

Meth.

CONSIDERATIONS IN SELECTING THE SITE OF THE INVESTIGATION:
THE RECONSTRUCTION OF THE GENERAL LAND-USE HISTORY OF A FORESTED
AREA

The site of the present investigation had to satisfy three basic requirements. One of the principal objectives of this research was to document the forest stands which had grown on a particular area since pre-colonial time. Therefore, the first requirement was that the site should never have been subjected to a land use which necessitated the eradication of its trees. The intensity of the proposed study placed another demand upon the area. The site had to be accessible enough to permit daily visits with the minimum of travel time and to facilitate the transportation of heavy, bulky specimens to the laboratory. The third requirement was that the area be located within the boundaries of the Harvard Forest. Then the site could be declared expendable, which would assure the maximum degree of research freedom.

The immediate task was to locate an accessible area on the Harvard Forest that had never been subjected to land clearing. Approximately 60 percent of the total land surface in the town of Petersham had been cleared by 1830 and was in farms or pasture (Fisher, 1921). No timbered area had escaped logging. In 1945, due primarily to farm abandonment which began around 1850, only 37 percent of this same area was in farms (Black and Brinser, 1952). In 1908, nearly two-thirds of the area of the Harvard Forest was in pure, even-aged white pine ranging chiefly from 40 to 70 years in age. Thirty years later there remained only two small remnants of this cover type (Lutz and Cline, 1947). Before the site of the investigation could be selected, a knowledge of its general land-use history had to be acquired.

The geographic character of most earth regions is determined by two sets of features: those which are a part of the original natural or physical earth, and those which have been superimposed on the original physical area by man as a result of his living in a region and utilizing its resources (Finch and Trewartha, 1949). In almost any region where forest is the predominant form of vegetation, the bulk of the land surface can be divided into two general

land-use categories: agriculture and forestry. The areal extent of each will vary over time, depending upon the demands of society.

The reconstruction of land-use histories of forested areas is concerned mainly with man's modifications and introductions: the changes that he has wrought in the *primeval landscape* (Hartshorne, 1939) while deriving benefits from it. The expressions of land use are most obviously reflected upon the surfaces of the forest floor and in the larger woody plants growing there. The basic problem confronting the application of modifications and introductions as land-use criteria rests upon the identification of the characteristics associated with the primeval landscape. The character of the primeval landscape has to be known or assumed before its reactions to use can be recognized. The recognition of those modifications and introductions brought about by man, and their interpretation by inductive reasoning provide the basis for the reconstruction of land-use histories.

At the present state of knowledge, only the gross expressions of land use can be employed. These, however, can be observed in the woods with the aid of simple instruments or none at all. Nevertheless, these characteristics are usually adequate for the reconstruction of general land-use histories of forested areas. Detailed histories require greater perspective derived from more intensive investigation.

Introductions to the Primeval Landscape

Man's introductions to the primeval landscape are the most pronounced indicators of land use. Their recognition is usually absolute. Their interpretation is reliable in regard to kind of use, but becomes mere tentative when applied to the degree of use.

Stone Walls, Stone Piles, Rail and Wire Fences

The stone wall is a characteristic feature of the New England countryside (Fisher, 1916). These walls indicate both kind and degree of land use. Their interpretation is based primarily upon size and manner of construction.

The narrow walls of large boulders and rather haphazard construction were usually erected as boundaries (Fig. M-A-1). This type of wall marked property lines or delineated areas of different use. Mowings were commonly separated from pastures and woodlots by this means.

Another type of wall, not as common as the first, is much wider and of more complex structure (Fig. M-A-2). This form of wall was constructed by erecting two parallel rows of large boulders, the rows being spaced several feet apart to form a rectangular trough. The trough was then filled with smaller boulders and stones. Many of these walls are five to ten foot wide. The principal function of the wide wall was as a bin, a depository where boulders and stones could be piled conveniently and neatly as they were removed from the acreages which were to be used more intensively. They are generally associated with smaller plots of land than the narrow walls and denote areas which have been plowed or cultivated.

