i>	KALLAT	Mountain Laurel
<i>Ligustrum obtusifolium</i>	LIGOBT	Privet
<i>Lindera benzoin</i>	LINBEN	Spicebush
<i>Lonicera japonica</i>	LONJAP	Japanese Honeysuckle
<i>Lonicera morrowii</i>	LONMOR	Tartarian Honeysuckle
<i>Lyonia ligustrina</i>	LYOLIG	Maleberry
<i>Ostrya virginiana</i>	OSTVIR	Hop Hornbeam
<i>Parthenocissus quinquefolia</i>	PARQUI	Virginia Creeper
<i>Prunus virginiana</i>	PRUVIR	Chokecherry
<i>Rhododendron nudiflorum</i>	RHONUD	Pinksterflower
<i>Rhus copallina</i>	RHUCOP	Winged Sumac
<i>Rhus glabra</i>	RHUGLA	Smooth Sumac
<i>Rhus typhina</i>	RHUTYP	Staghorn Sumac
<i>Rosa multiflora</i>	ROSMUL	Multiflora Rose
<i>Rosa palustris</i>	ROSPAL	Swamp Rose
<i>Rubus allegheniensis</i>	RUBALL	Blackberry
<i>Rubus enslenii</i>	RUBENS	Southern Dewberry
<i>Rubus hispidus</i>	RUBHIS	Dewberry
<i>Rubus occidentalis</i>	RUBOCC	Black Raspberry
<i>Rubus phoenicolasius</i>	RUBPHO	Wineberry
<i>Sambucus canadensis</i>	SAMCAN	Elderberry
<i>Smilax glauca</i>	SMIGLA	Catbriar
<i>Smilax herbacea</i>	SMIHER	Catbriar
<i>Smilax rotundifolia</i>	SMIROT	Catbriar
<i>Smilax tamnoides</i>	SMITAM	Catbriar
<i>Symphoricarpos orbiculatus</i>	SYMORB	Coralberry
<i>Toxicodendron radicans</i>	TOXRAD	Poison Ivy
<i>Toxicodendron vernix</i>	TOXVER	Poison Sumac
<i>Vaccinium corymbosum</i>	VACCOR	Highbush blueberry
<i>Vaccinium stamineum</i>	VACSTA	Deerberry
<i>Vaccinium vacillans</i>	VACVAC	Blueberry
<i>Viburnum acerifolium</i>	VIBACE	Maple-leaved Viburnum

Viburnum dentatum
Viburnum lentago
Viburnum prunifolium
Vitis aestivalis
Vitis labrusca
Vitis riparia
Vitis vulpina

VIBDEN
VIBLEN
VIBPRU
VITAES
VITLAB
VITRIP
VITVUL

Arrowwood
Nannyberry
Blackhaw
Summer Grape
Fox Grape
River-bank Grape
Forest Grape