A VEGETATION HISTORY OF WILLIAMSTOWN

1752 - 1977

by

Kathryn A. Saterson '77

A Thesis

Submitted in partial fulfillment
of the requirements for the Degree with Honors
in Biology

WILLIAMS COLLEGE

Williamstown, Massachusetts

May, 1977

ABSTRACT

A study was made of the distribution and abundance of the tree species recorded in the original lot surveys of Williamstown, Massachusetts (1752-1788), and of early historical accounts, in order to construct a map of the town's presettlement forest types. A map of the town's present forest cover was constructed, and the composition of 77 plots was compared to the presettlement composition .

The presettlement vegetation seems to have included five forest types. About 75 of the town supported a "Northern Hardwood - Hemlock" forest in which the principle tree species were beech, sugar maple, and hemlock, with secondary species including white pine, red oak, ashes, birches and basswood. Elevations above 2000 feet on Mt. Greylock and the Taconic Crest, tended to be a "Spruce-Fir-Northern Hardwood" forest, with beech and maple as the most abundant hardwoods. An "Oak-Hickory-Northern Hardwoods" forest probably covered the dry, northeast corner of town. The low, sandy area, in the same part of town, was covered with a "White Pine-Oak" forest. The lowlands along the rivers and streams supported a "Hemlock-Lowland Hardwood" forest, with elm, basswood, and butternut as the dominant hardwoods.

The most abundant species in the presettlement forests were beech and maple. About 42 of the trees noted in the surveys were beech, while about 18 were maple. The present forest composition shows that maple has increased to about 35 of the basal area while beech has decreased to 18. An increase in the abundance of birches and ash was also noted. These changes were related to the history

of land-use in Williamstown. An increase in human disturbance has caused the present forest's mosaic of secondary successions, and the related increase in earlier successional species abundance along with a decrease in the late successional beech.

The elevation, slope and aspect distribution of species in the presettlement and present forests were compared. The late successional beech and sugar maple are presently most abundant over 1500 feet, where there is least human disturbance. The earlier successional birches, ash and aspen are most abundant below 1500 feet, where there is more human disturbance and secondary succession. Some morphological and physiological characteristics of the predominant species were briefly examined, in order to better understand the distribution patterns in both the presettlement and present forests.

ACKNOWLEDGEMENTS

My deep gratitude to Hank Art, my adviser, for his advice and assistance throughout this project and for a pleasant walk through Hopkins Forest in the fall of 1973, for that is when my interest in forest history began.

My appreciation to Chris Reid and Beth Wieman for aid in the field, to Kathy Evans for the cluster analysis and to Bill Brookman, Bob Lear, Howie Levitz, Joe Mawson, Robert McCarthy, Conrad Ohman and Bill Rivers for their willingness to share their time and information.

A special thanks to all who continuously offered interest and support, particularly Meredith Patterson, Carol Relihan, Beth Wroth and the Saterson family.

Introduction

Purpose

This study is an attempt to reconstruct as accurate a description as possible of the presettlement vegetation of Williamstown, Massachusetts and to then compare the present vegetation with the past. There is a limited amount of precise, qualitative knowledge about the composition of the forests encountered by Williamstown's first white settlers in the mid-1700's. The area has now been altered by over 225 years of man's settlement and land use, which has included extensive clearing and manipulation of the forests during the peak of agriculture and the subsequent abandonment of much of this land. Yet, there is a good deal of historic evidence available, which makes it possible to determine the probable composition of the town's forests in the mid-1700's. The present study synthesizes previous pollen stratigraphy studies, early traveler's records, local histories and, most importantly, the early land survey records to construct a map of the presettlement forest cover of Williamstown. This reconstruction of forest history can impart a greater understanding of the dynamic processes of forest growth and succession, as comparisons are made with the forests of today.

Description of the Area

Williamstown is located in Berkshire County in the northwest corner of Massachusetts, bordering New York and Vermont, at the 42nd parallel. The total land area is 47 square miles or 30,016 acres. The highest point in the town is at 3,300 feet near the summit of Mt. Greylock, (which is 3,487 feet). The lowest point is on the Hoosic river at the Vermont border, where the elevation is about 55o feet. The central portion of the own lies in a valley, between the western slopes of East Mountain, Mt. Prospect and Mt. Greylock, and the eastern slopes of the Taconic range. The streams draining the town flow north, emptying into the Hoosic river as it flows across the northeast corner of the town. The Green river, Hemlock Brook and Broad Brook are the three streams flowing into the Hoosic.

Most vegetation classifications place Williamstown in the "Hemlock-White Pine-Northern Hardwoods" region of New England, where the composition is transitional between the coniferous forests to the north and the deciduous forests to the south. (Nichols, 1935; Westveld et. al., 1956; Kuchler, 1964; Braun, 1950). The predominant species in this forest type are beech (Fagus grandifolia) sugar maple (Acer saccharum), hemlock (Tsuga Canadensis), white pine (Pinus strobes), yellow birch (Betula lutea), and red oak (Quercus rubra). Red spruce is found (in addition to the above species) at the higher elevations on Mt. Greylock and the Taconic crest, which fall into the "Spruce-Fir-Northern Hardwoods" type (Westveld et. al., 1956; Kuchler, 1964; Braun, 1950). Oaks and hickories can predominate on dry hills. Other species commonly found in this area include red maple (Acer rubrum), white ash (Fraxinus americana), elm (Ulmus americana), basswood (Tilia americana), paper birch (Betula Papyrifera), black birch (Betula lenta), white oak (Quercus alba) and black cherry (Prunus serotina). The diversity of the forest types on different areas of

Williamstown will be considered in detail later. "The Berkshire Plateau, because of its rugged topography, affords a variety of sites suitable to a wide range of communities." (Braun, 1967).

Literature Review

A good number of studies have compared the present vegetation of an area with that of its presettlement forest, using early records, land survey notes, and remnant old growth forest to reconstruct the presettlement vegetation (Lutz, 1930; Kenoyer, 1934; Bromley, 1935; Ruap, 1937; Gordon, 1940; Raup and Carlson, 1941; Kenoyer, 1942; Marks, 1942; Stearns, 1949; Bourdo, 1956; McIntosh, 1962; Siccama, 1971; and Auclair, 1976.) Lutz (1930) reconstructed the original forest composition of an area in northwestern Pennsylvania from the 1814 land survey. He found that beech, hemlock, maple, birch, white pine and chestnut (Castanea dentate) composed over 88% of the species. Kenoyer (1934) mapped the "Forest Distribution in Southwestern Michigan as Interpreted from the Original Land Survey," but did not make comparisons with the present forest distribution. Bromley (1935) used the early traveler's records and historic evidence to reconstruct a description of the original forest types of southern New England. He examined the influences that two hundred years of cultivation, grazing and industrialization have had on the forest, and some of the resulting changes in forest composition. Raup (1937) described recent changed in climate and vegetation in southern New England, basing his description of pre-colonial forests on historical writings.

The character of the primeval forest of southwestern New York was reconstructed by Gordon (1940). He used land survey notes and field studies of areas that he considered to have been undisturbed. Raup and Carlson (1941) described the history of land use in the Harvard Forest (in Petersham, MA), using early land surveys and existing old age stands to describe the pre-colonial vegetation. They explained the succession of vegetation following the abandonment of cropland after the peak of agriculture around 1850. The concluded that eastern and northern slopes favored the development of northern hardwood-hemlock vegetation, while the dry, warm, west or south facing hillsides favored the central hardwood oaks and hickories. Kenoyer (1942) examined the "Forest Associations of Ottawa County Michigan at the time of the Original Survey" and found that about 34% of the forest trees were beech, 14% were hemlock, 13% were sugar maple and 9% were white pine. Marks (1942) studied land use and plant succession in Coon Valley, Wisconsin, but did not use original land surveys. He described the "aboriginal community" from patches of woods which eh felt had persisted, undisturbed, since before the area was settled.

Stearns (1949) compared the land survey notes of 1857-59 with 1946 quadrat studies of an undisturbed conifer-hardwood stand in Forest County, Wisconsin. He used the percentage of each species to calculate comparative densities and found that the evenly mixed stands of sugar maple, hemlock and yellow birch had changed to a forest with more sugar maple and less birch and hemlock. Bourdo (1956) reviewed the use of land surveys in quantitative studies of former forests, pointing out their value in reconstructing forest history. The 18th century forest composition of the Catskill Mountains region of New York was assessed by McIntosh (1962), using the early land survey records. He found that beech, hemlock, sugar maple and birch were the principle tree species present before the area experienced extensive occupation and disturbance, but did not describe the changes in the 20th century.

Siccama (1971) used the original trees recorded in the surveys of township lines in northern Vermont (1783-87) and the lot surveys in some Chittenden county townships (1763-1802) to study the

composition of their presettlement forests. His map of the probable presettlement vegetation was based on the geographical distribution of species of witness trees, elevation, soil types, topography and early historical records. A comparison with the forest composition in 1962 showed a large decrease in the percentage of beech, white there was an increase in the amount of maple, birch and pine. Changes in the importance of ecological parameters, such as soil type, catenal gradient and steepness, with the development of intensive agriculture were quantified by Auclair (1976). Using original land surveys, he reconstructed maps of the presettlement vegetation. This provided a record of land cover which coincided with the changing technological of the last 130 years. As agriculture has become more intensified, cropland has been increasingly restricted to the most favorable sites, where moisture related variables have become more important. Table 5 summarizes the composition of the presettlement forests in five of these studies, for easy comparison with the composition in Williamstown.

Prehistoric Vegetation

Palynological data from Berry Pond, in the Pittsfield State forest, has provided information on the pre-historic vegetation of the area (Whitehead, 1973). The productivity of the lake has reflected the composition of the vegetation around it, through leaching of nutrients or litter fall. The data indicates that the productivity of the lake increased in the late glacial to early postglacial eras (13,000 to 8,000 years ago) when the vegetation change from park-tundra to a boreal coniferous forest, of spruce, first, and then pine. The productivity of the lake then declined (9,000-5,000 years ago) as northern hardwood species and hemlock replaced the pine. As the amount of hemlock decreased sharply, a further increase in the lake's productivity was observed. This study revealed that the hemlock-northern hardwoods vegetation of the area was established as long as 5,000 years ago.

Bently (1962, Thesis, unpublished) described similar vegetation changes for the area, as revealed in his study of pollen layers from Pownal Bog, in Vermont, just north of Williamstown. By dating cores from the bog, he, too, noted that the spruce maximum changed to a pine maximum from about 11,000 to 8,000 B. C. as the climate warmed. During the early part of the period from 7,000-3,000 B. C. there was an increase in deciduous species and hemlock, which may have reflected a moist, warmer climate. During the warmest part of the period from 3,000 B. C. -1 A. D. there were mostly deciduous species and hemlock was at a minimum. Most palynologists believe that hemlock is an indicator of moist climate, so the reduction in hemlock may indicate the relative dryness of the time, or it could reflect some other biological factor (Davis, 1965). In the pollen zone for 1 A. D. to the present (a time of gradual cooling and increasing moisture), Bently noted maximums for hemlock, birch and white pine. He attributes the rise in white pine, in the latter part of the zone, to the abandonment of farms in the last 200 years, and the subsequent seeding in of white pine.

Presettlement Vegetation Defined

The belief that the first settlers encountered a changeless, stable, virgin and undisturbed forest is largely a myth. As the above section has shown, the vegetation of the area was constantly changing for thousands of years, so there is no reason to believe that it was static in the mid-1700's. There really is no

such thing as an "original or virgin forest, unless one simply defines the vegetation encountered by the settlers as the original vegetation. Gordon (1940) defines the "forests primeval" as the vegetation existing at the time of settlement and accepts the fact that natural disturbances such as fire and disease caused inevitable instability in the forests.

The presettlement forests to be reconstructed in this study are defined as the forests existing at the time of the area's settlement, in balance with natural disturbances, yet unaffected by man.

The inevitable question arises, as to what degree the American Indian might have influenced the vegetation here before the arrival of white settlers. Indians had inhabited parts of New England for thousands of years and it is unlikely that they left all the forests completely undisturbed.

It was a custom for many, each fall, to burn any part of the forest that was dry enough, in parts of Southern New England.

> …for it being the custom of Indians to bourne the wood in November when the grass was withered and leaves dryed, it consumes all the underwood and rubbish, which otherwise would overgrow the country, making it impassable, and spoil their much affected hunting. (quoted in Hawes, 1923).

These fliers were also used to drive game, facilitate travel and increase the amount of grassland (Day, 1953). Many Indians were agricultural, so they must have cleared some areas to arm and they also used wood for fuel. But, there is no evidence for lasting Indian settlements in Williamstown, and Hawes (1923) thought that the effect of Indian fire was slight except in the coastal region of New England. Timothy Dwight (1822) explained that the Indians only burned those parts of the forest that were dry enough, which were usually on uplands with dry soil. He says that oak and yellow pine areas were burned often, but that beech and maple grounds were too wet to be burned (Swight, 1822, Vol. IV, p. 38). He noted that the "vegetable mold" (litter) under beech-maple areas was 6" to 1 foot deep, while on oak-pine grounds it really exceeded an inch because of frequent burning. This would lead us to speculate that there were not many deliberate fires in most of Williamstown, for most of the town was beech-maple. The northeast corner of the town was predominantly pine and oak, so it is likely that it could have been subject to burning. Ebenezer Kellogg's history of Williamstown (in Field, 1829) does state that a mountain northeast of the village (now called Pine Cobble) was made almost naked by frequent fires, allowing one to see deer on it from the valley below. Bromley (1935) gives additional support for the conclusion that Williamstown was probably not subject to Indian burning. He says that most of southern New England was burned by Indians, except for the Berkshire and Taconic Hills, which would include Williamstown. Thus, it seems likely that the forest encountered by the first European settlers of Williamstown were not considerably altered by unnatural disturbances.

Historic Accounts of the Presettlement Vegetation

The lot surveys of the town, begun in 1752, offer a quantitative description of the forest composition, while the observations and notes of early travelers and settlers are invaluable in giving a more complete qualitative description of the presettlement vegetation. While not all parts of the town were covered in the land surveys, the historical descriptions have included most areas of the town. Timothy Dwight did extensive traveling throughout New England and New York in the late 1700's. His journal contains descriptions of the vegetation of Williamstown and surrounding area, during the first 40 years of the town's settlement.

During his journey of 1799, Dwight noticed that the trees along the Hoosic river, on its approach to Williamstown, were "chiefly maple, beech and evergreens." (Dwight, 1822, Vol. III, p. 166). Twenty feet from the summit of Mount Greylock he noted that,

> The forests are maple, beech, cherry and birch. There are also several large spots and streaks of evergreens, chiefly hemlock and spruce. (Dwight, III, p. 169).

The trees on the summit of Greylock were described a "dwarf-like" with branches that were "universally thick, short and clumsy." (Dwight, III, p. 170). Yet the trees were still thick and tall enough to prevent a clear view, forcing Dwight to climb to the top of them. It seems that the summit was not as open, or as covered with sparse vegetation as it is today. He noticed that maple and beech were found in all soil moistures in Williamstown. The forests Dwight encountered were by no means static, and he observed succession toward a climax type, saying "Every subsequent growth of trees becomes of course larger and finer than the preceding, until the forest arrives to its utmost height and perfection." (Dwight, Vol. III, p. 177). Though he does not mention Williamstown specifically. Dwight did encounter areas that had been cut for fuel, and were being renewed by seed and stump sprouts. "Good grounds will thus yield a growth amply sufficient for fuel once in fourteen years." (Dwight, Vol. I, p. 75). Dwight explains that 9/10 of the forests he encountered were of two types; either "oak, hickory, etc." or "beech, maple, etc." (Vol. IV, p. 151).

Dwight describes the principle forest trees of New England and some of their uses (Vol. I, p. 21-25). White pine is called the "noblest tree," growing to 6 feet in diameter and 250 feet tall. Hackmatack (or Tamarack) is found in uplands or swamps. He found hemlock on every soil, but said it "delights most in ground which is moist, cold and elevated." He noted white and black spruce, fir, white cedar, and black, white, yellow, red and rock oaks. Sugar maples were used in sugaring and grew to 120 feet tall. The hickories include white (Juglands cinera), shagbark, (Carya ovata), walnut (Juglans or Carya), pignut (Carya glabra) and bitternut (Carya cordiformis) and were used for nay purpose needing elastic or flexible wood, and for fuel. In early accounts of vegetation the word "walnut" was used synonymously with "hickory," yet butternut was noted separately (Raup and Carlson, 1941; Bromley, 1935). Beech, birch (white, yellow and black), elm, cherry, and basswood were present. The ashes included white, red (Fraxinus tomentosa), black (F. nigra), prickly (Xanthoxylum) and mountain (Prys americana), with white ash mentioned as being excellent for utensils. Chestnut was mentioned as one of the most useful trees for fencing and building, and, finally Dwight noted poplars (white, Populus alba), aspen (Populus tremuloides), black (Populus nigra) or balsam (P. balsamifera) as among the principle trees of New England.

Descriptions of the area's early vegetation can be gathered from other sources as well. Thompson, in his book Vermont (1824), described the original physiographic types of the area as (1) "alluvial areas": supporting oak, butternut, elm, walnut and chestnut, (2) "higher flats": dominated by pine, (3) "medium uplands": with sugar maple, beech, birch, ash, elm basswood, butternut, cherry, hornbeam (Carpinus caroliniana), spruce (Picea rubens) and hemlock, spruce and fir (Abies balsamea) (Bromley, 1935). Sprucefir was the dominant type at higher elevations, while it was hemlock-hardwoods on lower slopes. Dwight said that the fir was "thinly scattered upon the mountains south of New Hampshire and Vermont" and was rarely found below latitude of 44° but he was probably referring to valley bottoms (Dwight, Vol. IV, p. 51).

In the very early 1800's "nearly the whole [county] was covered with thick and almost impenetrable forests." (Field, 1829). In describing the valley of Williamstown, between the Taconic and Greylock, the Reverend Chester Dewey said, "…the thickness and luxuriance of the forests on the hills have called forth

the admiration of all the lovers of wild scenery." (Field, 1829). "Saddle Mountain [Mt. Greylock] is covered with a complete forest." (Field, 1829) Dewey's "Vegetable List" for the country noted that basswood was found on low grounds, butternut was found in the alluvial lands and woods, beech, hemlock and chestnut were found in the woods of both "plains" and hills, and hackmatack was found in marshes. Fisher (1933) imagined the primeval wilderness of New England saying

> …one may picture a forest in which broad-leaved trees and hemlock formed a dense stand from 80 to 100 feet high, above which, either by small groups or single trees and varying greatly in abundance, white pines reached a height o f150 feet or more…such a forest was self-maintaining (climax)… (Fisher, 1933).

During the early 1700's the boundary between Massachusetts and New Hampshire (which then included Vermont) was in dispute. In 1740, Richard Hazen was appointed by Governor Belcher and the Council of New Hampshire to survey the western and principal section of this boundary, running a line due west from Pawtucket Falls on the Merrimac River. He set the line 1 45' north of "due west", thus including about 1/3 of what is now Williamstown within the Massachusetts boundary. Had he not made this error, the site of the college and the slopes of Mt. Prospect would have been in Vermont. Hazen's journal of this 1741 survey includes observations in Williamstown. On Sunday, April 12, 1741 he and his companions waded the "Hosek River' and slept on the west side. It rained that night "which caused us to stretch our blankets and lye under then on ye bare Ground, which was the first bare ground we laid on after we left Northfield." (Hazen, 1879, p. 331). On Monday, April 13 they climbed over Northwest Hill to the crest of the Taconics, describing what was then Mt. Belcher (and is now called Smith Hill).

> This Mountain was Exceeding good Land, bearing beech, Black birch and Hemlock, some Basswood. Over this Mountain we Concluded the line would run betwixt New York Government and these whenever it should be settled… (Hazen, 1879).

On Tuesday, April 14, the land just beyond the west slopes of the Taconics was described as "…good for settlements, bearing Large white oaks in some places, in others Beech, Maple, WhiteAsh, etc." (Hazen, 1879, p. 331).

A Brief History of Land Use of Williamstown

In April of 1749 the General Court of Massachusetts ordered a survey of the townships of East and West Hoosac (which is now Williamstown). Oliver Partridge reported to the court, on November 10, 1749, that there was

> A very valuable and rich tract of land in the middle of the Township… (a) Great part of the land in both townships is considerably loaded with timber. (Perry, 1904).

In January of 1750, orders were adopted to lay out 63 House Lots in West Hoosac (which was incorporated as Williamstown in 1765). Each was to be 10 acres, and each settler was to get 1/63 of the township. Within 2 years each settler had to clear, fence and cultivate 5 acres and build a house, which they had to live in for 5 years. The proprietors of the House Lots (First lot division—see figure 1) decided on the locations of the other divisions, and drew one lot in each division. The surveying of the First Division was completed in 1752. The most desirable land appeared to be the more easily farmed and grazed meadow lands along the Hoosic and Green rivers, so these became the 2nd and 3rd divisions by 1754. The 4th division was also surveyed in 1754. By 1765 the 5th, 6th and 7th divisions were laid out, while the Stone Hill

Reservation was set aside in 1764. The 8th and 9th divisions began to be divided up in 1771 (Carney, 1976). The economically important and noticeable tree types in the 6th and 7th divisions are revealed by their names; the "Pine Lots" and "Oaks Lots." ("Hemlock Brook." "Birch Hill," and "Pine Cobble" all probably reflect the tree species they supported. See Appendix B).

The evidence indicated that Williamstown was heavily wooded in most parts, so that the early settlers came in and "went to chopping" (Perry, 1904). The proprietors voted at a town meeting in 1760 to "clear the street east and west as far as the town lots extend, and north and south from Stone Hill to the river." (Perry 1904). The need for roads grew along with the town. Water Street was laid out in 1761, to provide access to a mill on the Green River.

> Of ten trees marked by this survey for the line of this road, 8 were hemlocks, showing the prevailing timber along the lower Green River. (Perry, 1904)

Perry mentions that the forest on lot 3-15 was originally unbroken but that by the early 1800's there was a spruce swamp between the house and the river. All kinds of timber were plentiful, except for the desirable pines. The proprietors voted themselves the "liberty to cut timber on the undivided land" and to prosecute any outsiders found cutting pine (Perry, 1904). The pine and oak lots were laid out in 1765, so each proprietor could have their share of these valuable trees. All the pine and oak lots were north of the Hoosic river, with most of the pine lots located on the sandy areas near Broad Brook. The durable white oak timer was used for the sills, frames and corner posts of houses, and possibly also for rafters, studs and braces. The pins to fasten timbers together were made of white oak. The huge white pines were used for sheathing, panels, pews, rived clapboards and cleft shingles. John Smedley built a sawmill at the junction of the Hoosic River and Broad Brook in 1763. This mill produced most of the pine and oak lumber used in town.

When West Hoosac was incorporated as Williamstown in 1765, it was fast becoming an agricultural town. There were 538 acres under cultivation (approximately 11 acres per family), and livestock included 83 sheep and 73 cows (Brooks, 1974). This means that 98% of the town was forest. A map of the town in that year showed 4 grist mills (3 on the Green river and 1 on the Hoosic), 3 saw mills (2 on the Green river and 1 on the Hoosic) and a tannery on Sweet Brook (Resch, 1976). During the peace following the French and Indian Wars, preceding the Revolution, the town prospered and the south part came under cultivation. In 1787 the disputed border between new York and Massachusetts was set and surveyed by David Rittenhouse, John Ewing and Thomas Hutchins, and is known as the Hutchins Survey. The northwest corner of town was moved east ½ mile, giving 150 aces of Williamstown to New York, while the southwest corner of the town was moved about 1.4 miles, giving a 3000 acre area of land to Massachusetts. This land, called "the Gore," was annexed to Williamstown in 1838.