Almost any conceivable variation of these two general types of walls can be observed. Narrow walls of small boulders and stones occur, as do unfinished sections of the wider form which appear as two closely spaced parallel narrow walls. Narrow walls may have been used in conjunction with or to supplement the wide type of wall. Likewise, the corners formed by narrow walls were often used as bins for smaller boulders and stones. The degree of land use is usually indicated by the relative proportions of the smaller components contained in the walls. The more numerous the smaller boulders and stones, the greater the intensity of land use.

Piles of boulders and stones are frequently observed in the New England forests. These structures have the same land-use implications as the wide stone walls, and often occur on the same area. They are the results of efforts to prepare areas for more intensive agriculture (Fig. M-A-3).

Rail fences or their remains are also encountered in the New England forests. They were frequently used in conjunction with narrow stone walls. Their remains are most common in this region on areas of glaciofluvial soils where boulders and stones are not so prevalent on the surface and are often entirely lacking. The ages of the trees growing on and between the rails is one means of determining the minimum length of time which has elapsed since the fence was erected. Its state of decomposition can be used for date approximation.

Wire fencing in New England would appear to have had a use comparable to that of wooden rails. Wire also was used, and still is, to supplement narrow boulder walls. Occasionally, old smooth or twin-barbed wire fences are found in the forest. They will persist for a long time, especially when suspended off the ground by having been fastened to live trees. Invariably, the bole of a tree becomes disfigured where strands of wire have been attached. The bole tends to grow around the wire and often completely encases it (Fig. M-A-4). Cross sections of the boles can be made at these points of contact and ages determined which will lead to an approximation of the date when the fence was erected. Often the scars on the boles are the only evidence remaining of a wire fence. Customarily, three strands of wire were used, and evidence of their past existence can be observed in three localized areas of deformities on the lower four to five feet of the tree boles. Old fences can often be traced by aligning the trees which bear such scars. Woven wire fences may also be observed in the forest. While barbed wire was commonly used to fence cattle and horses, woven wire was required to confine sheep. Many of the forested areas in Vermont are partitioned with old sheep fences.

Man has always been proud of his personal possessions, particularly of his land. The means which he has devised to delineate his property holdings provide criteria which can be used for general land-use history reconstructions. In New England, boulders and stones are commonly employed. Coarse mineral fragments are utilized almost everywhere for similar purposes whenever they occur on the surfaces of the landscape. These structures often afford a ready clue to the characteristics of the native rock and glacial till of the local vicinities of the walls. Rail fences are common in the southern Appalachians and in the Midwest. White pine stumps with parts of their larger roots intact are placed on edge to form fences in Pennsylvania and upper New York State. Live tree fences of catalpa and osage orange have been employed in the Midwest for many years. Wire and brush fences of mesquite and juniper are likewise a feature of the far western countryside. And the agricultural areas of the Gaspé and Maritime Provinces appear to be held together with pole fences. All of these introductions to the landscape provide a means of interpreting past practices of land use.

Cellar Holes and Building Remains

Old cellar holes and other remains of home sites are often observed in the forest (Fig. M-A-5). The town of Petersham, which was settled in 1734, has the remains of approximately 70 cellar holes within its limits (Black and Brinser, 1952). In central New England, the clearings associated with these sites afford the requisites for the establishment of white pine. It is not uncommon to find old-field white pine stands or their remains in the dooryards of these former dwellings.

Comparable to the cellar holes of central New England are the abandoned logging camps of northern New England. The 'hovels' banked with refuse are especially a familiar symbol of past logging activities.

Introduced Plants

Introduced or exotic plants have land-use implications. Remains of orchards and solitary domestic fruit trees are frequently found growing in forest stands. These trees are usually relics of past land uses which required a degree of clearing. Black locust, introduced into New England many years ago, escaped its confines and invaded small clearings. Dead trees of this species are decidedly resistant to decay and are suggestive evidence of former land use. Clumps of barberry and lilac are also found in areas of intensive land use, especially on old dwelling sites.

Wherever human communities have been established within historic time, exotic plants have been introduced. Many of these, particularly the longer-lived trees and shrubs provide land-use criteria.

Modifications of the Primeval Landscape

Features that commonly are considered components of the natural setting itself provide another class of land-use criteria. The trees and the forest floor are the constituents of the landscape which are influenced most obviously by man's activities. The major difficulty is to determine how and to what extent they have been affected. The basic question involves the

differentiation of natural phenomena from artificial modifications. As a result, modifications of the primeval landscape must be employed with caution as land-use criteria. Nevertheless, experience has demonstrated that these modifications do have definite diagnostic value. Furthermore, they are always present in the forest to be exploited by the investigator, while the more easily interpreted introductions are often lacking.

Ages of the Tree Boles

The most obvious means of documenting the land-use history of a forested area is by the ages of the boles of the standing live trees. Ages can be determined by increment borings extracted from the boles as near the ground level as possible. If the dates of origin of the boles generally precede the date of local settlement, the logical conclusion is that the area has been forested since pre-colonial time. However, it is possible for the tree boles of a wooded area to be much younger than local colonization, regardless of the fact that the area had never been subjected to land clearing. In New England, less than five percent of the existing forests date back to colonial time (Fisher, 1933). Disturbance is the factor responsible. Logging, wind, fire, insects, and pathogens are the principal agents. Any disturbance of the pre-and post-colonial forest would tend to alter the age distribution of its components, the trees being the most obviously affected. Any tendency toward an area-aged condition should suggest the possibility of disturbances.

Ages of Sprout Clumps

The ability to reproduce vegetatively is a characteristic common to most of the broadleaf trees or so-called "hardwoods" of North America. The most usual form of vegetative reproduction is the sprouting from stumps after a logging operation. Conifers, in contrast, do not generally sprout from stumps, the redwood and pitch pine being the exceptions in this respect (Fisher, 1903; Luz, 1934).

Many of the hardwood elements in the forest are present in the form of clones which have been perpetuated by sprouting. The ages of the current boles may date back to a disturbance, while the root systems or portions thereof may be much older, having been a part of the previous

generations of sprouts on the same clone. Many of these sprouts represent the same trees that grew in the pre-colonial forests. Their presence in abundance on an area precludes the possibility of land clearing, and provides a useful clue to land-use reconstruction.

Cross sections of roots from sprout clumps can be obtained and their age determined (Fig. M-A-6). In this manner, dates of origin of the clones can be extended into the past much further than present bole ages would indicate.

Origins of the Trees

The origins of the forest trees provide another means for determining land-use history. Almost any disturbance, natural or man-created, will tend to increase the number of trees of sprout origin. Land clearing followed by abandonment presents a pronounced exception. A hurricane preceded by several days of rain would provide another. In this latter instance, more trees are liable to be uprooted than broken off, which would tend to nullify the sprouting capacity of the broad-leaf trees. Pathogens specific to root systems and deep ground fires, either alone or in combination with the physical forces of wind, ice, and snow resulting in uprooting, might also diminish vegetative reproduction.

Logging is the primary agent or instigator of sprouting. In almost any region where hardwoods predominate and economic conditions permit the utilization of small trees, large areas of sprout forests are characteristic of the landscape. Forests of sprout hardwoods have been created by frequent logging in southern New England (Leffelman and Hawley, 1925). The woodlot has furnished small-dimensional fuel wood on short rotations since colonial time, while the demands of the charcoal, railroad, and mining industries have created vast expanses of coppice forests.

Forest stands preponderantly of stump-sprout origin have a physiognomy that can be recognized even while motoring along the highway. The group-wise arrangement of the boles which originate from multiple-stemmed sprout clumps presents a distinct contrast to the stand of trees primarily of seedling origin (Fig. M-A-7). Closer scrutiny of the individual clumps or clones will reveal the past existence of several generations of sprouts. The sizes of the parental

clumps are usually related to the number of times their sprouts have been cut back. Each succeeding generation tends to increase the diameter of the clumps by being laterally displaced toward its circumference. Extremely large clumps may well have persisted vegetatively since colonial time.