By 1800, the population of Williamstown was 2086, and 20,000 acres of land had been cleared of trees. This means that only about 33% of the town was left as forest (Brooks, 1974). The Hickox family had settled on the summit of Bee Hill (Mark Livingston map in Brooks, 1974. See Appendix B.) and had nearly all of the 400 aces on the slopes under cultivation or pasture. They had planted 1000 apple trees, as had the Prindle family on Birch Hill. Buxton Hill (now part of the Hopkins Memorial Forest) was supposed to have been entirely clear of forest at this time, too (Brooks, 1974). The farms in town were getting larger and more consolidated. The forest of the town were being cleared for farmland, burned for fuel, and felled for used ranging from utensils to fences. There were so many farms cleared by the time of Dwight's 1806 journey through the area that he could say "Williamstown is a collection of plantations." (Dwight, 1829, Vol. II, p. 305). Some fields had even been abandoned already, for he noted that oak-hickory grows to white pine

after cultivation (saying that spontaneous generation could not account for the white pine!). Farms were located amidst thick forest,

> The Hopper is one of the wildest and mot romantic spots in this section of our country. The Patches of evergreens occurring on the sides of the mountain (Mt. Greylock) are frowning with gloom on the spectator, whose eye is then relieved by resting on the bare cliffs or cultivated fields beside him. (Field, 1829).

There were also farms along the banks of the Hoosic river, where the rich alluvial soil was "well adapted to the production of grass, and in the higher parts, of wheat, Indian corn, etc." (Field, 1829).

The peak of agriculture, when the greatest amount of land was cleared, was sometime between 1800 and 1830. A map from that year (figure 1) shows 42% of the total acreage clear of forest. An 1838 lithograph of Williams College showed all the land from Weston football field to Mail Street as cultivated farmland. Cedars lined the road by West College, and there were white ashes in the foreground (Resch, 1976). Joel's ' Sentry, at the base of Taconics was repeatedly ploughed to its very top (Perry, 1904). By 1830 there were many dairy farms with as many as 20 cows per farm. Wheat and rye production began to diminish with the opening of the Erie Canal in 1825 (Brooks, 1974). Since the east could not compete with the cheap western wheat, more and more wheat production was abandoned and dairying increased. When the railroads opened the Midwest in the 1860's, farmland bean to be abandoned and the town became more industrialized. There were 57 mill workers in town in 1865 and 272 in 1885 (Brooks, 197). The abandonment of farmland that began in the 1860's was partially offset for a while by the cutting of timber for wood and fuel.

It was in the second half of the 19th century that,

> Steam power and small mills reached higher up the mountains for fuel than the farms had reached for soil. Together, they stripped the trees from the hills … (Brooks, 1974).

By the end of the Civil War, Williamstown supported 2600 people. Trains used wood for fuel; the Boston Maine Railroad owned a woodlot on the summit of Mt. Prospect (Browne, no date). A large strip of Johnsons' Pass, on the western border of town, was "completely cleared of woods to feed the capacious maw of a charcoal kiln. " (Perry, 1904). In a description of the "White Oaks" area, it was said that most of the "valuable white oak and white pine timber had been cut off by the early 1800's. The demands of the mills and locomotives for fuel stripped the mountains of their remaining growth." (Broos, 1974). In 1883 there were 2 pine groves in "White Oaks," one by the Sand Spring hotel and one at the end of Cole Avenue, which served as "memorials to the old pines" (Perry, 1904). The second growth pine in Coles' Grove (a resort at the end of Cole Avenue) were 50 years old in 1883. (There were almost annual natural fires on the mountain nearby so the use of the resort declined by the turn of the century.) The grove was cut in 1918 to be used for the ship timber in World War I. In a description of the top of Petersburg Pass, in the 1890's, it was said that "the gap is entirely free from trees on both its approaches," and that the winds there are so strong that "…a new forest growth will but slowly recover its hold on the soil." (Perry, 1904). Goodell Hollow was described by Perry as a place where

> The thick woods on the high hillsides right and left have been repeatedly cut off, to be burned into charcoal to feed the furnace fires of the Lanesboro Iron Company. (Perry, 1904).

By 1900, most of the original forest had been cut at one time or another.

As farming continued to decline (beginning in the 1850's), more and more fields and pastures were becoming 2nd growth forests. The road up to Petersburg was through "woods and waste land and past uncovered cellars and signs of desolation and abandonment." (Perry, 1904). The lower farms between the two branches of Sweet Brook had been abandoned in 1894. By this time the foothills of the Taconics were "clothes to the very top with deciduous trees, particularly birch, beech, maple and chestnut." (Perry, 1904). Perry made many observations of the vegetation in the early 1890's. Not a single white oak was ever found in the Hopper, or within 2 r 3 miles of it, while the forest on the east side of adjoining Bald Mountain (which is now called Stony Ledge) was "composed mostly of deciduous trees." (Perry, 1904) The hilly parts of the "White Oaks" area were again covered with oaks, while white pines were also beginning to grow in again. Many of the farms that had begun to be abandoned in the 1850's had seeded up to nearly pure stands of white pine. Most of this good quality timber was removed for the wooden box industry, from 1890 to 1920 or so (Fisher, 1933). These abandoned fields were then succeeded by such hardwoods as grey birch and poplar. The Williamstown situation appears to have been typical of most New England. It was estimated that 60% of Southern New England was brush or young forest in 1935 as a result of farm abandonment (Bromley, 1935). The growth and succession of these young forests continued throughout the 20th Century. White (1973, unpublished) noted that the amount of bigtooth aspen in the Hopkins Memorial Forest decreased from 1935 to 1971. Berkshire County grew by 36% from 1952-1972, which would put more pressure on the land, yet the amount of agricultural and open land decreased from 21% of the county in 1952 to 15% in 1972. 64% of Williamstown was covered with forest in 1952 while 66% was forested in 1972. In 1973, Brooks noted that "There is more forest now than in 1953 and three times as much as a century ago." (Brooks, 1974).

The second growth forests now covering most of Williamstown have not been left to follow their natural successions, though. Many areas of the town have been logged intensively during the past 40 years, and many are still logged to some degree today.

METHODS

Construction of Species Maps From Original Surveys

The information from the Williamstown lot surveys (1752-1780's) was used to construct maps of the tree species distribution in the presettlement forests (Figures 4-20). The validity of using these surveys to indicate the character of the presettlement forest must first be considered. The town's proprietors appointed men to survey each division of land. Beginning with the "house lots" in 1752, sixty-three lots of different sizes were laid out in each of 9 divisions, with the proprietor of each house lot then receiving one lot in each subsequent division. The survey notes for the second "meadow lot" read:

(chart)

A tree was noted at the corner of most lots, but in many cases a stake or a pile of stones served as the corner marker. This could reflect the surveyor's attempts to actually note the tree closest to the corner of the lot; so that if no tree was close by, they gathered a pile of stones. Distances from the true corner to the cited tree were not recorded by the surveyors. It is doubtful that some surveyors had a preference for gathering stones rather than recording trees, for the same team of men surveyed the 4th Division, where most corners are marked by stones, as did the 5th Division, where trees are recorded for most corners. (This could also imply that the 4th Division was a more open area, with a lower density of trees.) Because the locations of the lots and divisions cover the town somewhat randomly, the trees noted at corners provide a quasi-random sampling of the species present at the time of the survey. The basic assumption then is that the trees cited represent a sample of the forest cover, and that the number of times a species is referred to is indicative of its general abundance in the area.

Two common questions arise as to 1) the ability of the surveyor to recognize different tree species and 2) whether or not the surveyor was biased in his selection of corner ("witness") trees. The fact that such a variety of species were recorded his prompted McIntosh (1962) to say that they early surveyors were probably "competent woodsmen with an excellent knowledge of the trees." Twenty four different species were tallied in the Williamstown surveys, from 1752 to the late 1780's. McIntosh (1962) also points out that the most common species are easily recognizable. One problem that is encountered, though, is the use of a collective name such as "maple," "oak", or "birch" to indicate one or more species. The Williamstown surveys do exhibit this problem of interpretation for some species. The fact that one surveyor could note both "birch" and "white birch" on the same lot might imply that birch could only refer to grey, black, or yellow birch, or it could be that the surveyor did not always bother to write "white" when referring to white birch. There is rarely a distinction between red and sugar maple in the surveys, and the notes just record "maple." Both white and black oaks are referred to by the same surveyor, and this does imply that eh knew the difference between these two species. But, this does not necessarily mean he knew the difference between red and black oaks. Because of the similarity of the two species, and the fact that black oaks are rarely found in this area, it is likely that the black oaks recorded in the surveys were probably red oaks. Taking these questions of species identification into account, when calculations were made (Tables 1, 2, 3) I grouped the birch species into a "birch" type and the oak species into an "oak" category. Lutz (1930)

concluded that the survey notes recorded forest data resulting from careful observation, and that they reflect a “rather remarkable knowledge of forest trees.” Gordon (1940) reached the same conclusions.

Most of those who have considered this method of reconstructing vegetation have concluded that the surveyors did not exhibit much bias in their choice of trees. Gordon (1940) suggested that surveyors may have had a preference for beech as a bearing tree, but Lutz (1930) felt the choice of trees was more or less arbitrary. Bourdo (1956) felt that medium sized trees were preferred, but concluded that species preferences would not be important because the “choice of species adjacent to a corner was limited.” Siccama (1971) examined surveyor bias on witness tree selection, (in the surveys he examined, a stake was places on the survey line or corner and the distance was recorded to the closet “witness tree”) by examining stake to tree distances for different species. He found no bias for beech selection, for the mean distance from a stake to a beech was abut the same as the mean distance to other species, (Beech: 8.8 feet, Maple: 9.0 feet, Hemlock: 9.1 feet). The surveyor apparently recorded the tree nearest the corner, which met whatever diameter or state of vigor requirements were held.

There are some other problems associated with the validity of the early surveys. Not all areas of the town were surveyed so the vegetation record is not evenly distributed over the entire town. There is a particular lack of information for the highest elevations, particularly the “Gore,” which was not annexed to the town until 1838. In addition, one cannot determine the exact location of each bearing tree because the surveyors made large allowances in their measurements for slack in the chair, and they tended to estimate distances in five-link increments) McIntosh, 1962). Bourdo (1956) also points out the possibility that some surveyors may have turned in “spurious records,” so that what exists in their field notes may never have existed on the ground.

But, taking these problems into consideration, the lot surveys still remain an extremely useful source of information about the presettlement forest. One can assume that the chance of one species being nearest a random point (the corner of a lot) is a function of the relative abundance of that species. Unfortunately, the method of survey in Williamstown did not measure the distance from a corner stake to the closest tree, as it did in the area Siccama (1971) examined, so the density of each species could not be estimated. One can also assume that the Williamstown surveyors were relatively unbiased in choosing the tree closets to each lot corner.

In order to map the distribution of each species, a large base map of the lots was first constructed. The 24” X 20” map of the lots and divisions, made by J.H. Coffin in 1843, was traced and a few corrections were made in his numbering by referring back to the survey notes (see Appendix A and E). Using the lot survey notes (as copied by Coffin from the original records, in 1843) each tree was plotted on a blueprint of this base map. The trees noted in the surveys for 2 roads, and the trees noted in the 1787 Hutchins survey were also placed on this map. Individual maps of the locations of each species were then made (see Figures 4-20).

Contour lines were traces from U.S.G.S. topographic map of the town, for 100 foot intervals from 600-1000 feet, and for 500 foot intervals from 1500-2500 feet. The 1200 foot contour line was also traced onto this map. The lines from this map were photographically superimposed on the lot division base map, producing a photograph with contour lines overlaying the lot division lines. This overlay made it possible to determine the elevation, percent slope and aspect for each of the 521 trees recorded in the surveys and to make comparisons between species. Each tree was placed in one of the ten elevation intervals, and then, for easier comparison between species, one of there intervals; <600-900 feet, 900-1500 feet, and 1500-

>2500 feet, (Table 2). The percent slope at each tree's location was determined by counting the number of contour intervals per inch on the original topographic map (see Table 3). The aspect for each tree was categorized as N, NE, E, SE, S, SW, W, or NW. These were then used to group the trees of each species into the more general north, south, east or west facing categories (Table 2). Because it is assumed that the number of times a species was mentioned in the survey reflects its relative abundance in the area, the relative percent of each species in the forests was determined from the total number of trees cited (Table 1). The lot map has rivers and streams on it, so it was possible to calculate the percent of each species along a stream (Table 4).

1830 Map of forested areas

A copy of an 1830 map of Williamstown was obtained from the state archives in Boston. Color slides were taken of the original, making it possible to fully delineate the forested areas on a copy of the 1830 map, with the original lot survey lines superimposed on it (see Figure 1). The forested areas on the full scale map were measured with the Lasico polar planimeter, revealing that only about 58% of Williamstown was covered with forests in 1830. An overlay of the topographic lines was made on the 1830 map (Figure 2), revealing that the only uncleared areas were ridge and mountain tops and steep slopes.

Map of Present Vegetation

Information on the present vegetative cover of Williamstown was gathered from a number of sources. The map that was constructed cab be overlaid on the 1971 University of Massachusetts Map-Down base map for Williamstown. The map-down is the result of mapping land-use types and vegetative cover types, as revealed by aerial photographs, onto a U.S.G.S. topographic map. All the urban land types were shaded in with pink (plus cemeteries and mines) white the agricultural and recreation land types were shaded in with blue. Because aerial photographs were used, the forest land could only be broken down into hardwoods, softwoods, or a mixture yet different density and size classes were distinguished. The areas designated "S" (where softwoods constituted at least 80% of the stand) and "SH" (where softwoods predominated in a mixture of softwoods and hardwoods) were colored light green, so that the only areas left open on the map were for hardwoods, or a mixture of hardwoods and softwoods where hardwoods predominate. I then set about determining what species made up these hardwood and softwood stands (Maps enclosed in back pocket. Figure 23 and Appendix D).

Much of the southeast quarter of the town lies within the Mount Greylock State Reservation, where a Continuous Forest Inventory (C.F.I) program is in effect. Every few years an inventory is made of the species composition, and a number of other characteristics, for permanent plots in the reservation. Data from the 1967 CFI, for the 18 plots within Williamstown, was obtained from the Department of Forestry and Wildlife Management at U. Mass. (Appendix C shows the plot locations). The total basal areas for the species on each plot were calculated. The two basal area dominants of each plot were then used to interpolate the vegetation of this area. The actual location of each type was estimated as accurately as possible, using the information contributed by a topographic map, the Map-down categories of the area, and a soil type map of Williamstown. It must be acknowledged that the placement of divisions between vegetation types is often arbitrary and can represent the center of a more gradual transition zone

between 2 types. Any vegetation mapping requires a generalization, abstraction or typification of the actual vegetation patterns. The general Map-down categories were very helpful, when combined with the information from an actual plot. For example, the Greylock C.F.I. plot on Stony Ledge was predominantly red spruce and sugar maple, and it was surrounded by areas designated "SH" and "HS" on the map-down. So I could extrapolate and call the whole area spruce-sugar maple. Gordon (1940) described the method of using information on the vegetation of one area to determine the probable vegetation of a similar area.

> It is reasonable to assume that contiguous areas on similar sites were covered with essentially the same vegetation. By "site" is meant the altitude, slope, exposure, relative relief and soil type.

The second major sources of information on the present vegetation came from a "Five Year Forest Management Plan" for the south west corner of town (west of Oblong Road and Route 43 and South of a line running west from the Carmelite Novitiate), prepared by the Green Diamond Forestry Service, Belchertown, MA, in March of 1974. They mapped eight different vegetation types on the topographic map of the area, and included the basal areas for the species in each type. Since the mapping of this area was already done, it was just a matter of transferring the types onto my map, after correlating each type with my classification system (which uses the 2 basal area dominants).

The Williams College Center for Environmental Studies provided information on the vegetation in the 350 permanent plots of the 1600 acre Hopkins Memorial Forest, located in the northwest corner of town. The computer printouts entitled "Compiled Hopkins Forest Data By Species and by Plot" for 1972 and 1975 provided information on the basal area dominants in each of the ¼ acre plots. Here the information was almost too detailed for my purposes, but the area was classified, with the aid of maps of the 1972 basal area dominants, combined with the computer data. A map of the basal area dominants in 1936 provided valuable information on succession, when compared with the 1972 map.

Field study of 17 plots in different parts of town was undertaken to supplement the above information. Plots were randomly chosen in areas not covered by the above sources. A basal area prism was used to estimate the basal areas of each species encountered in four sites within each plot. The 2 basal area dominants of each plot were added to the map. In the classification used for this map, each type lists the two basal area dominants. Basal area was used to map the dominant vegetation because of the nature of the available information on the existing vegetation and the fact that time limitations prevented more extensive field study.

Information for the present vegetation map was obtained from other sources as well. Mark Livingston's 1974 Stone Hill map was used to supplement the field work on Stone Hill. Personal communication with Bill Brookman (Mt. Hope Farm Management Corp.) and Bob Lear (a state forester for Northern Berkshire County) allowed me to map the Mt. Hope Farm area. This was aided by a general survey of the vegetation on Mt. Hope Farm, done by Bob Lear in January of 1977. The town forester, Robert McCarthy, offered much information on the vegetative cover in many other parts of town.

In order to examine the elevation and aspect distribution of species today (se Table 6) (for comparison with the presettlement vegetation), it was necessary to locate specific sites on the vegetation map (Appendix C). The elevation, slope, and aspect were calculated for each of the 18 CFI plots and the 17 field-study plots. In order to obtain an unbiased selection of sites in the area mapped by Green Diamond, a 1 X1 meter grid was placed over

the Hopkins Forest map, yielding 24 sample points. Thus the 77 sites tabulated in Table 6 reflect all areas of town. Yet, the selection of only 77 sites may be too low, and certain areas, such as the northeast corner of town, are underrepresented in the distribution of sites.

Map of Pre-settlement vegetation

A map of the probable presettlement forest types (see figure 22) was constructed by combining information obtained from the species distribution maps, the 1830 map, the present vegetation map, and the historical descriptions. The species distribution maps showed elm and hemlock predominatly in lowlands along rivers, while the oaks and pines were restricted to the area northeast of the Hoosic river. Additional indicators of the probable composition of the presettlement forest were found by considering the present vegetation on areas that seem never to have been completely cleared. Many people (including the town forester) feel that the "Beinecke" stand in the Hopkins Memorial Forest has never been completely clear cut and that its vegetation is much the same as it was 220 years ago. A map with the 1830 forest cover overlaid on the Hopkins Forest section index (see Figure 3) shows that the "Beinecke" stand was still forested at the height of agriculture. This stand is predominantly beech, sugar maple and red oak. Geier (1973 unpublished) determined that some sugar maples there were 300+ years old, while the red oaks ranged from 200 to 250 years old. It is possible that plot 9-3 (on the same map) has never been completely cleared, since it was not cleared in 1830, and is located high on the Taconic crest. The dominant species in this plot are also beech

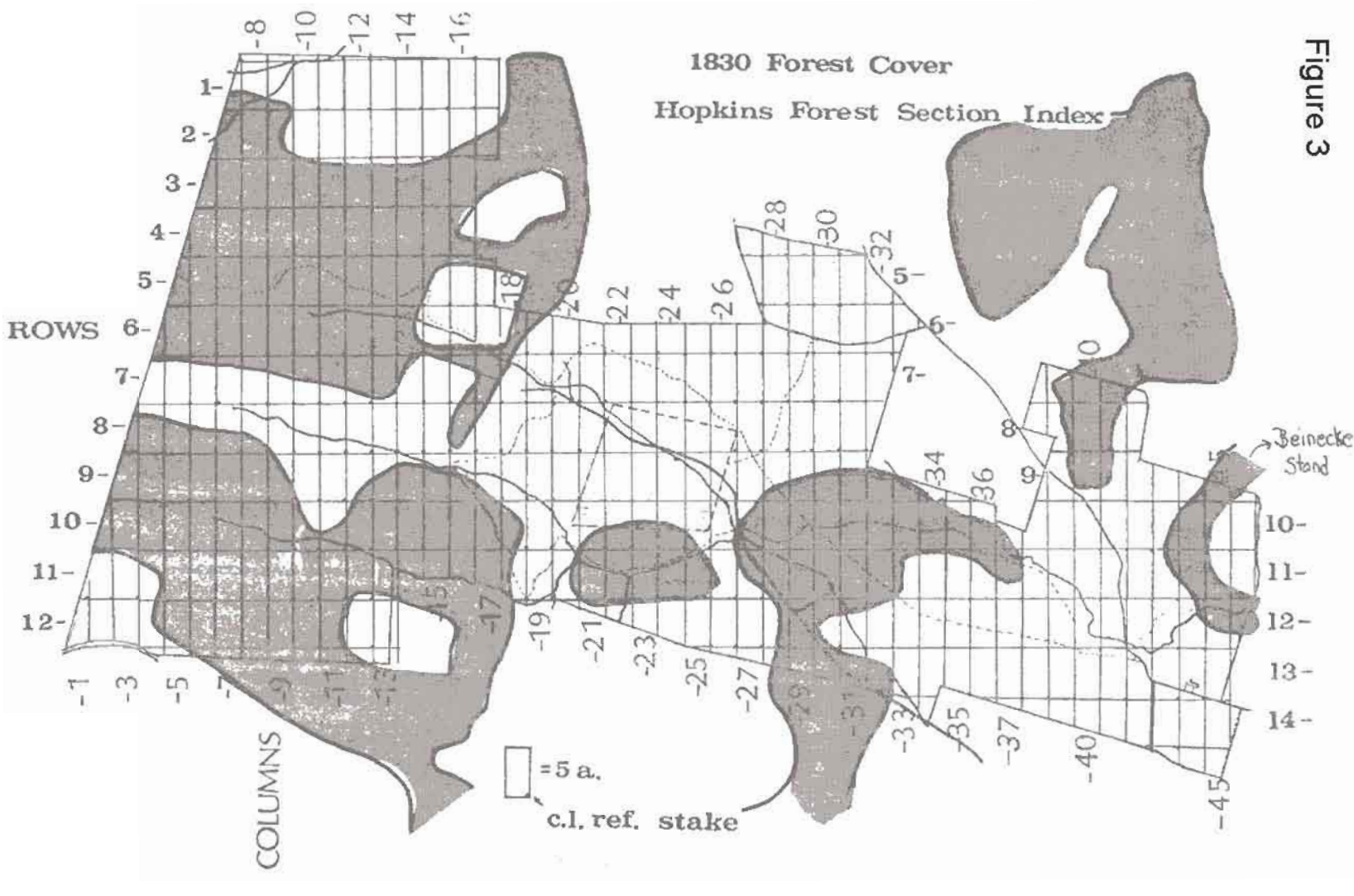

1830 Forest Cover
Hopkins Forest Section Index
ROWS
COLUMNS
= 5 a.
c.l. ref. stake
Beinecke Stand

Figure 3

and sugar maple. The crest of Stone Hill was uncleared in 1830, and a field survey there revealed large old beech and red oaks that probably over 220 years old. Even if this is not the original vegetation, it has been undisturbed enough that the present vegetation cannot have changed much. The historical descriptions of the area's vegetation were used to support the composition implied by the lot survey maps, and to compile an explanation of the species composition of each type.