Dead Stumps and Dead Tree Boles

Dead stumps and boles are common constituents of the forest and are reliable indicators of land-use history. Large stumps and prostrate boles of white pine, chestnut, red oak, and white oak in central New England will persist and maintain their identity for at least 150 years.

The surfaces of stumps and downed boles appear to be favorable microenvironments for the establishment of the lighter-seeded tree species. Hemlock, and black, yellow, and paper birches are frequently observed growing on these situations. In many instances the old stumps and boles have almost disintegrated, leaving as evidence of their past existence innumerable trees growing either in perched positions above the general level of the forest floor or in lines along the slight ridges of decomposed organic matter (Figs. M-A-8 and M-A-9). The general history of a wooded area can be supplemented by determining the ages of such trees and the ages of the stumps and boles on which they are growing.

Mounds and Pits of Uprooted Trees

Mound and pit microrelief created by the uprooting of trees is another feature of the natural setting which can be used to help ascertain the land-use history of a wooded area. It is not exaggeration to state that scarcely a single naturally timbered area in the United States has not been subjected to uprooting of its trees. Mound and pit microrelief is as much a characteristic of the forest as the trees. The presence of mounds and pits definitely denotes that trees once occupied the immediate areas of disturbance.

A pronounced number of trees in the present forests are growing on mounds. Occasionally they are perched on mounds in such a manner that their root collars are several feet above the general level of the forest floor (Fig. H-A-10). Such trees became established shortly after the mounds were formed, and their ages date the disturbances to within a few years. Dates

of uprooting and ages of perched trees contribute to a chronology of events which can be compared with the historical setting of local colonization.

The absence of mound and pit microrelief in a wooded area presents several implications. There is sufficient precedence for expecting the evidence of uprooting in the forest. So much so that its absence immediately makes the observer wonder about the past land-use practices. The characteristic relief produced by uprooting may maintain its identity for at least 500 years on the glacial till soils of central New England. The possibility that a forested area had never been uprooted is very remote. The chances of its not having been uprooted in the last 500 years is less remote, but highly improbable. The absence of uprooting evidence usually indicates that the area had been cleared and used for agriculture. Absence in addition suggests the intensity of agricultural practice.

Plowing will destroy the surface features of mounds and pits in a very few years (Fig. M-A-15). Pasturing will reduce them, but a much longer time it required (Fig. M-A-11). One pasture was observed in Maine which still showed the evidence of uprooting 100 years after clearing (Abbott, 1951).

Absence of uprooting evidence may also indicate a particular timing in the sequence of land use. The chances of uprooting are greatly diminished on a wooded area that has been cleared at short intervals since colonial time. Not only is a young forest apt to be less susceptible to violent winds, but its form and physiological condition created by frequent logging tend to decrease the occurrence of senile uprooting. Frequent logging, especially by the highly mechanized practices of today, not only alters the microrelief of uprooting but imparts to the forest floor its own characteristic features, features which may become more pronounced over time (Weltzman, 1952). Also, the present areas of timber may have escaped uprooting because they had been cleared and were under agriculture at the time of more recent wind disturbances. Approximately 40 percent of the acreage in the town of Petersham was in cultivation or pasture in 1811 (Raup and Carlson, 1941). These acreages escaped severe windthrow during the hurricanes which are known to have occurred in this region in 1815 and 1821 (Perley, 1891;

Brooks, 1940). Thus the timing of events associated with land use and wind disturbance can influence the occurrence of mound and pit microrelief.

Old-field Forest Stands

Old-field stands or their remains provide criteria which can be used for land-use history reconstructions. Their identification and interpretation are exemplified by the old-field white pine stands of central New England.

White pine so dominated the central New England landscape during the last half of the nineteenth century that Sargent designated the area a white pine region in his tenth Census Report of 1880 (Sargent, 1880). That these stands were related directly to land use has since been documented (Fisher, 1916 and 1921; Raup and Carlson, 1941). Today such coniferous stands are referred to as "old-field white pine," and are considered, a by-product of human society. Settlement, land clearing, agriculture, and land abandonment were the historical steps which preceded this white pine era. The remains of these stands provide a means of documenting the land-use history of the general region. Land which had been cleared and subsequently abandoned is still precisely delineated on the ground by the evidence of forest stands composed predominantly of white pine. Furthermore, due to the chronology of the events which preceded the white pine era, the general date of origin for these stands can usually be placed between 1840 and 1870.

Settlement, land clearing, agriculture, and land abandonment are associated with the general development of human communities. In the last 300 years, the same sequence has been repeated, many times. In its wake have evolved relatively even-aged, essentially coniferous, forest stands. White pine is the characteristic tree of the old-fields in central New England. Red cedar and gray birch are prominent in similar situations of southern New England (Lutz, 1928). The abandoned fields of northern New England are taken over by white and red pine, red spruce, balsam fir, hemlock, and northern white cedar (Hawley and Hawes, 1912). Slash, longleaf, shortleaf, and loblolly pines are old-field constituents in the South. The Midwest and Appalachian regions have Virginia scrub pine, shortleaf pine, and red cedar as their old-field counterpart. Almost anywhere in the eastern half of the United States the old-field coniferous

stand or its remains marks a definite stage in the land-use history of the locality. The processes involved would appear to be comparable for all of them. The primary tree participants and the chronologies vary.

Hardwoods also occupy abandoned agricultural land and form old-field stands. Their role in this respect is not as generally recognized as is the conifers'. In some regions of the United States, however, old-field hardwood stands impart a definite character to the landscape. In the Appalachian Plateau Province, the farmer wages a constant battle against the hardwood encroachment of his fields. Every year the West Virginia farmer mows the "filth" or the native hardwood tree and shrub regeneration in his pastures. A few years of laxity or complete abandonment usually results in the conversion of pastures to hardwood stands.

In central New England, hardwoods occasionally form old-field stands on abandoned agricultural land. Lutz and Cline account for "this unusual succession by the presence of a number of old open-grown hardwoods in the pasture at the time of abandonment and by the wetness of the site" (Lutz and Cline, 1947). Tryon cites the futility of attempting to establish coniferous plantations on the old-fields of the Hudson Highlands of southern New York (Tryon, 1949). The costs of releasing the plantations from the "local pioneer hardwood species" is prohibitive. Invariably, old-field stands are a mixture of conifers and hardwoods. This is particularly the case in central and southern New England. Many of the so-called "old-field pine stands" were and are designated as such because of the emphasis usually placed upon the economic preference for the pine. Volumes of these stands commonly ran 15 to 20 thousand board feet of pine and 8 to 10 cords of hardwood per acre.

As an indication of land-use history, the relatively even-aged, predominantly coniferous or hardwood stand must be regarded with caution. Each and every one is not related directly to land abandonment. Other observations can be made, however, to assist in documenting the old-field origins.

Tree and Forest Forms

The forms of the individual trees in a forest stand and of the stand in general suggest past practices of land use. At this time, only the gross expressions of form can be used as criteria of past land-use history, since the reactions between the genotypes of the trees and their environments are extremely difficult to evaluate. The basic problem involves the segregation of those phenotypic characteristics which are rigidly controlled genetically from those which are highly influenced by the external environment. Since man can influence the form of the forest in much the same manner as natural agents, another problem arises: the differentiation of man-caused or artificially created forms from those which naturally develop. As a result, tree and forest forms can seldom be applied as decisive criteria of previous land use. Observation of them, however, lends credence to conclusions based primarily upon other features.