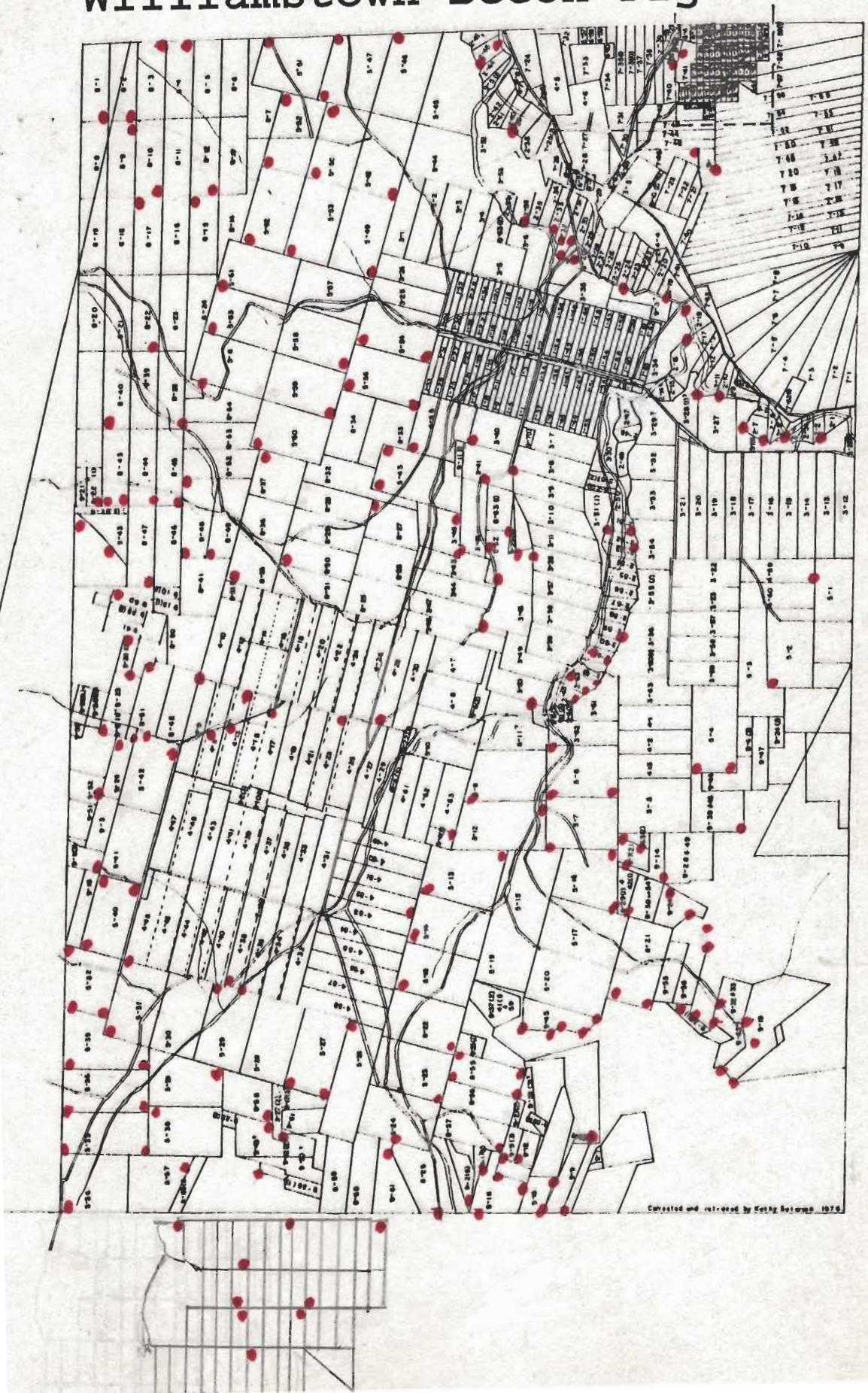
RESULTS AND DISCUSSION

Presettlement Vegetation

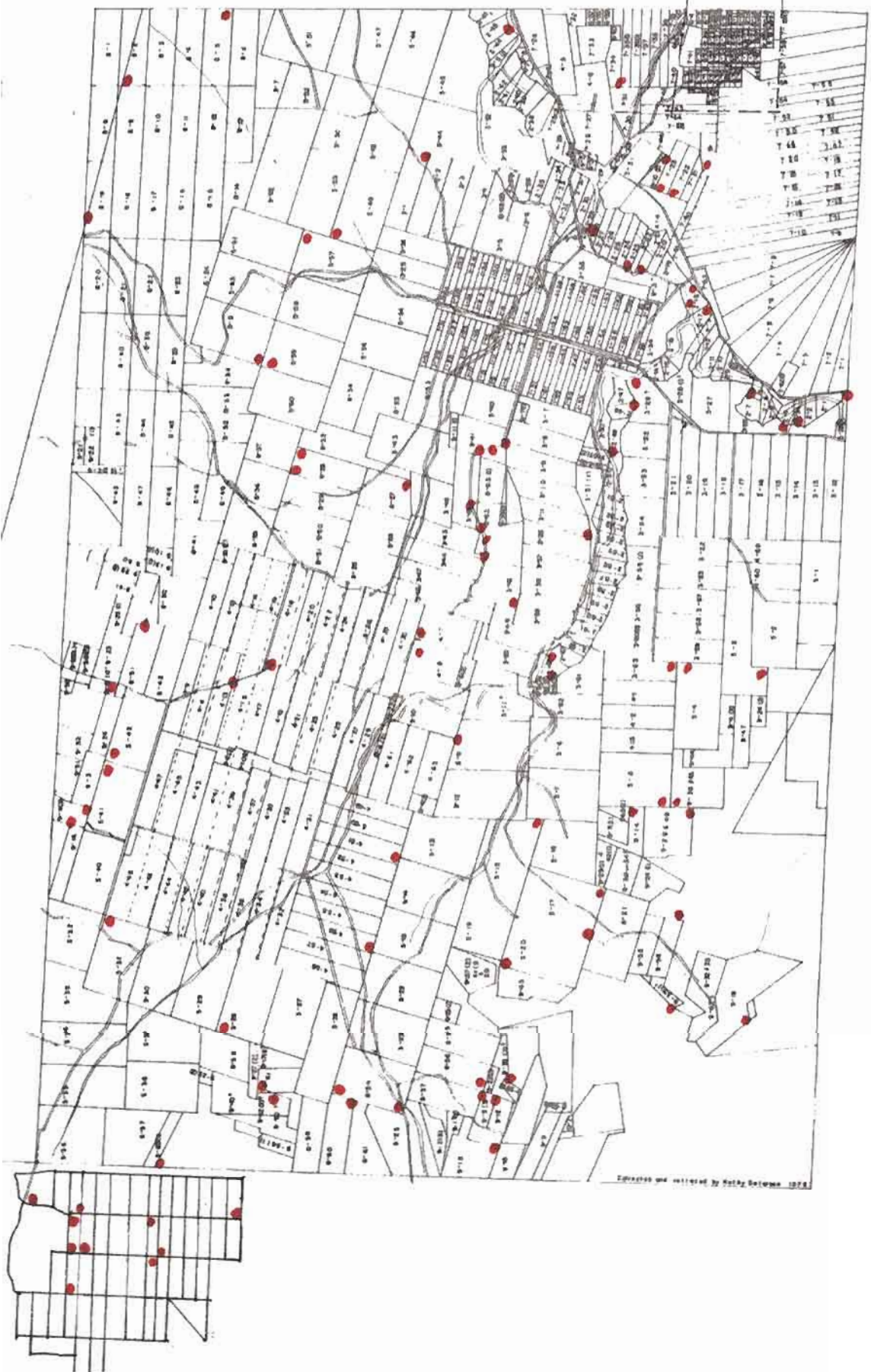
Species Distribution and Abundance

Figures 4-20 show the location of each tree cited in the surveys, thus providing a visual description of the distribution of each species in the town. There were no survey notes for division 1, and most of the lots in divisions 4 and 7 had piles of stones as corner markers, so there is a noticeable lack of all species in those areas. Beech and maple were evenly distributed throughout the town, and maple was never noted in an area where beech was not also located. Figures 6, 7, and 8 show that white oaks, black oaks (which were probably mostly red oak) and white pine were located almost exclusively in the northeast quarter of town, to the east of the'Hoosic river. The predominance of beech and maple was lower in this area than in any other part of town. The birch species were fairly evenly distributed through all areas of town. The higher elevation birches of Figure 10 may be yellow birch, while the others are black birch and paper birch. Surveyors in the Catskills usually just said "birch," but when species were noted, 58 were yellow birch, 37 were black birch and 5 were paper (white) birch (Mclntosh, 1962). Hemlock, elm and butternut (Figures 11, 12 and 18) were located predominantly along streams or brooks. The hemlock was also noted in other areas. Basswood and witch hazel (Hamamelis virginiana) were noted in very similar areas; the northeast and southwest areas of town, and along the Green river between Blair road and Route 2. The ashes (Fraxinus spp.) were located in all areas of town (Figure 15), while the chestnuts (Castanea dentata)