The even-aged coppice hardwood stand is a very pronounced forest form that can be related to land use. Sprout stands usually denote a history of repeated logging, which in turn may indicate the area to have been in continuous forest since pre-colonial time. The consideration of almost every conceivable form, though, must be approached with caution when an attempt is made to relate this characteristic to previous land use. Even the connotation of the coppice stand must be tempered. Repeated burning, insect depredations, pathogens, and snow and ice breakage can create similar stands. The typical multiple-stemmed hardwood sprout clump with its cut stump remains of former generations, however, is rather difficult to misinterpret.

The use of wooded pastures was and still is a common agricultural practice. Such acreages, even 100 years after abandonment, can often be recognized by the form of the stands they support. The characteristic, open-grown, broad-crowned, relic trees of the wooded pasture may still be standing. They have been allowed to remain through the merchantable rotation of the old-field stands which followed pasture abandonment. At present, either they tower over the members of the ensuing stands or display a marked contrast in form to the younger, forest-grown constituents (Fig. M-A-12). Such areas are usually sprinkled liberally with white pine stumps. In central New England, wooded pasture relics are most commonly elms, sugar maples, white pines, white ashes, and oaks. Again, land-use implications must be qualified. High-grading or selective logging can result in a storied-stand the upper canopy of which may be composed of

inferior, economically sub-marginal trees. Other features, however, namely, the preponderantly stump-sprout origin of the lower canopy trees, the absence of white pine stumps or infrequent occurrence there, and the usually more forest-grown form of the largest trees, can be observed to assist in the differentiation of the past processes responsible for the forms of the present stands.

The forms of old-field white pine stands can frequently be related to the rate of land abandonment. Fields abandoned slowly over a period of several years often result in stands of "cabbage pine" even when there is a sufficient seed source. The incidence and effect of weeviling is usually greater in open-grown stands. Prostrate juniper, a common old-field shrub, also seems to occur more abundantly on slowly abandoned pastures. Occasionally these shrubs will even persist in the understory along the margins of the hardwood stands which so often follow the logging of the old-field white pine (Fig. M-A-13).

Individual tree form within a forest stand is sometimes indicative of land use. The form most easily recognized for what it represents is that of the broad-crowned, open-grown tree. The relics of wooded pastures afford an example; fence row trees another. Trees left in solitary or relatively open situations by selective logging or any natural disturbance have a tendency to develop coarse crowns. This feature should not be confused with strongly related genotypic characteristics. Red oak has been described as a crown-aggressive tree (Patton, 1922). Some red oaks have the ability to compete for crown space to the disadvantage of their forest associates. As a result, even-aged stands are observed where large-crowned red oaks dominate the upper canopy. This condition is particularly noticeable where red oak is growing with birches, red maple, and white ash (Fig. M-A-14).

Individual tree and stand forms present one of the least reliable criteria for diagnosing land-use histories. The knowledge is lacking to enable the reconstruction of the conditions which were instrumental in creating the forms that are observed in the forests. Form can be related to natural developmental processes, the influences of which can often be duplicated by land-use policies based upon the demands and vagaries of human society.

Stand Composition

Species composition of the forest as a basis for the reconstruction of land-use history has somewhat the same deficiencies as forest form. The basic problem at the present time is to separate the influences of men from the natural trends in the development of the vegetation.

The old-field coniferous stand again provides the classical example of the relationship between land use and forest composition. It can function as a basis for further reasoning. The significance of the old-field stand is generally recognized. Yet there exists a degree of reluctance to accept the probability that the less conspicuously man-influenced stand compositions are as artificial as the old-field conifers.

White pine was a preferred species even before the promulgation of the Broad Arrow Policy. It has been selectively logged and at the same time judiciously pampered since colonial time. Logging crews conscientiously avoid patches of white pine reproduction. Thousands of man-hours are expended every year in the United States eradicating the hosts of the blister rust and spraying against the weevil.

Every region has or had its preferred tree species, trees which, due to their inherited characteristics, fulfilled some particular demand of society. Almost every conceivable combination of forest composition has been created by man of the indigenous species within any given region. The major problem confronting the researcher in the woods is the differentiation of natural patterns of distribution from those which have been created by man's activities. The landscape is covered with a mosaic of vegetational patterns, some of which have resulted from man's modifications of the natural patterns, some of which have resulted from man's modifications of the natural trends in the development of the vegetation.