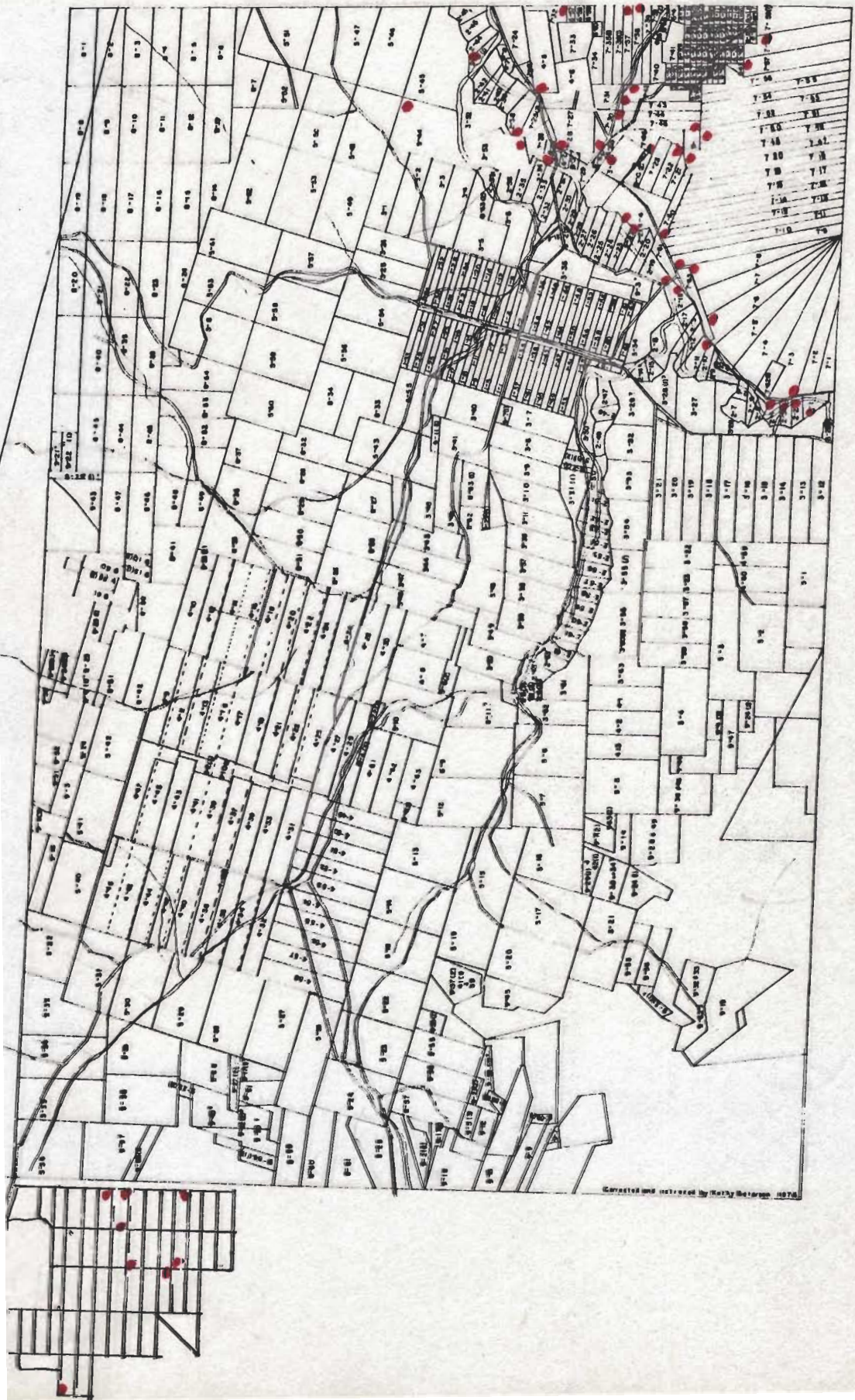
Williamstown Beech Figure 4



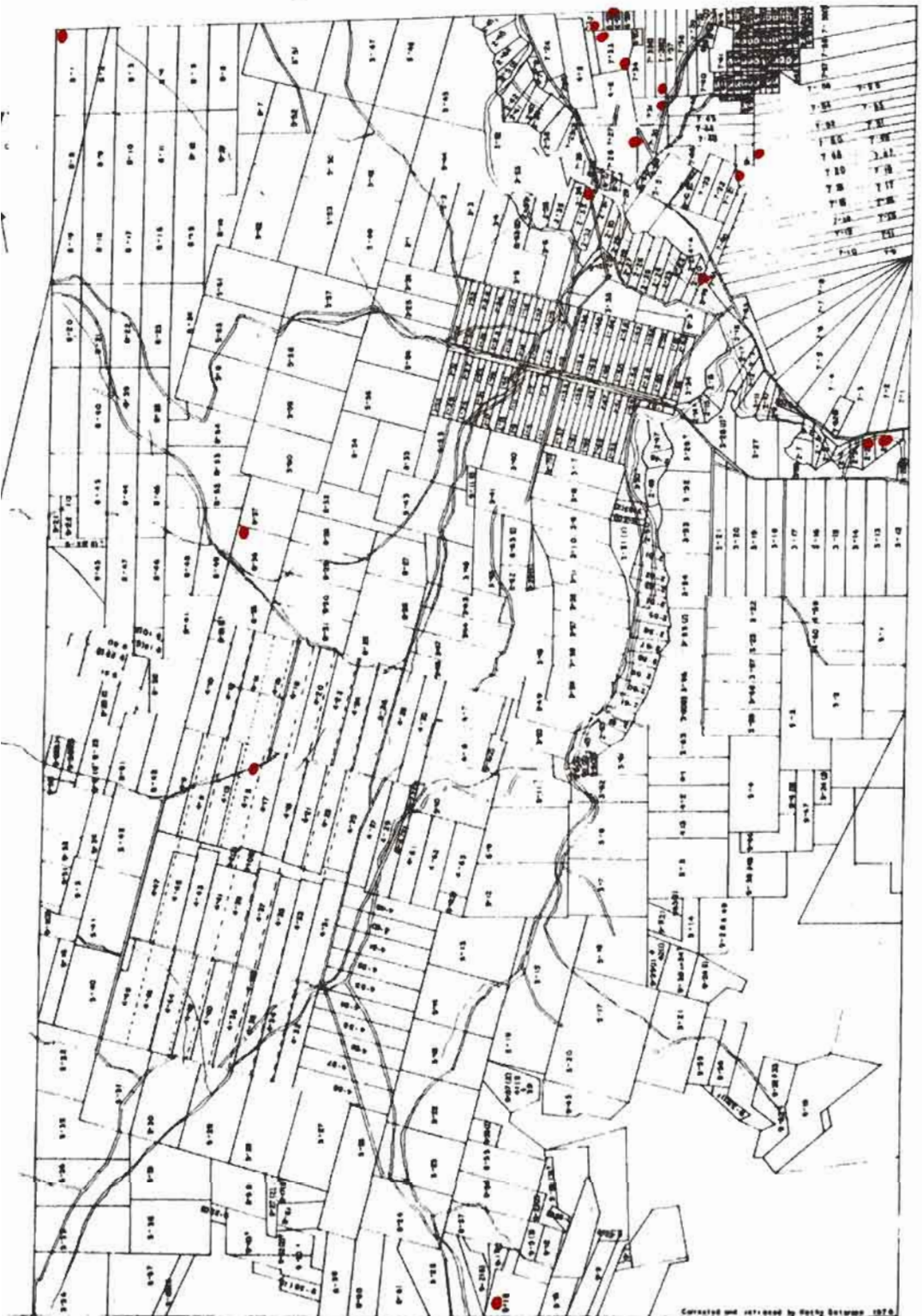
Williamstown Maple Figure 5

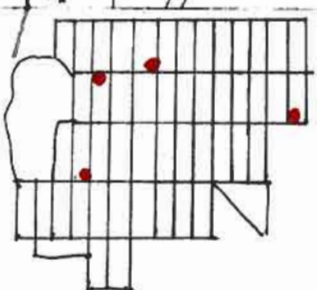


White Oak Figure 6

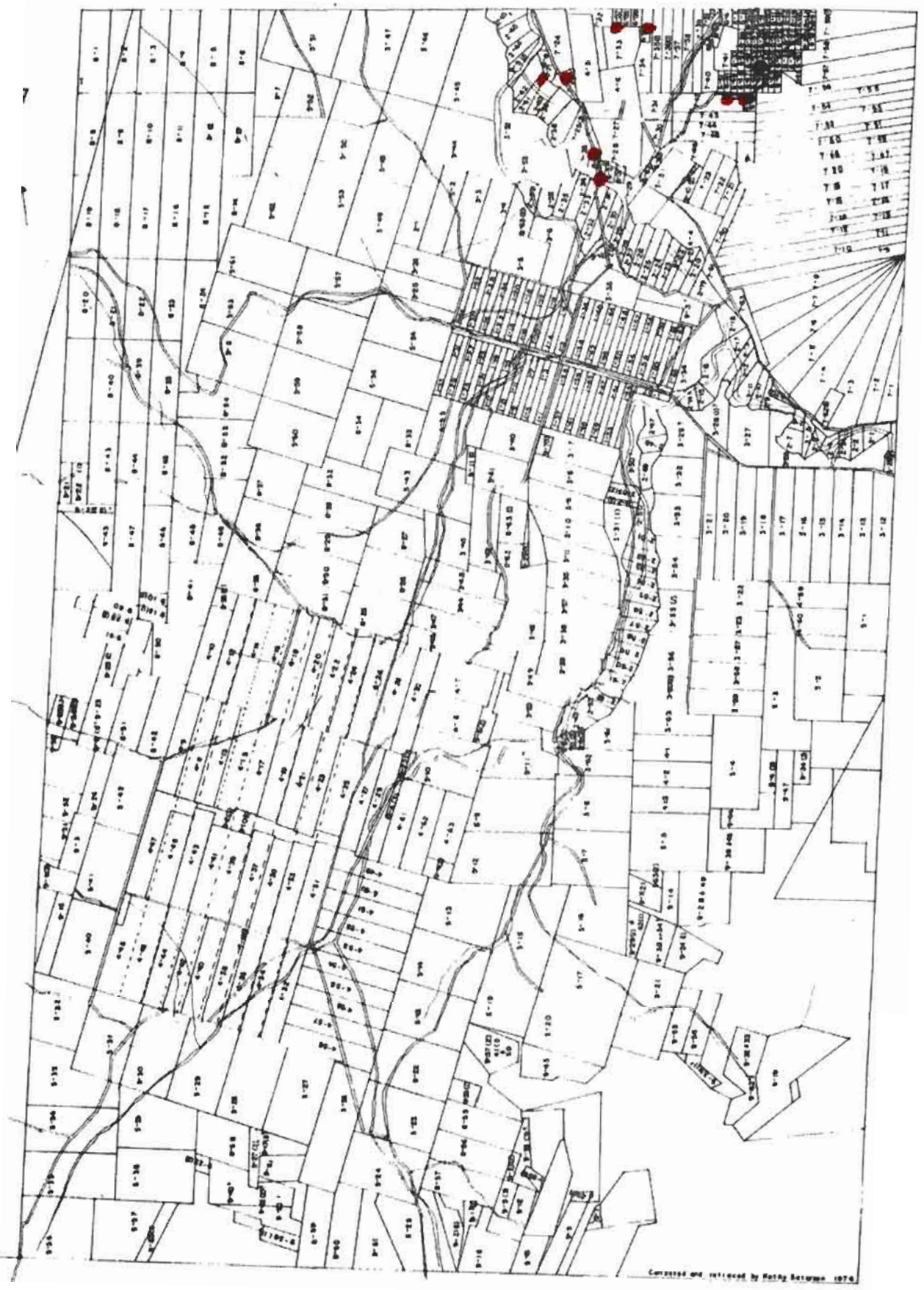


Black Oak Figure 7

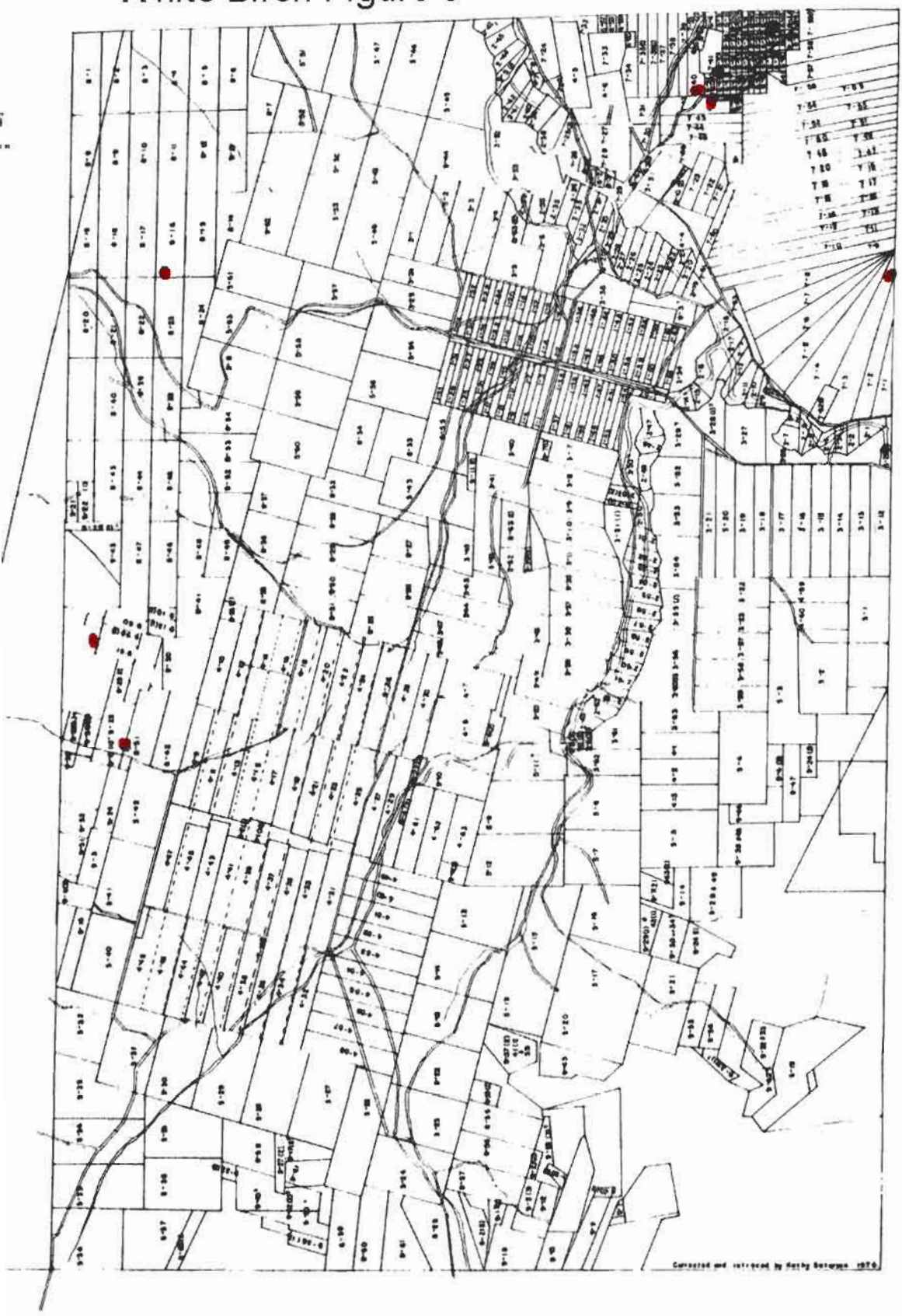




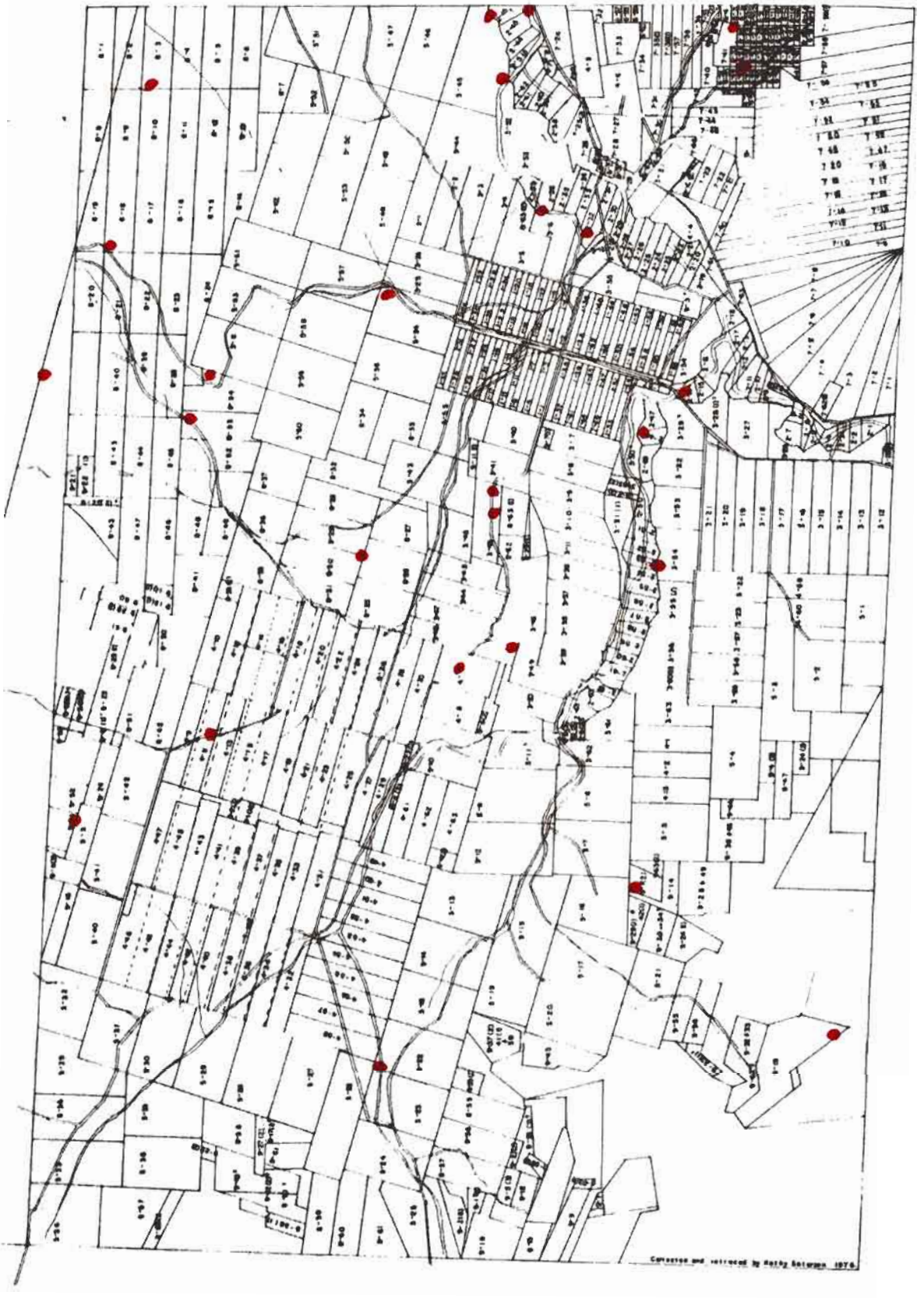
Pine Figure 8



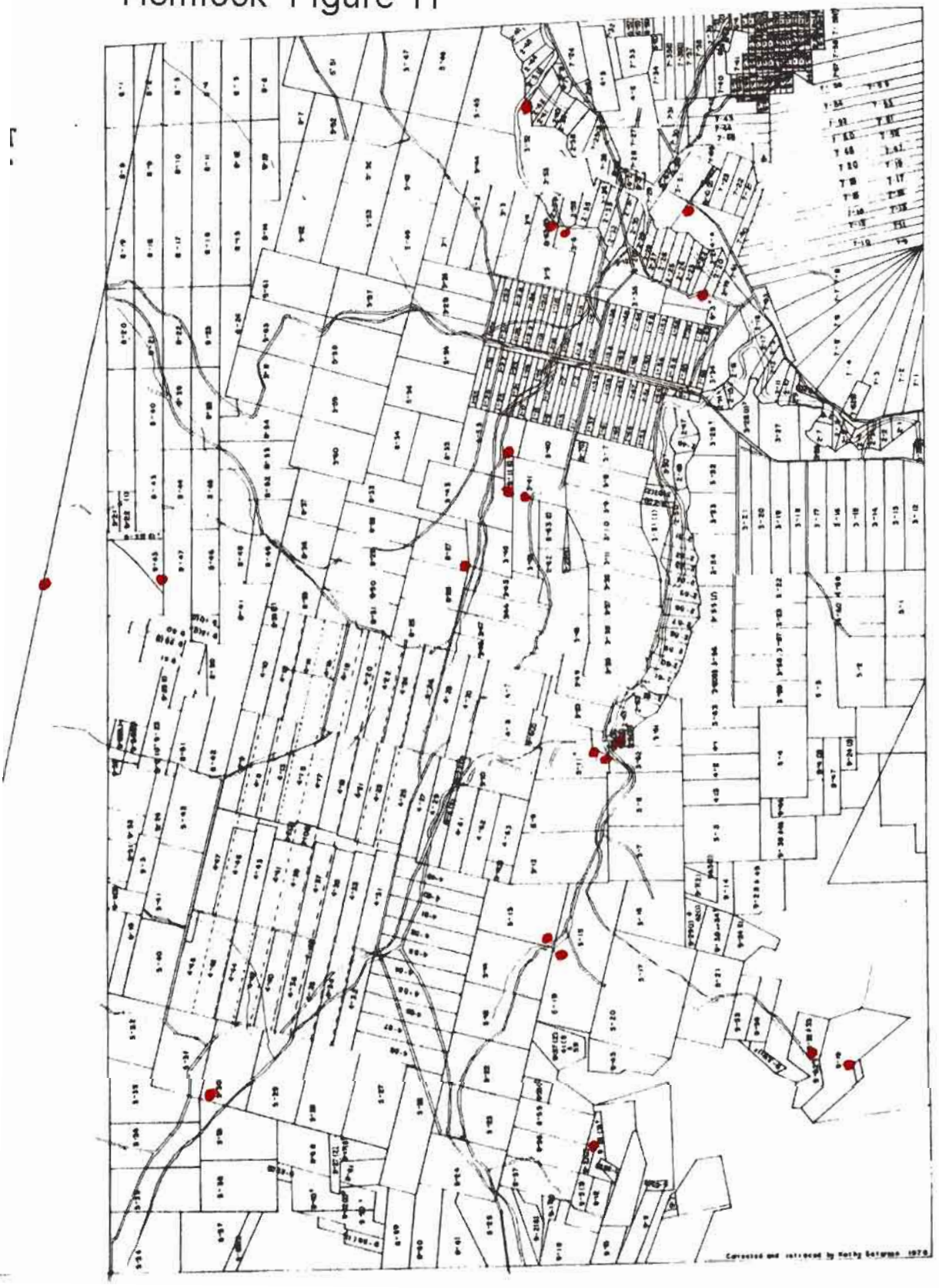
White Birch Figure 9



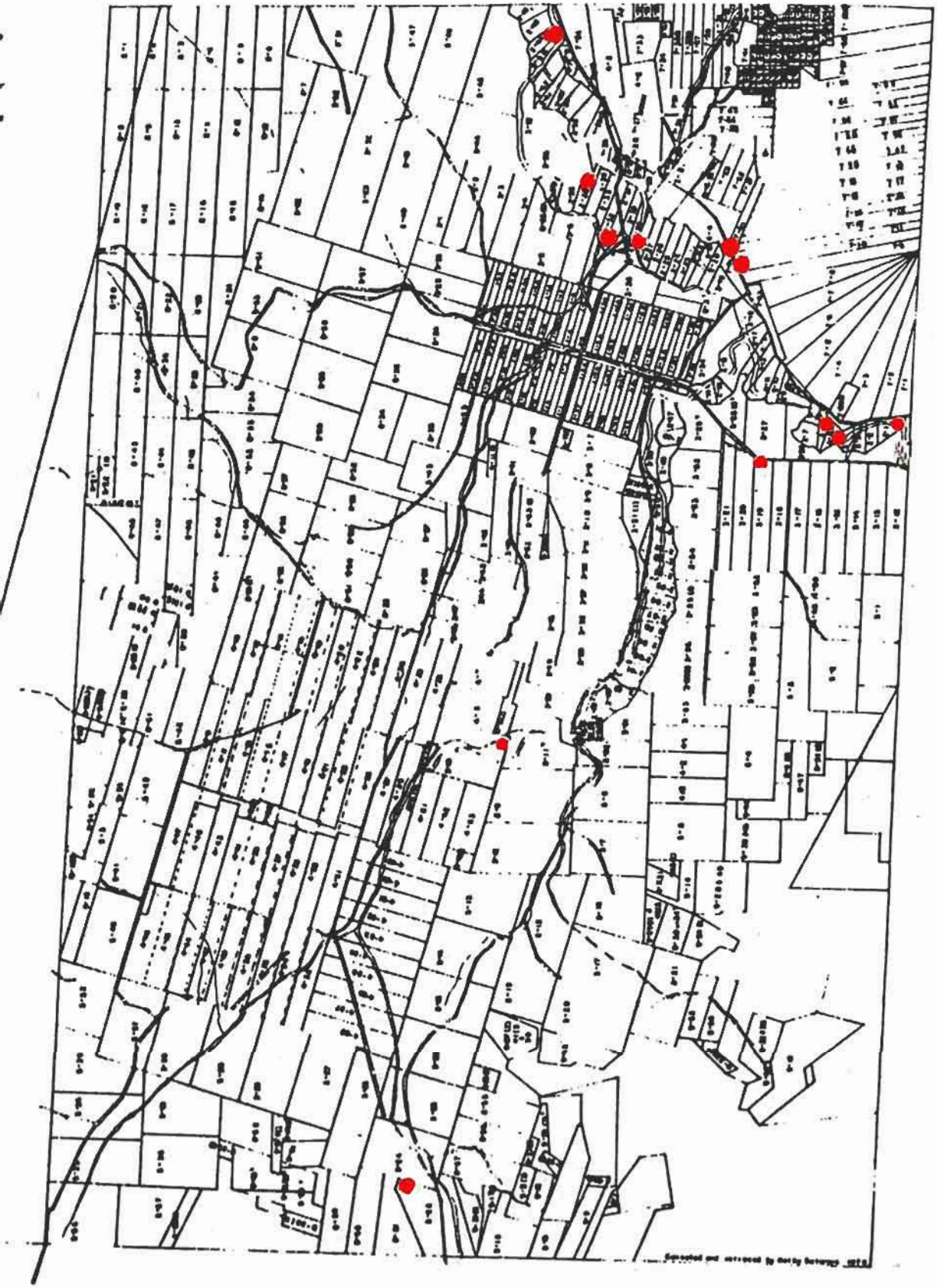
Birch Figure 10



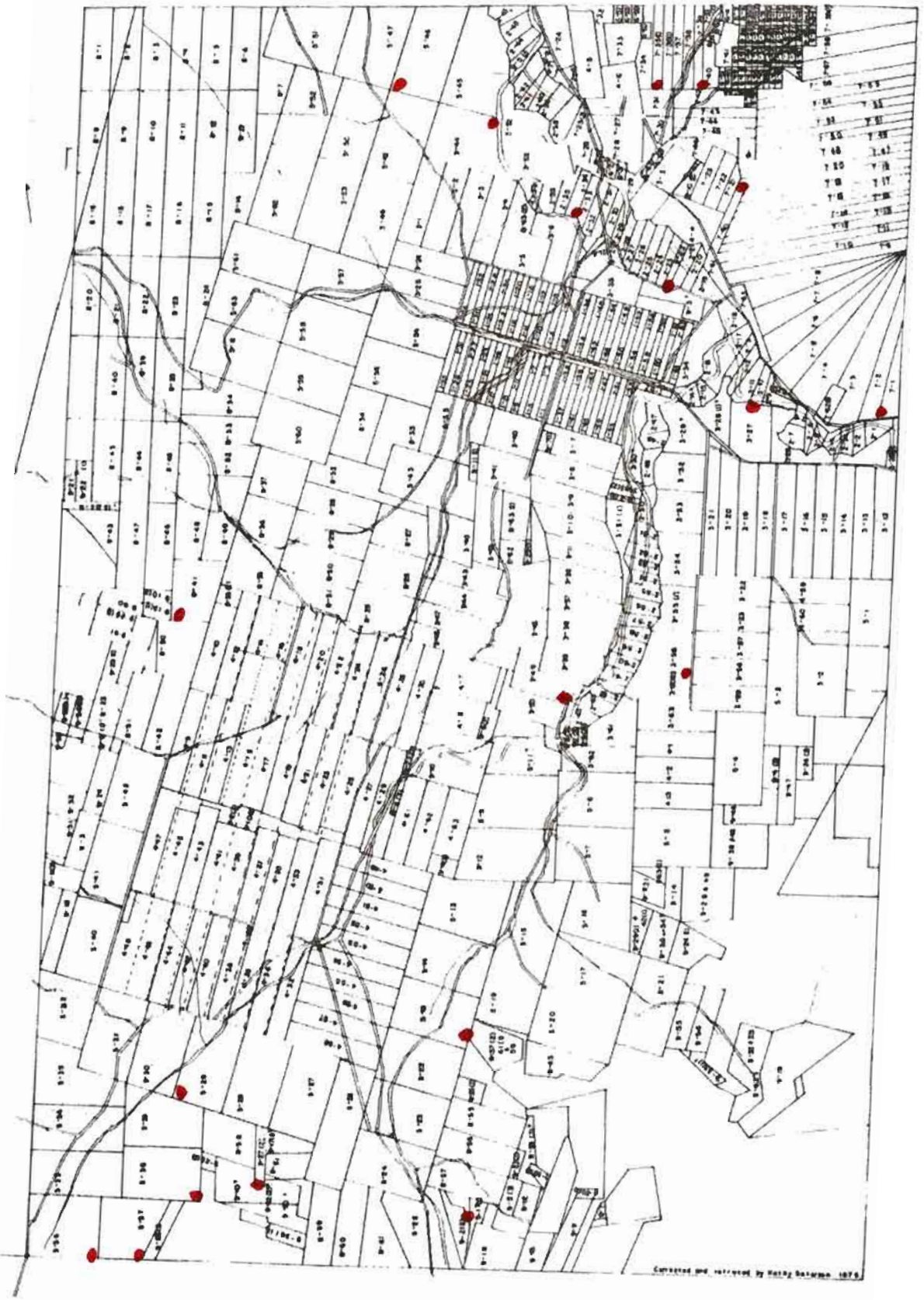
Hemlock Figure 11



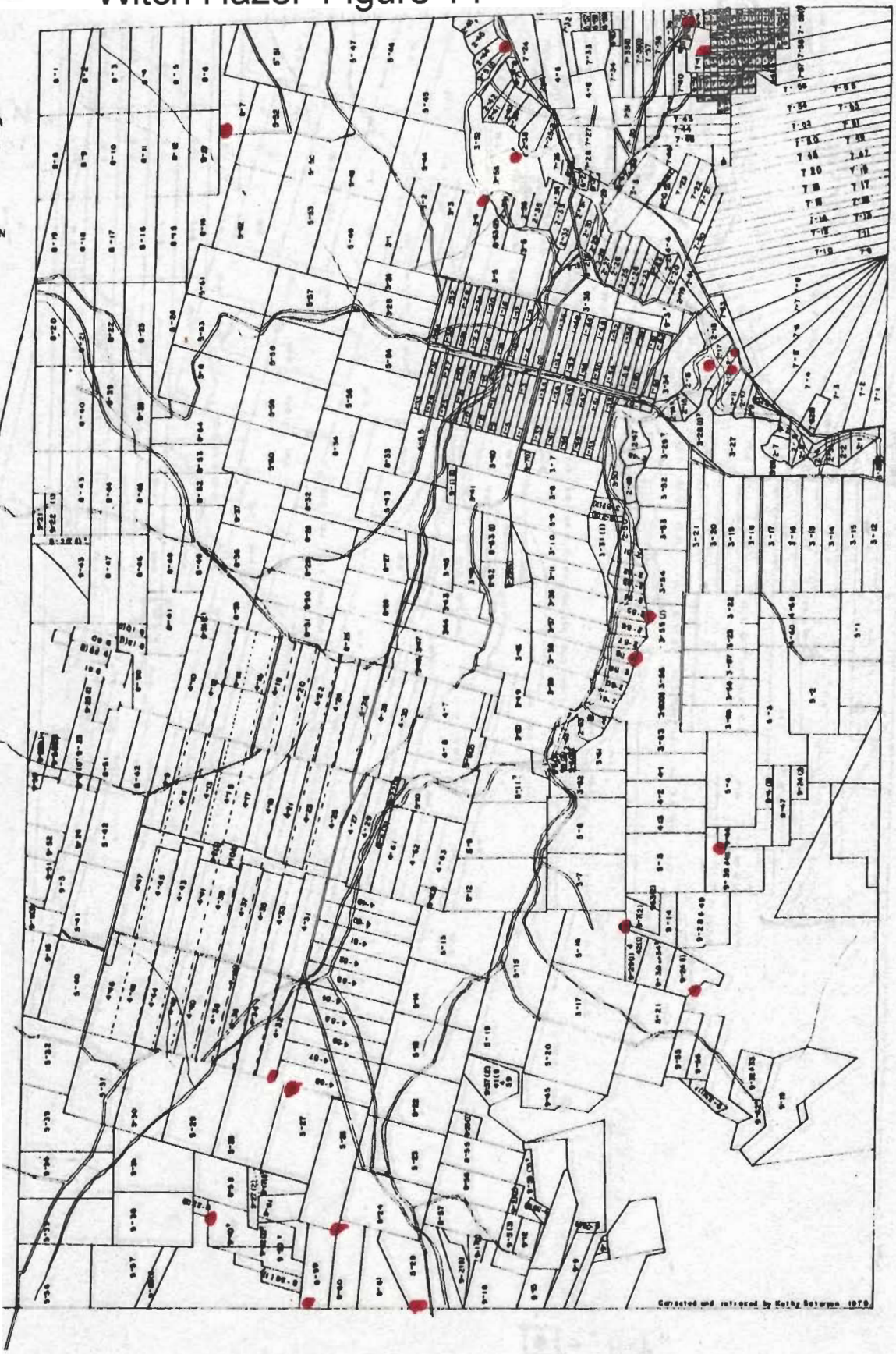
Elm FIgure 12



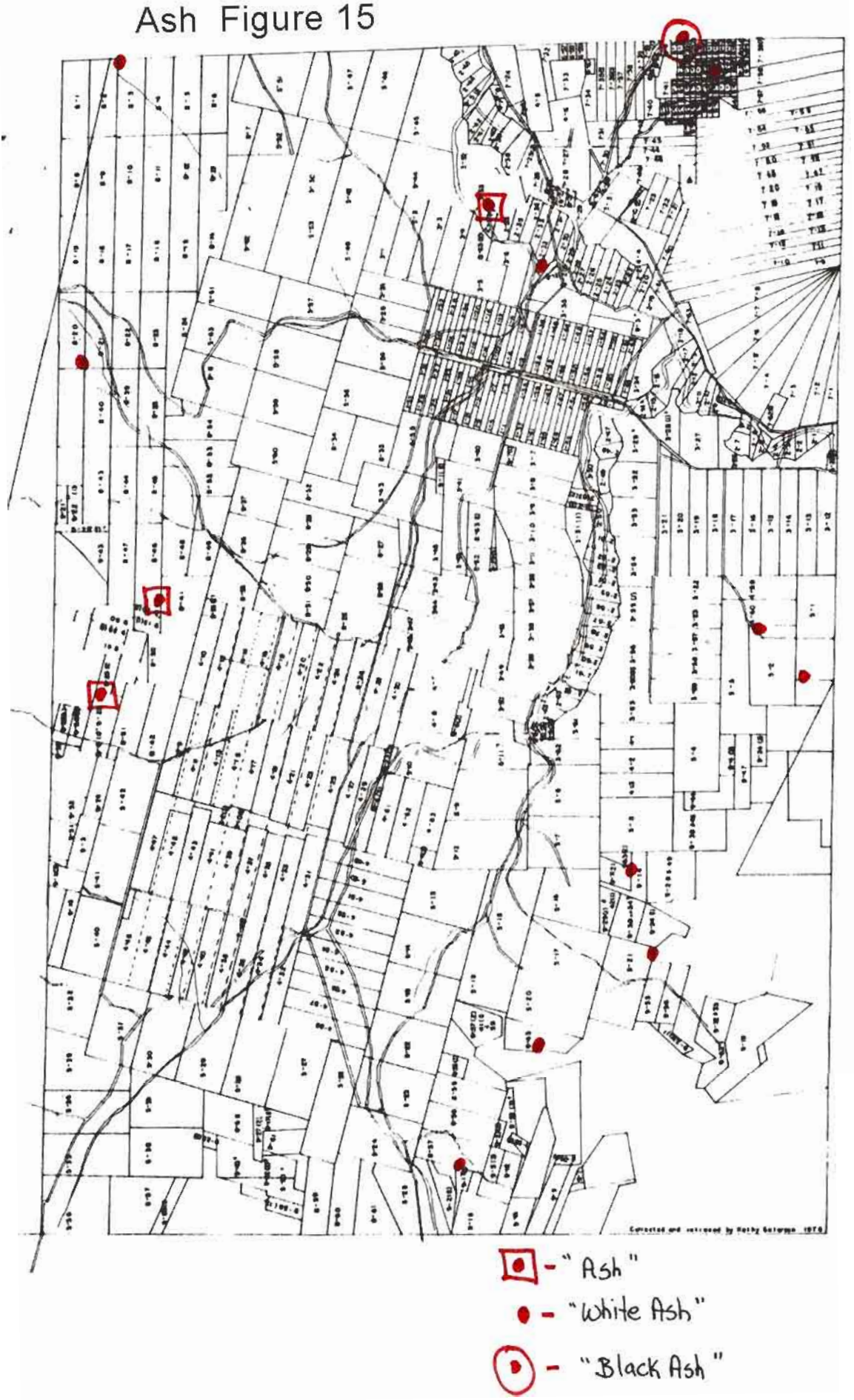
Basswodd Figure 13



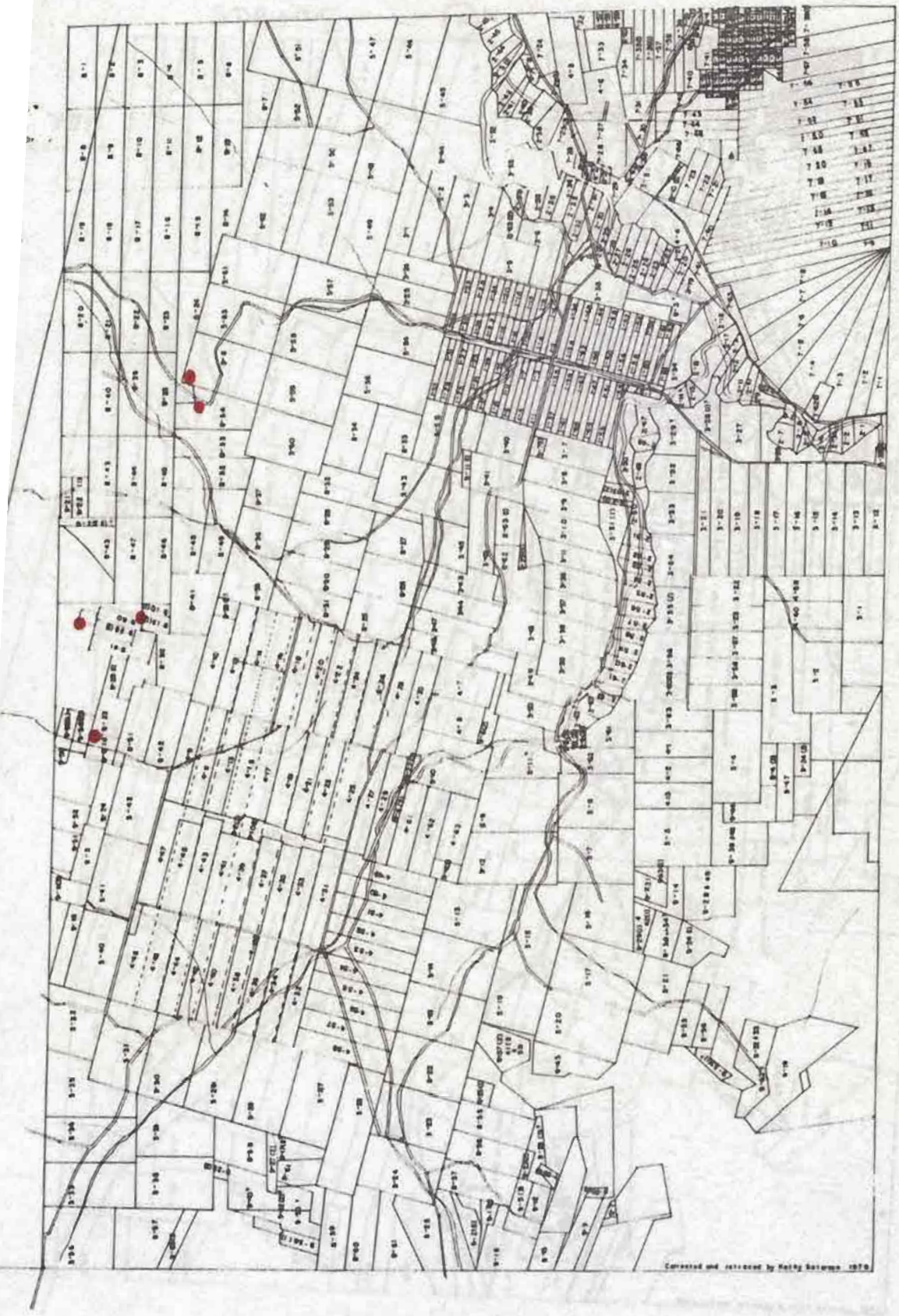
Witch Hazel Figure 14



Ash Figure 15



Chestnut Figure 16



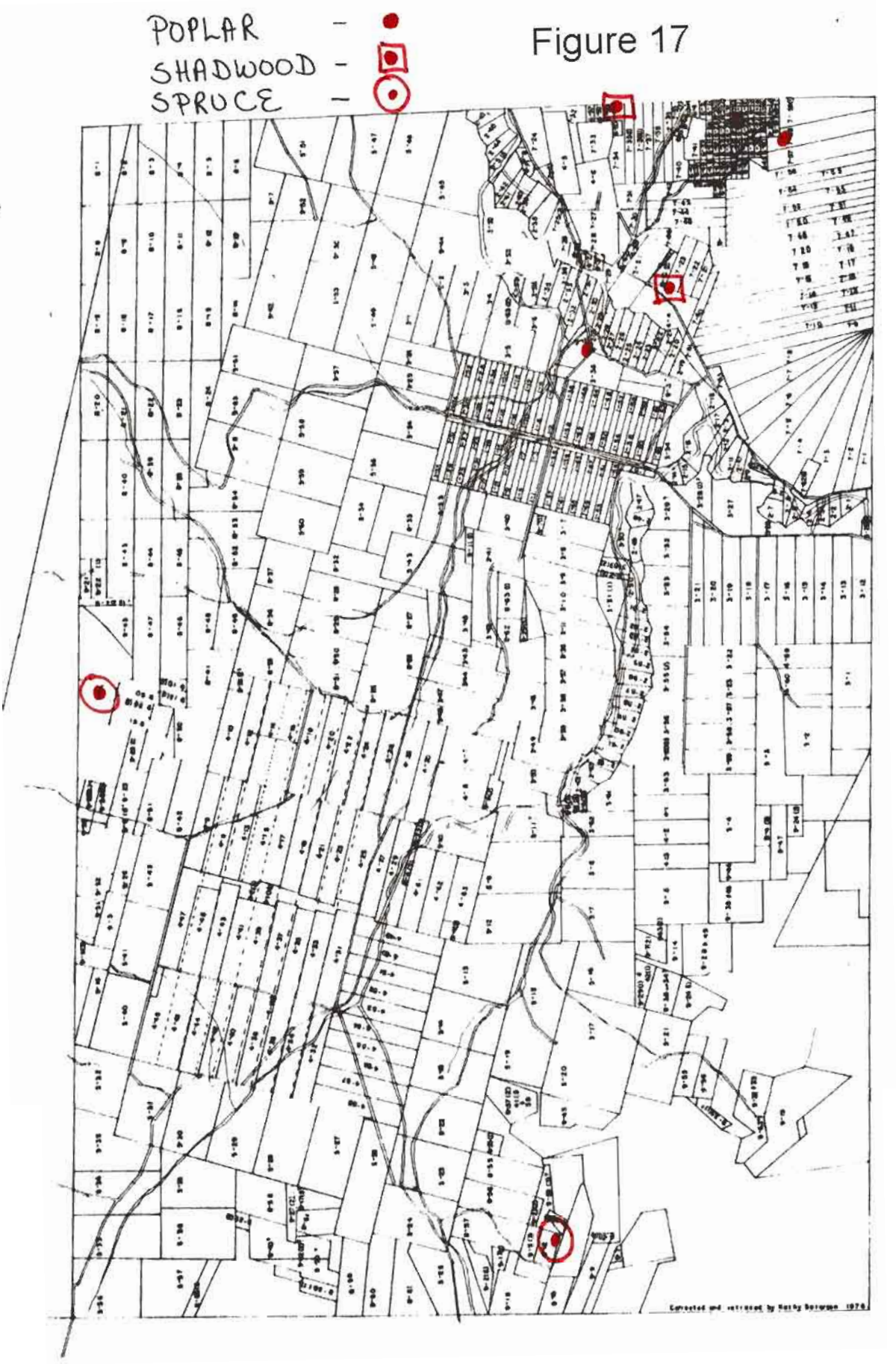
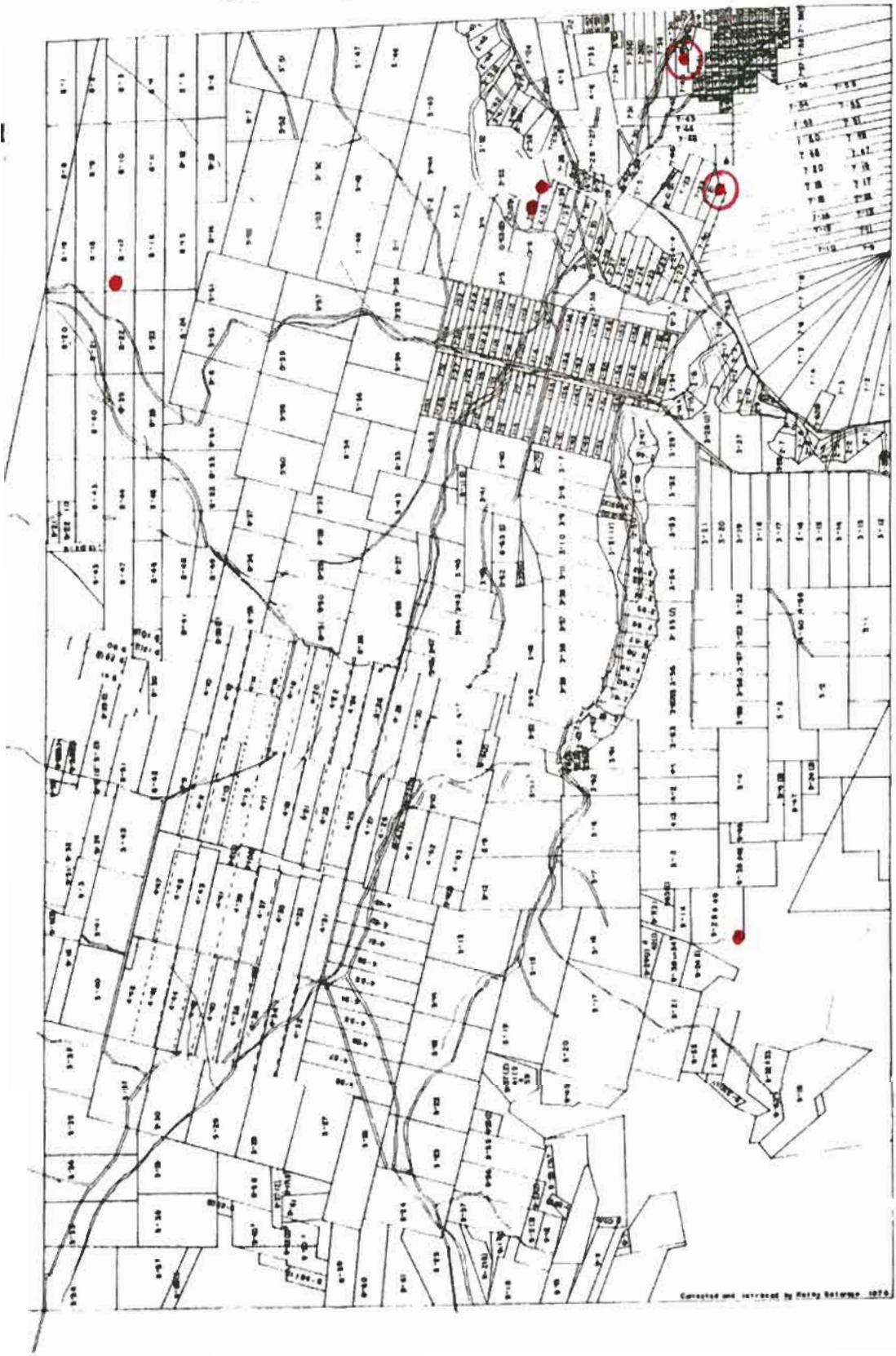

POPLAR –
SHADWOOD –
SPRUCE –
Figure 17

Figure 18

BOXWOOD -

CHERRY -

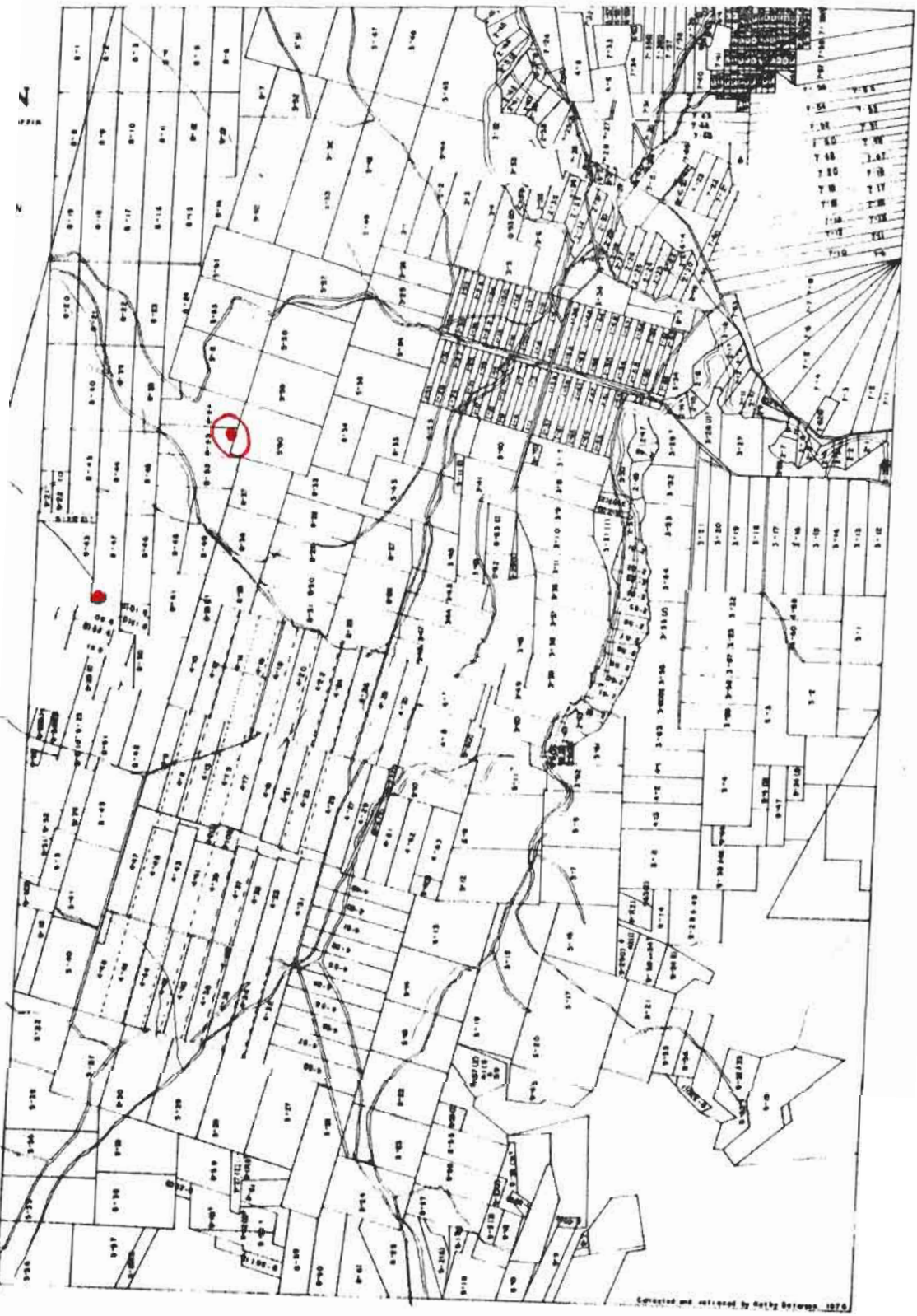
Figure 19



HACKMATACK –

MOOSE MAPLE –

Figure 20



were all noted on the slopes of the Taconics on the western side of town (Figure 16). If one accepts the assumption that the species distribution indicated in the surveys reflects the general character of the forest, then certain forest types seem to be implied. The area of town northeast of the Hoosic river seems to have been predominantly oaks and white pine with beech, maple, birch and poplar composing the secondary species. The lowlands along the rivers tended to support hemlock, elm and butternut. The rest of the town was generally what might be called a northern hardwood forest; with beech and maple as the dominant species while birches, hemlock, basswood, ash and witch hazel were the secondary species.

Table 1 shows the 23 different species noted in the surveys, and their abundance as a percentage of the total number of trees cited. Beech was probably the predominant species in the presettlement forest, for 41.7 of the trees cited in the surveys were beeches. Maple follows as 17.7, while the oak species might have comprised 12.5 of the forest in Williamstown. Table 4 shows the percent of each species on a river and it is significant that over 50 of the hemlock and elm cited were located on the bank of a stream or river.

Table 2 summarizes the elevation and aspect distributions of each species, while Table 3 shows the slopes that each species was located on. The aspects are summarized in 2 ways; northern vs. southern and eastern vs. western. 66 of the beech was located at elevations of 901-1500 feet, and tended to be on moderately steep slopes of 16-30 with a northern (NW, N or NE) aspect. Probably most of the beech was noted at 901-1500 foot elevations, because there was little surveying done at the highest elevations.

Maple was also located predomlnantely at the mid elevations of 901-1500 feet and tended to be found on slopes of less than 30. There seems not to be a significant difference in the aspects maple was found on. Very few oaks were noted above 1500 feet or on slopes greater than 30, and, they were most abundant on slopes with southern and western exposures. (71 of the trees had southern aspects vs. 2 with northern aspects, while 83 had western aspects vs. 6 with eastern aspects.) It is worth noting that the north-east corner of town has very little land over 1500 feet, and since most of the oaks were located there they could not have been noted any higher. Birches were most often noted in the mid-elevation interval (901-1500 feet) on slopes of 16-30, with no one predominant aspect. Hemlocks were found predominantly at elevations below 900 feet (55 were on rivers or streams), on slopes of 5 - 15 with aspects predominantly northern and eastern. Basswood was concentrated below 900 feet, on western slopes of 16-30. Ash was found mostly between 901 and 1500 feet on slopes of 16 - 30, with no significant aspect differences. The elms were concentrated below 900 feet on slopes of <5 (53.8 on rivers), and none were noted above 1500 feet. No pines were noted above 1500 feet and all were located on southern and western aspects. Most of the pines were on slopes of <5, and the number of pines decreased with increasing slope. Chestnuts were not found below 900 feet, and the majority (60) were between 1500 and 2500 feet, on slopes greater than 15, with southern and eastern aspects. In considering the "other" species, it is difficult to reach conclusions because so few of them were noted. However, all of the spruce was noted above 1500 feet and the poplar tended to be on northern and western

Table 1

Presettlement Forest: Abundance of Each Species Cited in the Surveys

Scientific Name	Name used in Surveys	Number cited in Surveys Total = 521		%
Fagus grandifolia	beech	217		41.7
Acer saccharum or *A. rubrum*	maple	92		17.7
Quercus spp.	(oaks)	65		12.5
Q. alba	white oak		44	8.4
Q. velutina	black oak		21	4.0
Betula spp.	(birches)	34		6.5
B. alleghaniensis or *B. lenta*	birch		26	5.0
B. papyrifera	white birch		8	1.5
Tsuga canadensis	hemlock	20		3.8
Hamamelis virginiana	witch hazel	20		3.8
Tilia americana	basswood	19		3.6
Fraxinus spp.	(ashes) ash +	14		2.7
F. americana & *F. nigra*	white ash + black ash			
Ulmus americana	elm	13		2.5
Pinus strobus	pine	9		1.7
Castanea dentata	chestnut	5		.9
	other:	20		3.8
Prunus sp.	cherry		4	
Juglans cinera	butternut		3	
Populus sp.	poplar		3	
Carya sp. or *Juglans* sp.	walnut		2	
Amelanchier sp.	shadwood		2	
Picea sp.	spruce		2	
Cornus florida	boxwood		2	
Acer pensylvanicum	moose maple		1	
Larix sp.	hackmatack		1	

Table 2

Presettlement Forest: Elevation and Aspect Distribution of Species Cited.

	ELEVATION INTERVALS						ASPECTS							
	<600-900ft.		901-1500ft.		1500->2500ft.		NORTHERN (NW-N-NE)		SOUTHERN (SW-S-SE)		EASTERN (NE-E-SE)		WESTERN (NW-W-SW)	
SPECIES	# cited	(%)	# cited	(%)	# cited	(%)	# cited	(%)	# cited	(%)	# cited	(%)	# cited	(%)
Beech	38	(18)	143	(66)	36	(17)	115	(53)	49	(23)	59	(27)	79	(36)
Maple	25	(27)	51	(55)	16	(17)	33	(36)	27	(29)	29	(32)	42	(46)
Oaks	38	(58)	28	(43)	1	(2)	1	(2)	46	(71)	4	(6)	54	(83)
Birches	9	(26)	17	(50)	8	(24)	11	(32)	11	(32)	13	(38)	15	(44)
Hemlock	11	(55)	8	(40)	1	(5)	13	(65)	3	(15)	11	(55)	9	(45)
Witch hazel	9	(45)	10	(50)	1	(5)	8	(40)	7	(35)	6	(30)	11	(55)
Basswood	10	(53)	6	(32)	3	(16)	10	(53)	6	(32)	4	(21)	10	(53)
Ash	2	(14)	10	(71)	2	(14)	7	(50)	7	(50)	4	(29)	6	(43)
Elm	11	(85)	2	(15)			6	(46)	5	(38)	4	(31)	3	(23)
Pine	4	(44)	5	(56)					6	(67)			7	(78)
Chestnut			2	(40)	3	(60)			5	(100)	4	(80)	1	(20)
Others:														
Cherry	2	(50)			2	(50)	1	(25)	1	(25)	1	(25)	1	(25)
Butternut	3	(100)							1	(33)	2	(67)		
Poplar	1	(33)	2	(67)			1	(33)					2	(67)
Walnut	1	(50)	1	(50)							1	(50)	1	(50)
Shadwood	1	(50)	1	(50)					2	(100)			2	(100)
Spruce					2	(100)			1	(50)	1	(50)	1	(50)
Boxwood	2	(100)							1	(50)			2	(100)
Moose maple					1	(100)			1	(100)			1	(100)
Hackmatack					1	(100)			1	(100)	1	(100)		

Table 3

Presettlement Forest: Number of Each Species Cited in Each Percent Slope Category

Species	<5%		5-15%		16-30%		31-45%		>45%	
Beech	33		43		81		37		21	
Maple	15		30		31		10		6	
Oaks	14		24		25		1		1	
White Oak		8		21		14		1		
Black Oak		6		3		11				1
Birches	5		5		19		4		1	
"Birch"		5		5		12		3		1
White Birch						7		1		
Hemlock			11		4		4		1	
Witch Hazel	2		9		4		4		1	
Basswood	4		3		8		2		2	
Ash	1		3		6		3		1	
Elm	6		4		2		1			
Pine	5		2		1		1			
Chestnut					4		1			
Others:										
Cherry	2						1		1	
Butternut	2		1							
Poplar			2		1					
Walnut							2			
Shadwood			2							
Spruce							2			
Boxwood					2					
Moose maple									1	
Hackmatack							1			

Table 4

Presettlement Forest: Percent of Each Species Cited Along a River

Species	# located on a river or stream bank		% of each species on river	
Beech	17		7.8%	
Maple	9		9.8%	
Oaks	10		15.4%	
White Oak		5		11.4%
Black Oak		5		23.8%
Birches	7		20.6%	
Birch		7		26.9%
White Birch				
Hemlock	11		55%	
Witch Hazel	5		25%	
Basswood	3		15.8%	
Ashes	2		14.3%	
Elm	7		53.8%	
White Pine	1		11.1%	
Chestnut				

Table 5 compares the species composition indicated by the Williamstown surveys with those of five other presettlement forest studies. The vegetation of Chittenden County, Vermont (Siccama's study) would be expected to be the most similar to that of Williamstown, because it is the closest geographically, the local topography is much the same, and the climates are similar. There is a striking similarity in the composition of the two presettlement forests. The greatest difference between any species in Siccama's study, compared to one in this study, is about 3, except for oaks and white pine. The low percentage for white pine in Williamstown is probably due to the selective removal of the species for many uses, before the "pine lots" and "oak lots" were surveyed, more than ten years after the town's settlement. According to Gordon (1940), early settlers did remove white pine soon after settling. McIntosh evokes the same reasoning to explain the low pine percentage in the Catskills. The lower percentage of oak in Siccama's study could reflect the fact that the oaks, which can be the predominant type in southern New England, tend to be less abundant as one moves north. Beech was the most abundant species in each of the forests studied, while sugar maple and hemlock were the second and third most abundant species in each of the other studies. The lower hemlock abundance for Williamstown could indicate that the town did not have as many sites suitable for hemlock growth, but it is more likely a reflection of the fact that these tree surveys cannot be expected to yield an exact picture of the composition of presettlement vegetation, for there were inadequacies in the sampling procedures. The fact that Williamstown had a larger

Table 5

Comparison of the Percentage of Each Species in Other Presettlement Forests

Species	a Kenoyer	b Lutz	c Gordon	d McIntosh	e Siccama	f Present Study
Beech	33.7	30.85	61.0	49.5	40.4	41.7
Sugar maple	12.5	8.07	7.3	12.8	15.8	17.7
Hemlock	13.5	26.80	7.3	20.3	7.3	3.8
Birches		6.06	2.8	7.3	5.1	6.5
Oaks	5.1	3.52			2.8	12.5
Pine	8.6	5.99	0.1	.5	6.3	1.7
Basswood		0.14			2.8	3.6
Ash	7.3	1.04			3.3	2.7
Elm		.07			2.4	2.5
Chestnut		5.57	0.1	.5		.9
Other	19.3	11.89	21.4	9.1	14.0	6.7

a. Kenoyer (1942) — Ottawa County Michigan.

b. Lutz (1930) — 6,000 trees in the sample; 32 species. 271 square miles in NW Pennsylvania.

c. Gordon (1940) — 741 trees in the sample; 23 species; 182 square miles in SW New York. (Numbers from McIntosh, 1962).

d. McIntosh (1962) — 3,744 trees in the sample; 20+ species; in the Catskills of New York. (All below 3000 ft.).

e. Siccama (1971) — 2,038 trees in sample of Chittenden County, Vermont. 532 square miles; 42 species.

f. Present Study (1977) 521 trees in sample of Williamstown; 23 species. 47 square miles.

percentage of oak than any other study area is probably significant and reflects the presence of the dry, SW slopes northeast of the Hoosic River, which were suitable for an oak forest.

The species distribution and abundance in the presettlement forest, as implied by the surveys, is supported by the ecological characteristics of each species, as well as by the results of other studies and the historical writings mentioned in the introduction. We can conclude that the precolonial forests of Williamstown were generally made up of the same species found in the region today. The most widely distributed species in the presettlement forest were beech, maple, birches, and hemlock while the oaks, ashes, basswoods, white pines, elms, etc. had a more localized occurrence. A similar distribution was found for most of these species in northern Pennsylvania (Lutz, 1930).

The local distribution of trees is determined in large part by the topography and soils of each site. Table 2 shows beech, sugar maple and hemlock predominantly on northern slopes with the hemlock concentrated in lowlands below 900 feet. The oaks tend to be on warmer, south facing hillsides and western slopes. Raup and Carlson (1941) made similar observations in undisturbed precolonial tracts of land in central Massachusetts. They found northern hardwoods tending to be on northerly slopes and ravines while central hardwoods (oaks and hickories) tended to be on dry knolls. In a presettlement forest of northern Vermont hemlock had the greatest percentage below 500 feet and the amount decreased with increasing elevation (Siccama, 1971). Timothy Dwight (1799) also observed that hemlock was more common at lower altitudes, while Raup (1937) mentions that north facing ravines usually have a

larger percentage of hemlock. These observations reflect the fact that hemlock is a very shade tolerant species that grows well in moist areas. The transition zone from the northern hardwood to the spruce-fir zone, in the northern Adirondacks and the Green Mountains, is about 1800 to 2400 feet. A similar distribution in Williamstown is implied by the historical descriptions and the fact that spruce was only located above 1500 feet (Table 2). The surveys examined by Siccama (1971) revealed the same distribution of oaks as existed in Williamstown (Table 2). The majority of oaks were located below 900 feet, and their numbers decreased sharply with increasing elevation, both in Williamstown and northern Vermont.

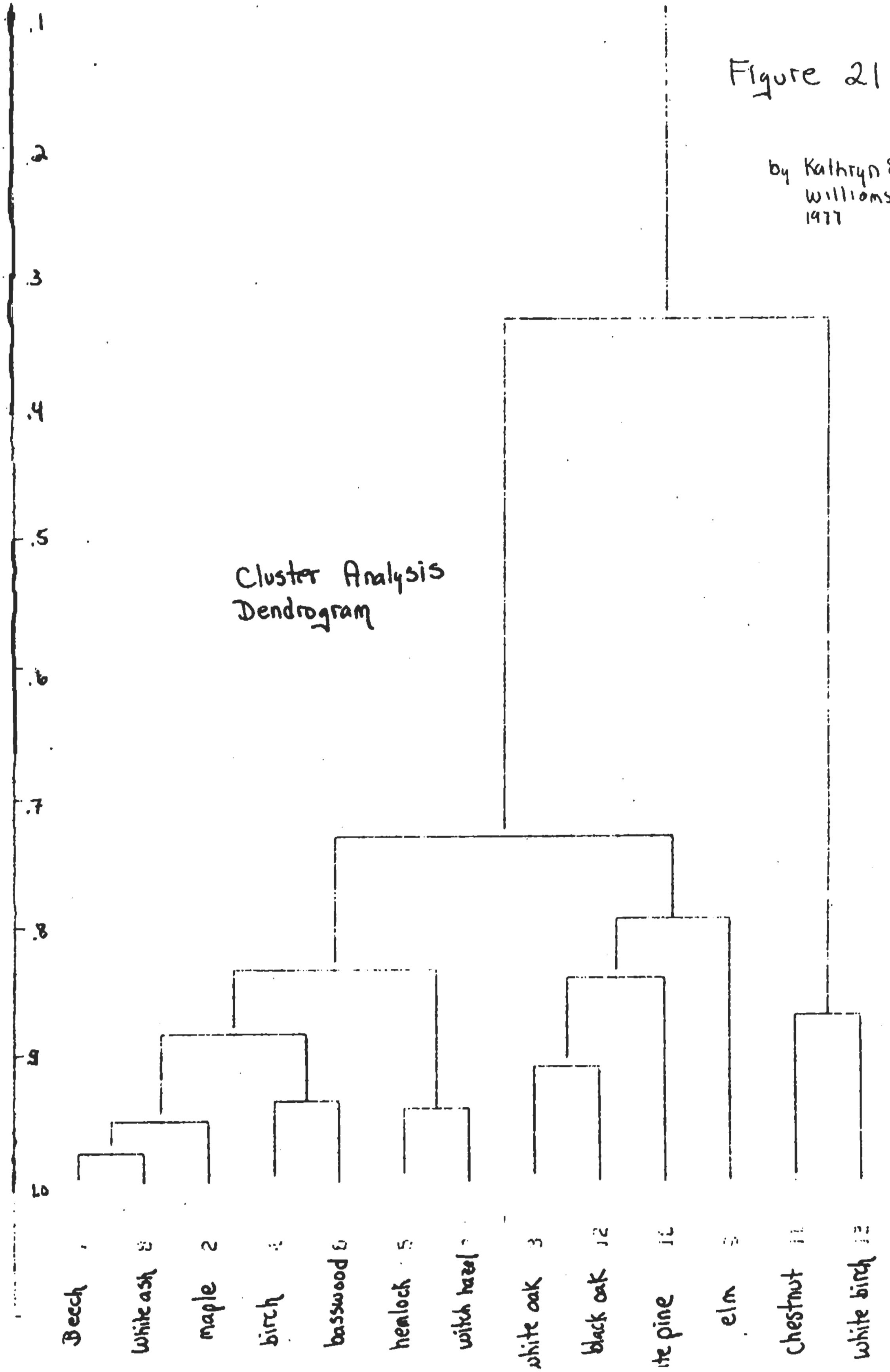
Elevation, slope and aspect are important influences on the distribution of trees in the presettlement forest. Direct gradient analyses (Whittaker, 1967; Loucks. 1962) assume that vegetation can be seen as a "complex continuum of populations, rather than a mosaic of discontinuous units." (This is also the basis for the construction of the presettlement type map.) The continuum approach postulates that species evolve toward a niche or habitat diversification which is reflected in the vegetation pattern, in discussing the effects of environmental parameters it will become clear that the combined influences of elevation, slope and aspect (Tables 2 and 3) are important determinants of the tree distribution in the presettlement forest.

Whittaker (1956) ranks aspects from wettest to driest'as NE-N-E-NW-W-SE-S-SW. Northern slopes are both cooler and moister than southern slopes, since they receive less solar radiation. Western slopes are drier than eastern slopes.because

they receive their maximum solar radiation during the hottest part of the day. An increase in slope produces a greater decrease in the moisture content of the soil on SW or W (xeric) aspects as compared to NE or N (mesic) ones. The slope increase on the mesic, northern aspect is partly offset by a decrease in the solar radiation the soil receives (Loucks, 1962).

The locations of the tree species in the presettlement forest reflect these elevation, slope and aspect parameters. The shade tolerance of each species (Table 7) is also reflected in its distribution. The very shade tolerant beech, sugar maple and hemlock were noted predominantly on northern slopes, with the higher moisture levels. Maples have long horizontal roots that stay within 6" of the surface, so the moist soils are "preferred" (Wilson, 1970). The oaks are less shade tolerant than beech or maple, while white pine is very shade ijntolerant, so it's not surprising that these species were only noted on southerly or westerly slopes. (Chestnut also requires a lot of light, and was noted mostly on southern aspects.) In addition, the oaks and pines are more often found on dry, well drained or sandy soils (Hawley, 1925). Oaks located on 16 - 30 slopes with S-SW aspects were on a much drier site than the beech or maple on similar slopes with N and E aspects. In contrast to maples, oaks have a relatively deep horizontal root system that can go a foot or more below the soil surface (Wilson, 1970).

A "cluster analysis dendrogram" (Figure 21) was produced by a computer, using a cosin Q similarity matrix. This matrix assigned a similarity coefficient (ranging from 0 for no similarity to 1.0 for complete correlation) to every possible pair



.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
by Kathryn Evans
Williams College
1977
Cluster Analysis
Dendrogram
Beech
White ash
maple
birch
basswood
hemlock
witch hazel
white oak
black oak
ite pine
elm
Chestnut
white birch

Figure 21

of the thirteen tree species from the preset t lenient forest. This measure of similarity between two species was arrived at by comparing their proportionate distributions in terms of elevation, slope and aspect (Tables 2 and 3). Each factor was given equal weight by the computer, in assigning the similarity coefficient. In the final dendrogram, the pair of species with the highest coefficient are connected by a horizontal bar at the level corresponding to their degree of similarity. Thus, the locations of beech and white ash have the greatest degree of similarity. The computer then considered this pair as a "cluster" and determined that the location of maple was the most similar to that of beech and white ash. The final dendrogram can be read from the top down, as it subdivides the trees into smaller and smaller groups within which the environments become more similar. The most significant division seems to be between the cluster with beech through witch hazel, whose species are found on mesic sites at all elevations, and the cluster with the oaks, white pine and elm for these species are found only on xeric sites below 1500 feet (Figures 6, 7, 8 and 12). The low degree of similarity of chestnut and white birch, to the rest of the species, is probably due to the fact that so few of them were noted in the surveys. This dendrogram shows how the environmental parameters of elevation, slope and aspect can imply the same species associations as the distribution maps (Figures 4 - 20).

In his assessment of the relationship between community variation and gross environmental influences, Loucks (1962) noted that the highest temperatures are found on southwest aspects Because of this "plants adapted to warm regions extend to the most

northern latitudes on this topographic position." This is supported by the presence of oaks only on the west and south facing slopes of town, for Williamstown is just about at the northern limit of the "Oak-Hickory" region, so species of the central hardwood forest may dominate well drained southern slopes (Westveld, 1956; Braun, 1967). The thick bark of the oak species provided them with good resistance to the fires that were probably frequent in this dry area, and their sprouting ability allowed them to recover quickly. The presence of beech on these steep western slopes is explained by the fact that even though they "prefer" moister sites, they are also able to grow well on dry, sandy soil (Hawley, 1925). It is a fairly fire resistant species, and it, too, is aided in recovery by producing root sprouts. One explanation for the abundance of white pine in this same area is that its shade intolerant seedlings could seed into the large openings caused by fire. Gordon (1940) has also suggested that these localized stands of white pine may have grown in on agricultural land that was abandoned by the Indians. Bromley (1935) noted that white pine was restricted to low, moist sandy areas at the time of New England's settlement, and thought this was because the young trees were so easily killed by fire. The white pines in Williamstown were located predominantly on the sandy soil near the Hoosic river.

Map of Presettlement Forest Types

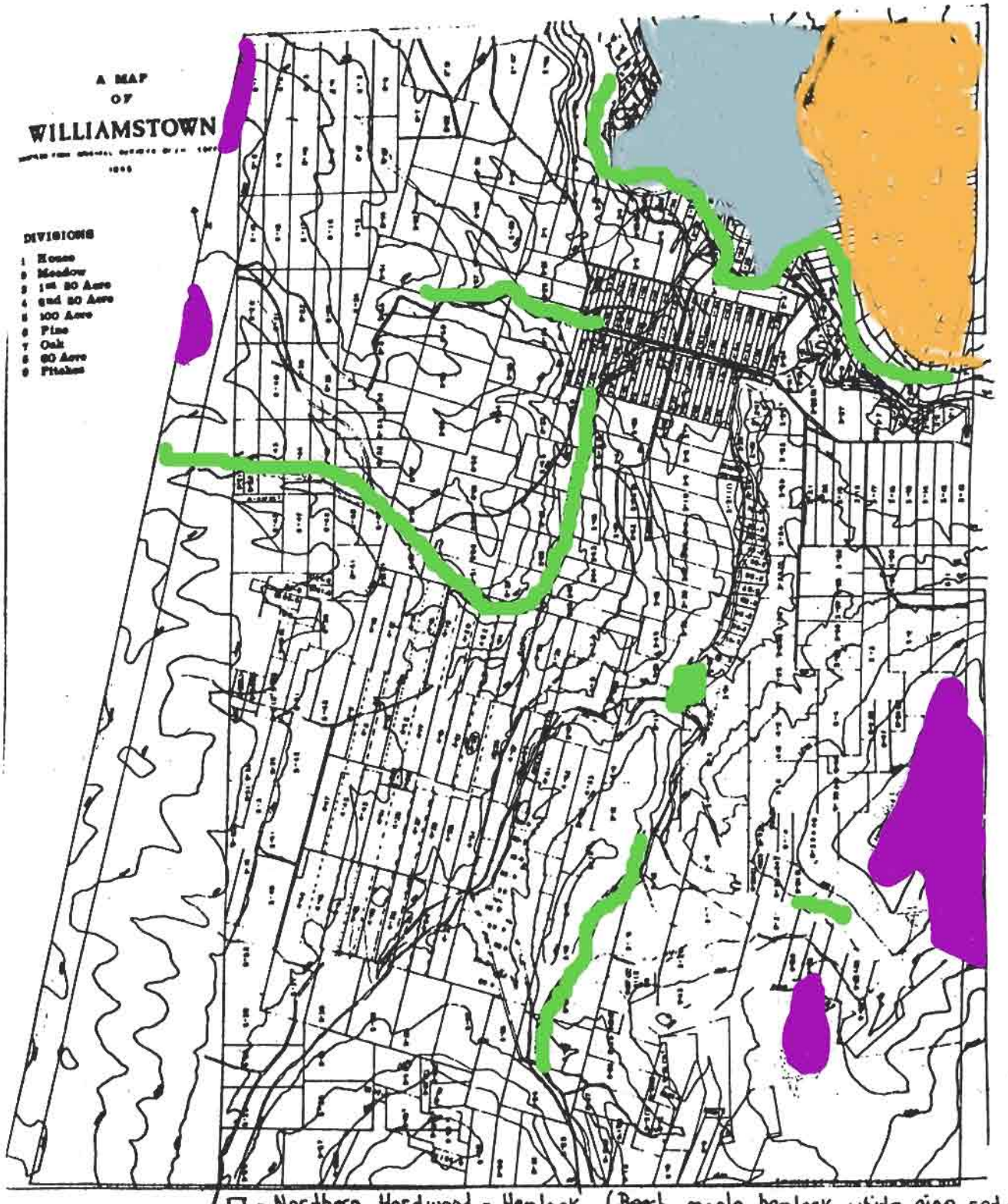
The information on species abundance and distribution obtained from the lot surveys and the historic accounts reviewed in the introduction were considered in making a map of the probable

forest types covering Williamstown at the time of its settlement in the 1750's (Figure 22). The forest type covering at least 75 of the town could be called a Northern-Hardwood-Hemlock forest The principle species were beech and maple, with secondary species including hemlock, birches, ashes, red oak, and basswood. The higher elevations, above 2000 feet, were probably covered with a Spruce-Fir-Northern Hardwood forest. This too was predominantly beech and maple, with areas of spruce, fir, and hemlock. The low-land areas along the rivers were predominantly hemlock, elm, and basswood, with admixtures of other northern hardwood species. The area northeast of the Hoosic River was probably predominantly an Oak-Hickory forest, with northern hardwoods as secondary species. The Sand Springs area, northeast of the Hoosic River was pre-dominantly white pine and oak, with some northern hardwoods.

These five types are a reflection of Williamstown's being in a transition zone between the Northern Hardwood-Spruce areas to the north, and the Oak-Hickory areas to the south. While only the dominant species and characteristics of each type will be described, it is Important to remember that local segregation and variation in the abundance of the dominants creates distinct com-munities within each general type. as is evidenced by the map of present vegetation. Each forest type has a describable structure and is distinct from other areas. This classification of the vegetation in Williamstown will be compared to the classifications of Braun (1950), West veld (1957). Kuchler (1964). and others, in an attempt to discern whether the presettlement types are also the potential natural vegetation of the area.

Mueller-Dombois (1974) discusses the differences between

Presettlement Forest Types Figure 22



□ - Northern Hardwood - Hemlock . (Beech, maple, hemlock, white pine, red oak, birches
■ - Red Spruce - Balsam Fir - Northern Hardwood
■ - Oak - Hickory - Northern Hardwood . (white oak, red oak, red maple, hickory.
■ - White Pine - Oak - Northern Hardwood .
■ - Hemlock - Lowland Hardwood. (Elm, basswood, hackberry)

"natural" and "original" vegetation, noting that the natural vegetation is what would exist without the interference of man, while the original vegetation is what existed before man had any influence on it. He then equates the "natural" vegetation with the "climax" or "potential natural" vegetation. In areas where there is so little information on the original vegetation (as in Europe), the potential natural vegetation map must be constructed from knowledge of the present vegetation. Fortunately, we have a good deal of information on the composition of the original forests in Williamstown, and can even visit remnants of undisturbed areas. Figure 22 shows the vegetation as it probably existed before European man had much impact on it, arid I think that with few revisions, it would reflect the potential natural vegetation of the area. If Williamstown were left undisturbed for many decades, the vegetation distribution would be likely to resemble that of the map, except that chestnut would be eliminated, and elm might be severly limited. A similar description of the potential natural vegetation of this area is constructed by Kuchler (1964), Braun (1950), and Westveld et. al_. (1956).

West veld et. al. (1956) constructed a map of the "Natural Forest Vegetation Zones of New England" which attempts to show the kinds of forests that originally existed, or that are likely to develop if succession is allowed to take its natural course. This map places most of Williamstown in the "Northern Hardwoods-Hemlock-White Pine" region. The potential (or climax) vegetation for this zone is dominated by sugar maple, beech, hemlock, and yellow birch, with "sub-climax" species including white pine and northern red oak, while the "pioneer" species include paper birch, aspen, and red maple. The top of the Taconic crese and the top of Mount Greylock fall into the "Spruce-Fir-Northern Hardwoods-zone. Here the climax trees are red spruce, yellow birc, sugar maple, beech, and hemlock, and the pioneer species are paper birch, aspen, and pin cherry. The presettiement vegetation map (Figure 22) supports both of these descriptions of the potenial natural vegetation. But, the Oak-Hickory-Northern Hardwoods portion of Figure 22 is not precluded from being part of the town's potential natural vegetation. For,

> Owing to its generalized nature, a zonal map lacks

> detailed accuracy. Thus the forest cover depicted on the map may not at all times correspond to that encountered on the ground. It is to be expected that within an area designated as a distinct forest zone there will be small islands and belts... supporting types that supposedly are not endemic to the zone and that theoretically belong to forest zones to the north or to the south. These 'intruders* ... owe their presence to favorable edaphic conditions. (Westveld et. al., 1956).

So, this oak-hickory dominated area, on the dry soil in the northeast corner of town is part of the "Transition Hardwoods-White Pine-Hemlock" type which Westveld maps to a point north of Pittsfleld. Here the climax trees Include red oak, white oak, hickory, white pine, and white ash.

Kuchler's 1964 map of the "Potential Natural Vegetation of the United States" is very similar to West veld's. On his map, all of the town, except for the Taconic crest falls into the "Northern Hardwoods" type, where he lists dominant species as maples, birches, beech, and hemlock. The Taconic crest is in a "Northern Hardwood-Spruce" type, which adds spruce to the above species. The only real difference in Kuchler's construct of the of the potential vegetation is the absence of white pine as one of the dominant species. It is somewhat questionable whether or not white pine could ever re-attain the predominance it had in the original

forest, for it is so easily replaced by aggressive pioneer hardwood species, and large individuals acting as seed sources have been reduced by extensive logging of white pine in Williamstown during the 1900's. Many plant ecologlsts consider white pine to be a naturally occurring dominant species in this area, so, given a very long period of time without the influence of unnatura disturbances caused by man, I think that white pine would again be an important species in the natural vegetation of Williamstown. Bromley (1935) suggested that white pine will re-establish itself as the hardwoods in "white pine-hardwpod" stand are cut for fuel. White pine existed in the presettlement forest as a result of natural disturbance, which is an inevitable occurrence in any forest.

Braun's description (1950) of the deciduous forests in eastern North America is in terms of the probable original forest cover. According to her vegetation classification, Williamstown

falls into the "New England Section" of the "Hemlock-White Pine-Northern Hardwoods Region." Her description of the potential vegetation of the area gives strong support to Williamstown's probable presettlement vegetation, as seen in Figure 22. She classifies most of the area as "hemlock hardwoods (with its white pine subclimax)" while the tops of mountains tend to be spruce-hardwoods. Red oak and occasionally white oak woods frequently extend north into this region but they are confined to lower elevations (the oak region of town would be a northern extension of her "Sprout hardwood" forest type). White pine stands (often mixed with red oak) occupy sand flats, or the low sandy land along rivers. All of these types are found on the map of the pre-

settlement vegetation in Williamstown. The occurrence of the hemlock-bottomland hardwood type along rivers was noted in historical descriptions and in the surveys. Gordon (1940) also noted that white pine and elms were found on flood plains.

The Nature of the Presettlement Forest

The map of the presett lenient vegetation indicates that Williamstown was not covered by just one forest type, yet it is important to realize that the landscape was not uniformly covered with just the dominant species mentioned for each type. The range of species noted in the historical descriptions and the surveys (Table 1) indicates that the forests were in the natural dynamic state of flux and change caused by natural disturbances. The communities described are the products of innumerable interactions between the vegetation and the environment, and the "climax" forest is still best described as a mosaic of patches of constantly changing composition and structure. Disturbances such as fire, windthrow. lightening, insects and disease were undoubtedly periodically killing trees and creating gaps, allowing the invasion of pioneer or secondary species such as ashes, birches, cherry and poplar. As any tree ages it becomes increasingly stressed and inefficient, until it is weakened enough to succumb to insect or fungal attack, and is removed from the canopy. By this mechanism old, over-mature trees give way to the saplings and seedlings below. The majority of trees are finally removed from the overstory by windthrow. Henry and Swan (1974) noted that 56 of the black birch in an area grew on windthrow mounds, and a similar

distribution was observed for yellow birch at Hubbard Brook, New Hampshire (Forcier, 1975). The existence of a static, climax virgin forest of beech, sugar maple and hemlock was probably never realized. Disturbance caused a constantly changing mosaic of secondary succession, thus maintaining the early successional, shade intolerant, species noted in the presettlement forest. The percentages of these species are naturally lower, for even though a poplar stand might be pure when the trees are young, it will eventually give way to the longer-lived, more shade tolerant species, since the poplar rarely succeeds itself (Hawley, 1925). Diversity is an important aspect of stability, and the cycle of disturbance and succession allows for a greater diversity of species to exist in the climax environment. Without disturbance, black birch and white pine would rarely be found in an overstory with the shade tolerant species, while the shade intolerant aspens, cherry and birches would never get into the understory. The form of the climax as a final, stable, self-perpetuating community in equlibrium with its environment may be purely conceptual, unless one adds disturbance to the definition of equilibrium.

Changes in the Vegetation: 1752 - 1977

Present vegetation

The map of the present vegetation (Figure 23 - enclosed in back cover pocket) offers a great deal of information about the present and the past. It is interesting to note differences between the basal area dominants on the map and the categories of the map-down, for some successional changes can be observed. For example, an area behind Buxton School that was designated as "small hardwoods" on the Map-down in 1971, was found to be predominantly white pine at present. This is either because the white pine understory has matured enough in 7 years or because the hardwoods have been cut.

The diversity of the compostion of the forests in Williamstown today is revealed in the classification of fourteen tree species into twenty-one categories of basal area dominants on the present map. Some general trends in the locations of the types are apparent. Beech-sugar maple areas are located in all parts

of the town. but are predominantly on northern and eastern slopes above 1500 feet. In areas with yellow birch as the primary or secondary species, the slopes are usually west or northwest facing, while where beech and red oak are the dominants the slopes usually have a southerly aspect. All of the areas with spruce as a dominant species are on west or northwest facing slopes at elevations above two thousand feet, in the southeast corner of town. Red oak, sugar maple and birch species each appear in six of the categories. This alone does not reflect their relative abundance,for a classification category may be very limited in its extent. Yet, in conjunction with the map it is obvious that red oaks and birches have become widespread in the forests today, while beech is less predominant. The relationship between slope, aspect and vegetation is nicely demonstrated along the southwestern edge of the town, on the slopes of the Taconics. The southern slopes of each interval are beech-red oak, while the northern slopes are sugar maple-paper birch.

Hemlock is located predominantly on the moist areas along rivers and streams or on the moist northeastern slopes, as it is

in Mount Hope Farm. The abundance of the various birch species in all areas is evidence of the fact that the vegetation has been much disturbed during this century. In an area such as the west slope of Mount Williams, where a "sugar maple-red oak" area is adjacent to a "sugar maple-white ash" area, one would expect red oak to evenutally become more predominant than the ash. The occurrence of white pine areas is extremely limited in Williamstown today and, where it was noted, it was with early successional species such as bigtooth aspen or white ash.

Table 6 shows the elevations and aspects of the basal area dominants of 77 plots, tabulated in the same way as the presettlement vegetation is (Appendix C). Sugar maple and beech were located predominantly above 1500 feet (most of the area below 100 feet is now cleared of trees) with sugar maple on eastern slopes and beech on southern and eastern slopes. No birches were located below 900 feet. and all. of the yellow birch was found above 1500 feet on southern and western slopes. 55 of the red oaks were located above 1500 feet, while all of the red maples were at 900-1500 feet, on predominantely eastern slopes All of the red spruce was noted above 1500 feet. but bigtooth aspen was never dominant above that elevation ,

Succession

This vegetation history of Williamstown is an ecological study in its broadest sense, for it examines the totality or pattern of relations between organisms and their environment. There has already been much discussion of the distribution of trees in Williamstown and the evidence of succession, yet little

Table 6

Present Vegetation: Percentage of Each Species at Each Aspect and Elevation

Basal Area Dominant	<600-900 ft.	901-1500 ft.	1501->2500 ft.	NORTHERN (NW-N-NE)	SOUTHERN (SW-S-SE)	EASTERN (NE-E-SE)	WESTERN (NW-W-SW)	#of Plots in which Dominant	%of the 77 Plots Dominated by..
Sugar maple	5%	20%	75%	35	35	50	30	20	26%
Beech	7	29	64	29	71	36	14	14	18%
Birches		67	33	25	42	58	17	12	16%
paper		60	40	40	40	60	20	5	6%
black		100		20	40	80		5	6%
yellow			100		50		50	2	3%
Red oak	9	36	55	9	55	55	46	11	14%
Red maple		100	20	29	57	57		7	9%
White ash	60	20	100	80		60	40	5	6%
Red spruce				66	33		66	3	4%
Bigtooth aspen	50	50		50	50	50	50	2	3%
Hemlock		100		100				1	1%
White pine		100			100		100	1	1%
Quaking aspen		100			100	100		1	1%
							Total	77	

mention has been made of the underlying concept of a climax community. It is also necessary to discuss the ecological characteristics of the predominant tree species in their relation to the successional theory of dynamic plant ecology.

Succession may be viewed as the replacement of one plant community or species by another. Henry David Thoreau, in 1863, noted the tendency for disturbed areas to develop into even aged hardwood stands in central New England, and called this "forest succession" (Spurr and Barnes, 1973). Succession can be brought about by competition among plants, changes in the forest ecosystem, or external disturbances. The question of what the last stage of succession is (the climax) has been hotly debated for over fifty years. When the term "climax" is used in this paper it refers to the relatively stable, long-lived community that develops in plant succession, in the absence of any major human disturbance. The "climax" species tend to be shade tolerant, and thus able to reproduce under a dense canopy. Disturbance is a part of this climax concept, so that many secondary successions are constantly beginning in the gaps created by the kinds of natural disturbances already described. Forest communities with a structure and composition that is so stable that only understory "climax" species can fill in a gap are rarely found. Thus, succession may be described as a series of stages proceeding from a community of relative instability to one of relative stability.

The type of vegetation in an area (stage of succession) is

> controlled by the prevailing site factors (regional and local climate, soil fertility and moisture), the degree of disturbance, competitive relationships of the species and historical and chance factors. (Spurr and Barnes. 1973).

The vegetation types described for presettlement Williamstown are the result of all these factors. The oak-hickory type was probably more stable in the northeast section of town than the hemlock-hardwood type, due to the well-drained soils, hot southwest aspects and the frequency of natural fires.

Even though there is no specific, final, climax type to be expected for every site in Williamstown, there are some general successional trends that can be seen. On an abandoned old field

in Hopkins Forest one might expect to see shrubs —^ alder and grey birch or white pine —^ paper birch and red maple —> red oak, beech and sugar maple; with a variety of other species being present at each stage. These successional patterns are revealed in a comparison of the changes in basal area dominants in Hopkins forest from 1936-37 to 1972 (Art, 1974). Th number of plots in which paper birch was dominant decreased by two-thirds, while the number of plots in which red oak was dominant doubled. The number of plots in which sugar maple was dominant increased by one-third. Many of the paper birch plots had changed to red oak, sugar maple or beech plots. Sugar maple, beech and hemlock are generally classified as late successional species, red oak is classified as intermediate, and white pine, paper birch and red maple are classified as early successionals.

Morphological and Physiological Characteristics of Predominant Species

Table 7 summarizes a few of the morphological and physiological characteristics of ten species. This information helps to explain the successional status of each species, and some of the distributions observed in this study. Salisbury (1942) developed the hypothesis that plants of open habitats produce many, light seeds while plants of closed habitats (with low light intensity at ground level) produce fewer and heavier seeds. The adaptive significance of this is that the early successional species will have a greater success in invading the old field, or gap, if it produces many seeds that are highly mobile. The late successional species optimizes its reproductive capacity by producing fewer seeds, each of which has a greater amount of stored energy,in order to compete in the low light environment. This trend is illustrated in a comparison of the average number of seeds per pound and the maximum distance disbursed for beech and quaking aspen. The late successional beech would have 1,600 seeds per pound, most of which end up right below the tree, while the early successional quaking aspen has 2.5 to 3 million seeds per pound, some of which travel miles. The average number of calories in a seed increases as one moves from early to late successional species.

Succession and distribution patterns are in large part the

result of the different growth and survival characteristics of each species. The often patchy distribution of the light seeded black birch reflects the fact that its seeds have the best chance of success on rotting stumps or tip-up mounds. Sugar maple is presently more widespread than beech for it produces a lot of light, winged seeds compared to the heavy beech nut. Red oak is far more abundant than white oak in Williamstown today. This could be because red oak is a better sprouter or because it produces a good seed crop every 3 to 5 years as compared to every 4 to 10 years in white oaks (Fowells, 1965), Table 7 shows the aggressiveness of the different species and their maximum longevity. The late successional beech and sugar maple both can live longer than 300 years and are most successful at reproducing in the forest, while the early successional quaking aspen would not be expected to live longer than 100 years, and is most successful reproducing in the open.

In general, the seedlings of pioneer species are shade intolerant while the later successional species are shade tolerant "The correlation between tolerance and successional appearance, however, is not perfect." (Spurr and Barnes, 1973). Thus the late successionals can reproduce in a dense canopy while the early successionals need the high light intensity of disturbed areas. The tolerance to shade is often measured in terms of light compensation point (# foot candles: where respiration equals photosynthesis), so the shade intolerant species would require much more light. Loach (1967)found the lowest light compensation point for beech (50 foot candles) and the highest for quaking aspen (200 foot candles). The dense shade of a sugar maple overstory will favor the shade tolerant sugar maple species. They will grow slowly in the deep shade, but if disturbance makes more light available they will respond with accelerated growth, thus perpetuating the.sugar maple dominance. The same is true for hemlock. Gels (1971) explained that sugar maple can eventually invade a red oak area because it has a positive balance of photosynthesis all day (a very low metabolic rate), while oaks are closer to the light compensation point.

Land Use Changes Effecting the Present Vegetation

The present vegetation on the landscape of Williamstown is the product of over 220 years of man's interaction with this land. The major impacts of man on the vegetation have been the clearing of land for agriculture and the logging of trees for wood and fuel. Today, 66.3 of Williamstown is covered with forest land, in contrast to 98 in 1765 (Brooks, 1974), and only 58 in 1830. Yet almost all of this is second or third growth forest, having grown in on abandoned agricultural land or having been cut by loggers. Had the forests simply been cleared for agriculture in the early 1800's and then left undisturbed, one might expect their present composition to be somewhat similar to that of the 1750's. But, the map of the present vegetation shows a complex mosaic of varying stages of succession, which reflects more than the natural disturbances of disease and windthrow.

The present forest composition may have been changed by repeated cutting in the past, and it is certainly being effected by logging today. According to Bob Lear, a state forester, (personal communication 1977) the great abundance of red oak today is the result of lumbering during this century. He suggests that the town would have a much greater abundance of beech and sugar maple if left undisturbed. The composition of the vegetation is effected by selective logging for the most valuable tree species. Beech has a lower economic value than red oak, white ash and sugar maple. Therefore, it is usual management practice to selectively thin out young beech trees. This may partially explain the reduction in the amount of beech in the present forests (Table 6) in addition to the fact that the nectria-beech scale complex has been killing beeches since the early 1960's. Lear also supposes that the very low abundance of white pine in the town at present may be due to extensive logging in the early 1900's. Lutz (1930) noted that logging operations have favored an increase in the proportion of hardwoods. Since there is a lack of sources of white pine seed, the more aggressive pioneer hardwoods get into open areas first. According to Robert McCarthy

the town forester, (personal communication 1977) some logging presently is going on in many areas of town. The town logged the Bullock preserve (near Berlin mountain) extensively about 30 years ago, and that area is now predominantly sugar maple and white ash. Private landowners are logging the lower Pine Cobble area, the west side of Berlin mountain, and the southwest portion of town west of Oblong road. The disturbance caused by these waves of logging is severe enough that the present forest differs substantially from the presettlement forest in its compostion and structure, even though it is made up of the same species (Spurr and Barnes, 1973).

Comparison of the Presettlement and Present Forests

The structure and variation of the vegetation of a landscape is best examined on the levels of environmental factors, species populations, and characteristics of communities (Whittaker, 1967). This study adds a fourth level — that of the history of the present vegetation. Changes in the distribution and abundance of the predominant species can be evaluated by comparing Tables 1 and 2 with Table 6. Beech and sugar maple were both concentrated at 901-1500 foot elevations in the 1700's (Table 2). while they are now predominantly above 1500 feet. This could irnply that only the upper elevations are left undisturbed long enough for beech and sugar maple to become established, or it could simply reflect the fact that all the town's forests have become increasingly restricted to higher elevations. In the 1700's almost all of the oaks were noted below 1500 feet, while today more are noted above 1500 feet than below (Table 2 and 6). This change is probably due to the fact that since red oak is a predominant species in the second growth forests that follow disturbance, it is now found in all parts of Williamstown, instead of just the northeast corner. The present "beech-red oak" areas on the south facing intervales of the eastern Taconic slopes (Figure 23) reflect areas that were cleared on the 1830 map (Figure 1). It is also possible that oaks were able to move into the drier uplands due to the checking of natural and Indian fires by the European settlers (Marks, 1942). Still another possible explanation for the expansion of oaks into all parts of town is the observation

that black oaks tend to occupy areas that were opened up by the loss of chestnut (Lutz, 1928).

There was no change in the elevational distribution of the birches or spruce, but white ash appears to be more abundant at lower elevations today. The predominant species at each elevation in Table 6 may represent a successional pattern. It appears as though the earlier successional species are found more at the lower elevations, and the later successionals at the higher elevations. White ash and bigtooth aspen predominante below 900 feet; 60 of the birches and 100 of the red maples and white pines are located at 901 to 1500 feet; and beech, sugar maple, red oak and red spruce are all the most abundant above 1500 feet. This pattern is probably due to a decrease in the frequency and magnitude of human disturbance with an increase in elevation. According to Auclair (1976), as an area is developed (disturbed) by man, elevation becomes the single most important influence on vegetation.

The changes in the percentage (abundance) of many species reflects the increased human disturbance of the present forests (Tables 1 and 6). The abundance of some earlier successionals, like ash and birch, has increased, while the abundance of the late successional beech has decreased from about 42 in the 1750's to 18 today. The birches were noted as 6.5 of the presettlement forests, while they are dominant in 16 of the plots today. Taking into account the sources of error in the two methods, these appear to be significant changes. Beech seed is subject to high predation and it probably needs an undisturbed area for maximum reproduction by its vegetative root sprouts (Siccama, 1971). Sugar maple composed less than 17.7 of the presettlement forest (because the term "maple" included both red and sugar maple), while it is dominant in 26 of the present plots. These changes in the abundnace of beech and sugar maple are well explained by Forcier's (1975) study of yellow birch-sugar maple-beech microsuccession in climax forests. When biotic factors or human disturbance reduces the presence of beech on many microsites, the succession from birch to sugar maple dominance takes

place. Beech would eventually become dominant over the sugar maple, but its slow reproductive strategy and poor seed mobility delays its occupancy of suitable sites (Forcier, 1975). Thus the reduction in beech and the increase in birches and sugar maple probably reflects the increased disturbance of the present forests and the slow reproductive strategy of beech. But, it has also been observed that beech can often become secondary to maple in a stable community because the beech leaf litter slowly changes the soil from "mor" to "mull,"and sugar maple grows better on the "mull" soil (Ward, 1956). Ash increased from 2.7 to 6, while the white pine and oak percentages are much the same as they were two centuries ago. The decrease in hemlock, from 3.8 to 1 is probably insignificant, yet Lutz (1928) points out that the cutting of upland forests causes a decrease in hemlock because the sprouting hardwoods have a competitive advantage. Even though the present forests are second or third growth, in varying degrees of secondary succession, there are no outstanding changes in the variety of species present, except for the elimination of chestnut and perhaps elm.

Braun's descrption (1950) of second-growth forests in this region is directly applicable to the present forests in Williamstown. She begins by saying that "The original and present day forest aspects bear little resemblance to one another." Over two centuries of cutting and burning have resulted in a "mixed hardwood stand in which red oak is always prominent." The secondary forests on sand flats (such as the lower "White Oaks" area) are mixed white pine and red oak, while the younger communities on these flats can include red maple, birch and aspen. The map of the present vegetation shows white pine areas north of the Hoosic river and Broad brook, and a "red maple — paper birch" type along Sweet brook. "Northerly slopes and moist sites afford some advantage to reforestation by coniferous species." (Braun, 1950). Braun notes that a hardwood community of red oak, white oak, ash and red maple develops on drier situations, and this is evidenced on many of the southwest facing slopes of Williamstown today.

Therefore, the present vegetation cover of Williamstown contains evidence of the potential forest types that would develop without unnatural disturbance, while it also reveals how much human disturbance has altered, and continues to alter the vegetation landscape. In order to make a prediction about the future composition of a forest, the minimum that one would need to know would be 1) what species are present, 2) what the biological characteristics of each species are, and 3) what the frequency and magnitude of disturbance is. This study adds the evidence of historic patterns to 1 and 2 above, but there is not enough information on the present and future magnitudes of disturbance to precisely evaluate the stability of the present vegetation. Yet an understanding of the potential natural vegetation of the town, and the state of succession of the existing forests,provides the basis for the successful management and conservation of the forests of Williamstown, in harmony with natural forces.

Vegetation Changes Observed in Other Studies

The results obtained in other studies of the changes in presettlement vegetation are basically similar to those obtained in this study. Bromley (1935), Gordon (1940), Raup and Carlson (1941) and Steams (1949) all observed hardwoods (oaks, birches, and maples) replacing the original conifers (pine and hemlock) that were logged or cleared for agriculture. A study of Michigan

revealed that in an area where the presettlement type was hemlock-beech-maple, the dominant tree species had changed to bigtooth and trembling aspens, red oak, and red maple (Spurr and Barnes, 1973). Siccama (1971) found that beech predominated in the presettlement forests of northern Vermont (it was greater than 60 on upland midelevation soils and 13 on spruce-fir highlands), but it only comprised 3 - 5 of the northern hardwood forest in 1962. He feels this is probably due to beech's slow reproduction by root sprouts, so that it would attain its maximum development in old age, undisturbed forests. Such undisturbed stands no longer exist. Siccama observed an increase in sugar maple and birch (as was found in Williamstown) while maple had become more abundant in forests over 1000 feet than it was originally. Present secondary succession on abandoned farmland is reflected in the increase in pine, hardback and poplar. Siceama, too, noted an increase in oaks. In examining elevation distributions, Siccama's results show a decrease in hemlock and ash at higher elevations as birches become more abundant, while elm and butternut are concentrated

along rivers. The Increase in hemlock noted in Siccama's results is unexplained, while the white pine increase reflects secondary succession. Siccama's general conclusion was that there were "no outstanding changes in the presence or absence of species within soil substrate types or elevation belts," even though there were changes in the percentages of many species.

SUMMARY AND CONCLUSION

The presettlement forests of Williamstown were not stagnant, unchanging stands with the same composition over vast areas. The forests were relatively stable, but they existed in balance with the inevitable disturbance caused by natural forces. The early lot surveys, historical descriptions, and the present vegetation all indicate that the presettlement vegetation of Williamstown prob ably consisted of five general forest types. Each was stable on its local site and therefore representative of the potential natural vegetation. Most of the town was covered with a "Northern Hardwoods-Hemlock" forest, with beech and sugar maple as the most widespread and abundant species. White pine, birches and red maple were also abundant. The highest elevations, on Mt. Greylock and the Taconics. had a "Red Spruce-Balsam Fir-Northern Hardwoods-forest. The dry, southwestern slopes of the northeast part of the town were "Oak-Hickory-Northern Hardwood" forest, while the sandy areas along Broad Brook were predominantly white pine. The low-lands along the rivers supported forests that were predominantly hemlock, elm and basswood.

The effects of over 200 years of man's use of the land (disturbance) are revealed in the present forests. The vegetation appears as a discontinuous mosaic in various stages of succession. The abundance of later successional species, such as beech, has decreased while the abundance of the earlier successional species, like ash and birches, has increased. The elevation distribution 3f the species reflects a decrease in human disturbance with an increase in elevation, for the later successionals predominate at higher elevations. Thus it can be seen that the changes in species distribution and abundance, as revealed in this history of Williams town's vegetation, are directly related to both the specific morph. ological and physiological characteristics of each species, and to the degree of disturbance that man creates on the landscape.

REFERENCES

Art H W 1974 Thirty-five years of change in a western New England forest. Bulletin of Ecological Society of America. 55:40.

Auclair A.N., 1976. Ecological factors in the development of intensive management ecosystems in the midwestern United States. Ecology. 57:431-444.

Bentley, D.R., 1962. A Post glacial Pollen Diagram from Pownal, Vermont. Biology thesis. Williams College.

Bourdo E A. 1956. A review of the general land office survey and of its use in quantitative studies of former forests. Ecology. 37:754-768.

Braun, E.L. Deciduous Forests of Eastern North America. Hafner Publishing Co., New York. 1950.

Bromley, S.W., 1935. The original forest types of southern New England. Ecological Monographs. 5^63-89.

Brookman, W.R., Mount Hope Farm Management Corporation, Williams-town, MA. Personal communication. April, 1977.

Brooks, R.R.R. (editor). Williamstown. The First Two hundred Years 1753-1953 and Twenty Years Later. 1953-1973. Williams-town Historical Commission. 1974.

Browne, W.B. (Register of Deeds) Williamstown History, no date.

Carney, W., A Berkshire Sourcebook. Junior Leage of Berkshire Count y~.1976.

Cline A.C. and S.H. Spurr, 1942. "The Virgin Upland Forest of 'Central New England," Harvard Forest Bulletin ff2^.

Davis M.B., 1965. Phytogeography and palynology of northeastern 'United States. In H.E. Wright and D.E. Frey (eds.). The Quarternary of the U.S. Princeton University Press.

Day, G.M., 1953. The Indian as an ecological factor in the north-eastern forest. Ecology, 34:239-346.

Dickinson, Guy. Private landowner and logger in Williamstown. Personal communication. April, 1977.

Drury, W.H. and I.C.T. Nisbet, 1973. Forest Succession. Journal 'of the Arnold Arboretum. 54:331-368.

Dwight T Travels in New England and New York. 1822. Edited by B.M. Soloman.Bellknap Press, Cambridge, MA, 4 Volumes, 1969.

Ellenberg, H. and D. Mueller-Dombois. Aims and Methods of Vegetation Ecology. J. Wiley and Sons. New York. 1974.

Falk, J "Five Year Forest Management Plan." Prepared for the Williamstown landowner group by Green Diamond Forestry Service, Inc., Belchertown, MA. March, 1974.

Fernald, M.L Gray's Manual of Botany. D. Van Nostrand, New York, 1970

Field, Reverend (collector). A History of the County of Berkshire Massachusetts. In Two parts. The First being a general View of the County and the Second an account of the Several Towns. Samuel W. Bush, Pittsfield, 1829.

Fisher, R.T. 1933. "New England Forests. Biological Factors" in New England's Prospect. American Geographical Society, 218—223.

Forcier L K., 1975. Reprodictive strategies and the co-occurrence ot climax tree species. Science, 189:808-809.

Fowells, H.A. Silvics of Forest Trees of the United States Agriculture handbook Number 271.Forest Service, 1965.

Geier, R.E. "The Hopkins Forest Beinecke Stand ... a question of virginity?" Williams College, unpublished. May, 1973.

Geier, R.E. "The Moon Lot. Vegetational Analysis as related to its Land-use history" Williams College, unpublished May, 1973.

Geis, J.W. et. al., 1971. Oecologia. 7:276.

Gordon, R.B. 1940. The primeval forest types of southwestern New York. New York State Museum Bulletin, 321:102.

Hawes, A.F. 1923. New England Forests in Retrospect Journal of Forestry. 21:209-224.

Hawley, R.C. and A.F. Hawes. Manual of Forestry for the Northeastern United States. John Wiley and Sons, Inc. New York, 1925

Hazen, Richard. Journal of his 1741 survey of the boundary line of New Hampshire and Massachusetts. The New England Historical and Genealogical Register for the Year 1879. Vol. XXXI 11.David Clapp and Son. July, 1879.

lutchins, T. Map of his 1787 survey of the border between New York and Massachusetts. Williams College Hopkins Forest Farm Collection.

Cenoyer, L.A. 1943. Forest distribution in southewestern Michigan as interpreted from the original land survey.

Ellenberg, H. and D. Mueller-Dombois. Aims and Methods of Vegetation Ecology. J. Wiley and Sons. New York. 1974.

Falk, J "Five Year Forest Management Plan." Prepared for the Williamstown landowner group by Green Diamond Forestry Service, Inc., Belchertown, MA. March, 1974.

Fernald, M.L Gray's Manual of Botany. D. Van Nostrand, New York, 1970

Field, Reverend (collector). A History of the County of Berkshire Massachusetts. In Two parts. The First being a general View of the County and the Second an account of the Several Towns. Samuel W. Bush, Pittsfield, 1829.

Fisher, R.T. 1933. "New England Forests. Biological Factors" in New England's Prospect. American Geographical Society, 218—223.

Forcier L K., 1975. Reprodictive strategies and the co-occurrence ot climax tree species. Science, 189:808-809.

Fowells, H.A. Silvics of Forest Trees of the United States Agriculture handbook Number 271.Forest Service, 1965.

Geier, R.E. "The Hopkins Forest Beinecke Stand ... a question of virginity?" Williams College, unpublished. May, 1973.

Geier, R.E. "The Moon Lot. Vegetational Analysis as related to its Land-use history" Williams College, unpublished May, 1973.

Geis, J.W. et. al., 1971. Oecologia. 7:276.

Gordon, R.B. 1940. The primeval forest types of southwestern New York. New York State Museum Bulletin, 321:102.

Hawes, A.F. 1923. New England Forests in Retrospect Journal of Forestry. 21:209-224.

Hawley, R.C. and A.F. Hawes. Manual of Forestry for the Northeastern United States. John Wiley and Sons, Inc. New York, 1925

Hazen, Richard. Journal of his 1741 survey of the boundary line of New Hampshire and Massachusetts. The New England Historical and Genealogical Register for the Year 1879. Vol. XXXI 11.David Clapp and Son. July, 1879.

lutchins, T. Map of his 1787 survey of the border between New York and Massachusetts. Williams College Hopkins Forest Farm Collection.

Cenoyer, L.A. 1943. Forest distribution in southewestern Michigan as interpreted from the original land survey.

(1826-32) Papers of the Michigan Academy of Science Arts and Letters. 19:107-11

Kenoyer, L.A. 1942. Forest associations of Ottawa County, Michigan at the time of the original survey." Papers of the Michigan Academy of Science. Arts and Letters. 28:47-49.

Kuchler, A.W. Map of the "Potential Natural Vegetation of the United States" American Geographical Society. 1964.

Kuchler, A.W. Vegetation Mapping. Ronald Press Co., 1967.

Lear, State Forester at Pittsifled State Forest. Personal Communication, April 1977.

Livingston, M.L. "A Portraiture of Stone Hill" Center for Environmental Studies, Williamstown, MA, 1972.

Loach, A 1967. Shade tolerance in tree seedlings. New Phytologist. 66:607-621.

Loucks, O.L. 1962. Ordinating forest communities by means of environmental scalars and phytosociological indices. Ecological Monographs. 32:137-166.

Lutz, H.J., 1928. Trends and silvicultural significance of upland forest successions in southern New England. Yale Universtiy School of Forestry Bulletin. 22:68p.

Lutz, H.J. 1930. Original forest compostition in northwestern Pennsyvania as indicated by early land survey notes. Journal of Forestry 28: 1098-1103

MacConnell W.P. and W. Niedwiedz, Remote Sensing. Twenty Years of Change in Berkshire County. 1952-1972. Bulletin #629 Massachusetts Agricultural Experiment Station. September, -1975

Marks, J.B. 1942. Land use and plant succession in Coon Valley Wisconsin. Ecological Monographs. 12:114-133.

Marks, P.L. 1975. On the relation between extension growth and successional status of deciduous trees of the northeastern Unlted States. Bulletin of the Torrey Botanical Club. 102:172-177

Massachusetts Department of Environmental Management. Computer printout of plot and tree listing from the 1967 Continuous Forest Inventory on Mt. Greylock State Reservation. (Copy at Williams Center for Environmental Studies).

Mawson, Joe Department of Natural Resources, University of Massachusetts. In charge of Continuous Forest Inventory Personal Communication, January, February and April, 1977.

McCarthy, R.W. Williamstown Forester. Personal Communication, April, 1977.

Mclntosh,R.P. 1962. The forest cover of the Catskill Mountain Region, New York, as indicated by land survey records. The American Midland Natrualist. 68:409-423.

Nichols, G.E. 1935. The hemlock-white pine-northern hardwood region of eastern North America. Ecology. 16:403-422.

Ohman, Conrad. State Forester--Pittsfield State Forest. Personal Communication, January, March, and April, 1977.

Pappas, B. "The Occurrence of White Pine in the Hopkins Forest." Williams College, Unpublished, May, 1974.

Peattie, D.C. A Natural History of Trees of Eastern and Central North America Houghton Mifflin.Boston.1948.

Perry, A.L. Origins in Williamstown: A History. 1904. (original drafts at Williams College).

Raup, H.M., 1937. Recent changes of climate and vegetation in southern New England and adjacent New York. Journal of the Arnold Arboretum, 18:79-117.

Raup, H.M. and R.E. Carlson. 1941. The history of land use in the Harvard Forest. Harvard Forest Bulletin No 20. 64.

Resch, T. and J. Kate. Berkshire. The First Three Hundred Years. 1676-1976. Eagle Publishing Company. Pittsfield, Massachusetts. 1976.

Rivers, Bill. Division of Forest and Parks. Amherst, MA. Personal Communication. January, February, 1977.

Rutledge, D. "Changes in Vegetation Along Environmental Gradients in Hopkins Memorial Forest." Williams College Hopkins Forest Farm Collection. For Henry Art, unpublished, December, 1971.

Salisbury, E.J. The Reproductive Capacity of Plants. London: G. Bell and Sons, 1942.

Siccama, T.G. 1971. Presettlement and present forest vegetation in Northern Vermont with special reference to Chittenden County. The American Midland Naturalist. 85:153-172.

Spurr, S.H. and B.V. Barnes. Forest Ecology. Ronald Press Co. New York, 1973.

Steams, F.W. 1949. Ninety years change in a northern hardwood forest in Wisconsin. Ecology, 30:350-358.

Ward, R. 1956. The beech forests of Wisconsin - Changes in

forest composition and the nature of the beech border. Ecology. 37:407-419.

Westveld, Marinus, et. al., 1956. Natural forest vegetation zones of New England. Journal of Forestry. 54:332-338.

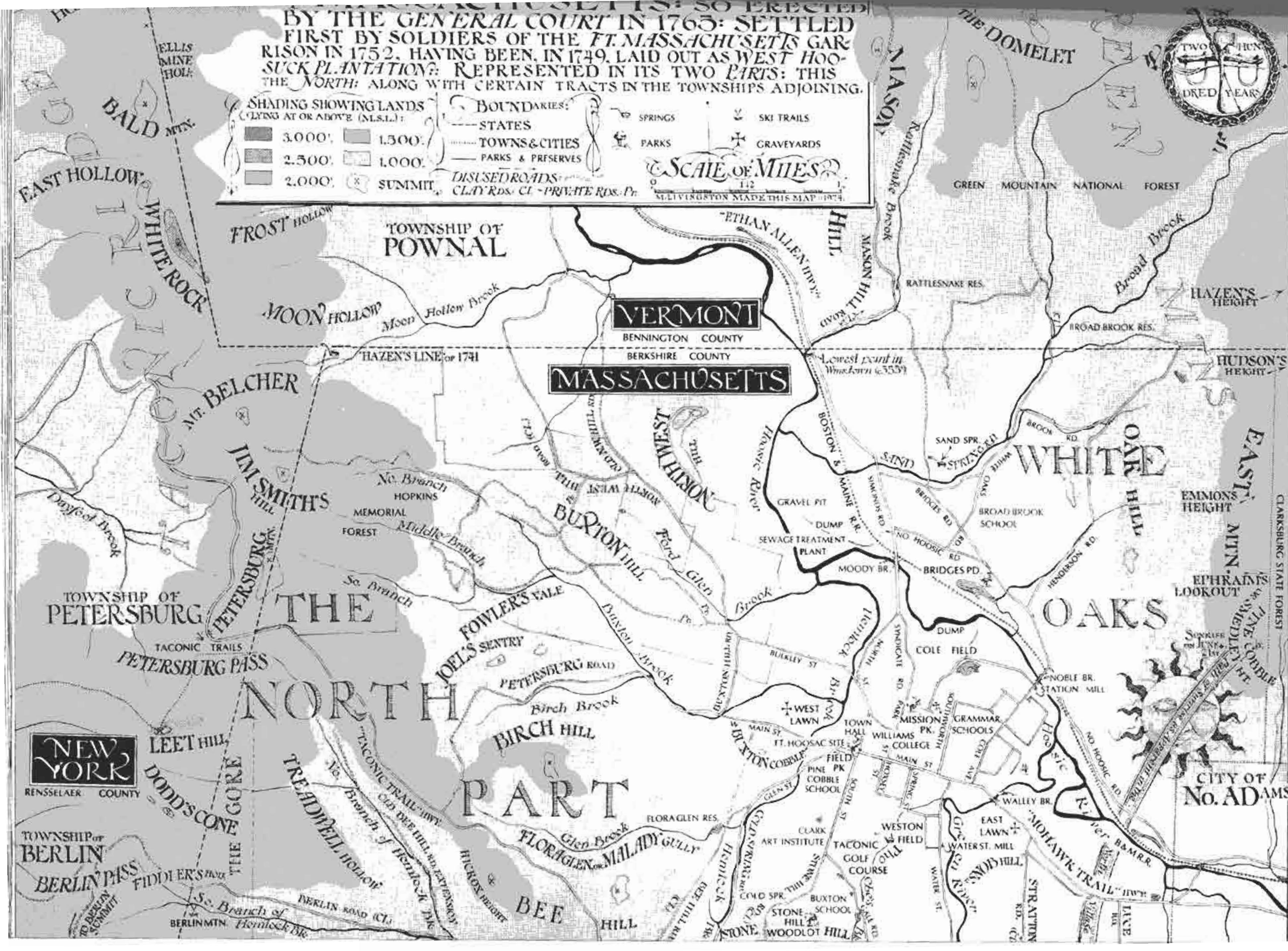
White, A. "Successional Patterns in Hopkins Memorial Forest." Williams College. Unpublished, May, 1973.

Whitehead, D.R. 1973. "Late glacial and postglacial productivity in a New England pond." Science. 101:794-747.

Whittaker, R.H. 1967. Gradient Analysis of Vegetation. Biological Review. Vol. 49. 207-264.

Wilson, B.F. The Growing Tree. University of Massachusetts Press, Amherst, 1970.

APPENDICES


BY THE GENERAL COURT IN 1765: SETTLED
FIRST BY SOLDIERS OF THE FT. MASSACHUSETTS GARRISON IN 1752, HAVING BEEN, IN 1749, LAID OUT AS WEST HOOSUCK PLANTATION: REPRESENTED IN ITS TWO PARTS: THIS
THE NORTH: ALONG WITH CERTAIN TRACTS IN THE TOWNSHIPS ADJOINING.
SHADING SHOWING LANDS LYING AT OR ABOVE (M.S.L.):
3,000'
2,500'
2,000'
1,500'
1,000'
SUMMIT
BOUNDARIES:
STATES
TOWNS & CITIES
PARKS & PRESERVES
DISUSED ROADS:
CLAY RDS. CL - PRIVATE RDS. PR
SPRINGS
PARKS
SKI TRAILS
GRAVEYARDS
SCALE OF MILES
M. LIVINGSTON MADE THIS MAP 1974
TWO HUNDRED YEARS
THE DOMELET
GREEN MOUNTAIN NATIONAL FOREST
MASON HILL
Rattlesnake Brook
MASON HILL ROAD
RATTLESNAKE RES.
Broad Brook
BROAD BROOK RES.
HAZEN'S HEIGHT
HUDSON'S HEIGHT
"ETHAN ALLEN HWY"
TOWNSHIP OF POWNAL
FROST HOLLOW
MOON HOLLOW
Moon Hollow Brook
EAST HOLLOW
WHITE ROCK
BALD MTN.
ELLIS MINE HOLE
VERMONT
BENNINGTON COUNTY
BERKSHIRE COUNTY
MASSACHUSETTS
HAZEN'S LINE OF 1741
Lowest point in Williamstown (553')
MT. BELCHER
JIM SMITH'S HILL
PETERSBURG MTN.
No. Branch
HOPKINS MEMORIAL FOREST
Middle Branch
So. Branch
Dayfoot Brook
TOWNSHIP OF PETERSBURG
TACONIC TRAILS
PETERSBURG PASS
THE NORTH PART
NORTH WEST HILL
BUXTON HILL
Ford Glen Brook
Buxton Brook
FOWLER'S VALE
JOEL'S SENTRY
PETERSBURG ROAD
Birch Brook
BIRCH HILL
NEW YORK
RENSSELAER COUNTY
LEET HILL
DODD'S CONE
THE GORE
TREADWELL HOLLOW
"TACONIC TRAIL" HWY.
No. Branch of Hemlock Bk.
HICKOX HEIGHT
BEE HILL
TOWNSHIP OF BERLIN
BERLIN PASS
FIDDLER'S HOLE
So. Branch of Hemlock Bk.
BERLIN ROAD (CL)
BERLIN MTN.
TO BERLIN SUMMIT
FLORAGLEN RES.
Glen Brook
FLORAGLEN OR MALADY GULLY
Hoosic River
BOSTON & MAINE R.R.
GRAVEL PIT
DUMP
SEWAGE TREATMENT PLANT
MOODY BR.
SIMONDS RD.
SAND SPRING RD.
SAND SPR.
WHITE OAKS
BRIDGES RD.
NO. HOOSIC RD.
BRIDGES PD.
BROAD BROOK SCHOOL
BROOK RD.
HENDERSON RD.
WHITE OAKS
OAK HILL
EAST MTN.
EMMONS HEIGHT
EPHRAIM'S LOOKOUT
PINE COBBLE OR SMEDLEY HT.
CLARKSBURG STATE FOREST
Sunrise on June 21st
CITY OF No. ADAMS
NOBLE BR.
STATION MILL
DUMP
COLE FIELD
Hemlock Brook
BULKLEY ST.
WEST LAWN
BUXTON COBBLE
TOWN HALL
MISSION PK.
WILLIAMS COLLEGE
GRAMMAR SCHOOLS
SOUTHWORTH
COLE AVE.
SYNDICATE RD.
PARK
MAIN ST.
FT. HOOSAC SITE
FIELD PK.
PINE COBBLE SCHOOL
SPRING ST.
HOXSEY ST.
SOUTH ST.
GLEN ST.
COLD SPRING RD.
CLARK ART INSTITUTE
TACONIC GOLF COURSE
WESTON FIELD
STONE HILL
WOODLOT HILL
BUXTON SCHOOL
COLD SPR.
Green River
WATER ST.
WATER ST. MILL
EAST LAWN
WALLEY BR.
"MOHAWK TRAIL" HWY.
STRATTON RD.
B&M R.R.
LUCE RD.


THE SOUTH PART
THE GORE
TOWNSHIP OF BERLIN
N.Y.
RENSSELAER COUNTY
RIDDER PASS
"MAC'S PATTIN"
McMASTER MTN.
SOUTH EAST HOLLOW
JOHNSON PASS
MILLS HOLLOW
MILLS MTN.
"HUTCHINS' LINE" OF 1787
COMSTOCK HEIGHTS
MATTISON HOL.
SABIN HEIGHTS
TOWNSHIP OF HANCOCK
BENTLEY HOL.
OLD PASS RD.
GRAVEL PIT
Sweet OR "Pattin" Brook
Woodcock's Corner
WOODCOCK RD.
OBLONG ROAD
Harmon Pd.
M. LINDLEY PARK
PHELPS' KNOLL
MT. GREYLOCK REGIONAL HIGH SCHOOL
"HEMLOCK BROOK RD." (STONE HILL ROAD)
SCOTT HILL RD.
GREEN RIVER RD.
Green River
OBLONG ROAD (Cl.)
SLOAN ROAD (Cl.)
Steele's Corner
SOUTH LAWN
HANCOCK RD.
WAUBEEKA SPRINGS GOLF COURSE
NEW ASHFORD ROAD
(WEST TOWNSHIP LINE OF 1749)
HANCOCK ROAD
Hancock Brook OR West Branch of Green River
INDIAN SPR. (MT. HOPE FARM)
STRATTON MTN.
JERICHO RIDGE
SOUTH MTN.
Ash Fort OR Ashford Brook, OR East Branch of Green River
TOWNSHIP OF NEW ASHFORD
DEER HILL
POTTER ROAD
CHADBOURNE'S KNOLL
MOUNT HOPE FARM
HOPPER ROAD
Hopper Brook
BRESSETT RD. (Cl., Pr.)
Sweet's Corner
MT. HOPE PARK
Taylor's Crotch, OR KRIGGER Mills
BLAIR RD. (Cl.)
GREEN RIVER ROAD
HILL
DUMP
SHERMAN SPRINGS RES.
TO THE NOTCH & RAGGED MTN.
MT. PROSPECT
SADDLE MTN.
"WILBUR'S PASTURE"
SUNRISE ON DEC. 22
INNER HOPPER
Money Brook
ADAMS
MT. GREYLOCK
TENT POLE RIDGE
STATE RESERVATION
THE HOPPER
Parris Bk.
OLD STONY LEDGE RD. (HOPPER TRAIL)
BALD MTN.
STONY LEDGE
STONYLEDGE
Goodell, OR Bald Mtn. Brook
Bacon Brook
"HARRISON'S FARM"
SPERRY CAMPGD.
THE HEART OF GREYLOCK
SPERRY RD.
ROCKWELL RD.
SADDLE BALL MTN.
OLD STONY LEDGE RD.
Roaring Brook
GOODELL HOLLOW
Frank Bk.

SCALE OF MILES: 0 1/2 1

M. LIVINGSTON FECIT: 1974.

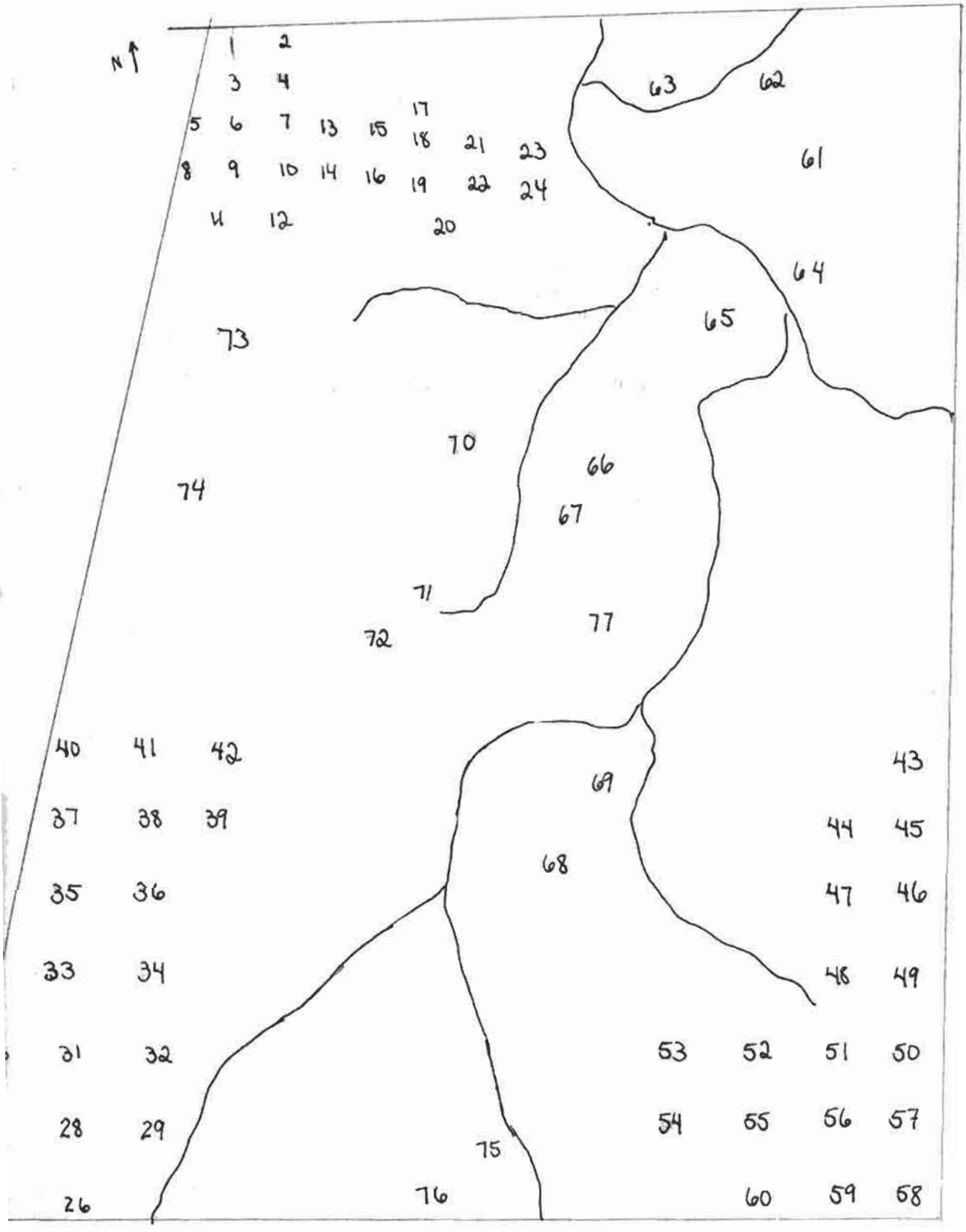
THE SOUTH PART OF WILLIAMSTOWN, &c.

CONFORMABLY DRAWN WITH THE No PART MAP FOR THE HISTORICAL COMMISSION.

MAPPED BY THE SAME SYMBOLS AS THE No. Pt.

APPENDIX C

Locations of Plots Studied for Present Vegetation Map & Table 6.



(Tabulated in Table 6)

Plot	Basal Area Dominant	Species with Second largest Basal area	Elevation (ft)	Slope(%)	Aspect
	Hopkins Forest Data				
1	Beech	Red Oak	1200-1500	24	NE
2	Red Maple	Paper Birch	1000-1200	16	NE
3	Sugar Maple	Red Maple	1500-2000	40	NE
4	Sugar Maple	Red Oak	1200-1500	16	NE
5	Sugar Maple	Beech	2000-2500	8	S
6	Red Oak	Sugar Maple	1500-2000	32	SE
7	Red Oak	Beech	1500-2000	32	E
8	Sugar Maple	White Ash	2000-2500	32	E
9	Beech	Sugar Maple	1500-2000	32	SE
10	Red Oak	Red Maple	1200-1500	32	E
11	Red Oak	Beech	2000-2500	56	SW
12	Sugar Maple	Paper Birch	1500-2000	32	E
13	Paper Birch	Red Maple	1000-1200	32	E
14	Beech	Yellow Birch	1200-1500	16	S
15	Red Oak	Red Maple	1000-1200	12	NE
16	Paper Birch	Red Oak	1000-1200	24	SE
17	Paper Birch	Ash	900-1000	16	N
18	Quaking aspen	Ash	1000-1200	2	SE
19	Red Maple	Red Oak	1000-1200	2	SE
20	Red Maple	Red Oak	1000-1200	16	SE
21	Red Maple	Sugar Maple	1000-1200	16	SE
22	Red Maple	Black Birch	900-1000	12	S
23	White Ash	Elm	600- 700	32	NE
24	Sugar Maple	Red Maple	700- 800	40	E
	Green Diamond Data				
25	Sugar Maple	Paper Birch	2000-2500	16	SW
26	Sugar Maple	Red Oak	1500-2000	48	E
27	Sugar Maple	Paper Birch	2000-2500	24	SW
28	Beech	Red Oak	1500-2000	40	SE
29	Black Birch	Sugar Maple	1000-1200	10	SE
30	Sugar Maple	Paper Birch	2000-2500	40	SW
31	Sugar Maple	Red Oak	1500-2000	45	NE
32	Black Birch	Sugar Maple	1000-1200	16	E
33	Beech	Red Oak	1500-2000	32	S
34	Sugar Maple	Beech	1200-1500	32	SE
35	Sugar Maple	Red Oak	2000-2500	16	S
36	Beech	Red Oak	1500-2000	32	S
37	Sugar Maple	Paper Birch	2000-2500	24	N

Plot	Basal Area Dominant	Species with Second largest Basal area	Elevation (ft)	Slope(%)	Aspect
38	Sugar Maple	Red Oak	1500-2000	48	NE
39	Black Birch	Sugar Maple	1000-1200	15	E
40	Sugar Maple	Paper Birch	2000-2500	40	W
41	Beech	Red Oak	2000-2500	40	S
42	Black Birch	Sugar Maple	1200-2500	40	S
	Mount Greylock Data				
43	White Ash	Sugar Maple	1500-2000	48	NW
44	Sugar Maple	White Ash	1500-2000	56	NW
45	Beech	Red Oak	2000-2500	40	SE
46	Red Oak	Sugar Maple	1500-2000	32	SE
47	Paper Birch	Red Oak	1500-2000	40	SW
48	Red Oak	Paper Birch	1200-1500	48	SW
49	Beech	Sugar Maple	1200-1500	48	SE
50	Red Spruce	Hemlock	2000-2500	72	NW
51	Paper Birch	Beech	1500-2000	40	NE
52	Sugar Maple	Yellow Birch	2000-2500	32	NW
53	Red Oak	Red Maple	1500-2000	32	SW
54	Red Oak	Red Maple	1500-2000	56	W
55	Red Spruce	Sugar Maple	2000-2500	16	S
56	Beech	Sugar Maple	2000-2500	64	N
57	Yellow Birch	Sugar Maple	>2500	40	W
58	Yellow Birch	Beech	>2500	8	S
59	Red Spruce	("weeds") poplar, aspen	>2500	40	NW
60	Beech	Yellow Birch	2000-2500	56	N
	Field Study Data				
61	White Pine	Bigtooth Aspen	900-1000	5	SW
62	White Ash	Red Oak	800- 900	20	NW
63	Bigtooth Aspen	White Pine	600- 700	10	SW
64	Red Oak	White Oak	700- 800	16	SW
65	Beech	Red Maple	600- 700	15	N
66	White Ash	White Pine	700- 800	12	NE
67	Red Maple	Paper Birch	1000-1200	15	N
68	Black Birch	Paper Birch	1000-1200	15	NE
69	Bigtooth Aspen	Beech	1000-1200	10	NE
70	White Ash	Sugar Maple	1000-1200	32	E
71	Hemlock	Red Maple	900-1000	26	N
72	Red Maple	Musclewood	900-1000	2	E
73	Beech	Red Oak	1500-2000	40	SW
74	Sugar Maple	Paper Birch	1200-1500	24	S
75	Sugar Maple	White Ash	1000-1200	30	E
76	Red Oak	Sugar Maple	1200-1500	56	E
77	Beech	Red Oak	1000-1200	40	SW