Plowing

Plowing is the criterion for perhaps the most intensive agricultural use of land in this region of central New England. At the peak of agricultural development in the town of Petersham, 85 percent of the land had never been tilled, though a large part of it is cleared for pasture (Raup and Carlson, 1941).

There are criteria which can be observed in the field that denote plowing. As stated previously, the absence of a mound and pit microrelief might be interpreted as evidence of former plowing. This condition is vividly demonstrated by Fig. M-A-15. The surficial features of the mound and pit relief can be so disrupted by plowing that they are no longer recognizable from above ground. However, the plow line and internal features of the mounds and pits may still be discernible. Plow lines are, therefore, another indication of cultivation. Such features, of course, require the exposure of soil sections by excavation.

Wide boulder fences and stone piles are other characteristics of plowed areas. This is particularly the case where such features have a sizable proportion of small boulders and stones in their structure.

In earlier days when animals were more commonly used in plowing, the practice was to throw up the first furrow against the base of the stone wall surrounding the plot. This practice permitted the use of the maximum area for cultivation, and also tended to keep the field margins clear of brush. Continuation of this practice before field abandonment resulted in a decidedly upward slope of the ground immediately at the base of the wall. Occasionally a marked difference may be observed between the elevations of the ground on each side of a wall which was erected along the contours of even a moderate slope. Especially marked is the elevation differential when the uphill side had been subjected to frequent plowing (Fig. M-A-16). On such slopes, plowing had undoubtedly created a condition favorable for erosion. As the mineral material was washed downhill, a portion of it was held back by the wall which functioned somewhat as a dam. The deposits thus formed over time have created a decided differential in the ground level on either side of the wall. Actual terrace-like forms involving two to three feet of relief and much greater horizontal distances have thus been produced. Such modifications may be employed as indicators of varying degrees of rather intensive land use, namely, plowing.

The modifications of the primeval landscape and the introductions into it by man provide a basis for land-use history reconstruction. Since modifications of the forest aspect of the landscape are largely associated with living organisms, they are subject to quite radical changes over time; changes which are as dynamic as the ranges of reactions between the organisms and

their external environment will permit. On the other hand, introductions to the landscape, though they may be either organic or inorganic in nature, tend to react over time in a manner more characteristic of inorganic elements. A forest stand, over time, is subject to changes usually referred to as a function of developmental trends. An apple tree, a form of introduction, grows old, while a stone wall becomes weathered, both of which might be likened to physical aging. As such, the criteria of modifications and introductions must be assigned different weights of significance when they are applied. The element of time is extremely important, especially the lapse of time since civilized man made his appearance in any specific area.

Seldom if ever are general land-use histories based upon two or three observations. The decision to select the area which was to be used as the site of the present investigation rested upon several combinations of criteria. To be sure, from the very first visit, the area presented the general appearance of having been in continuous forest since pre-colonial days. Undoubtedly it had been disturbed several times, but its trees had never been eradicated for agricultural purposes.

No stone walls or fences of any kind were present on the area or in the immediate vicinity. Evidence of an old-field white pine stand in the form of line trees or stumps was lacking. Boulders were abundant on the forest floor, especially in the western half of the area. Also, the forest floor was liberally sprinkled with mounds and pits created by the uprooting of trees. This combination of observations suggested that the area had never been cleared for agricultural purposes. Certainly it had never been plowed.

If the area had never been cleared for farming, its land use must have involved other practices. Or, had the area ever been used deliberately to meet the demands of human society? The prevalence of cut stumps and stump-sprout hardwoods indicated that the area had been logged several times. Many of the sprout clones represented at least the second generation of sprouts, a few others had supported three or four. Even though the ages of the present live sprouts were much younger than local settlement, the numbers of generations on a few of the clumps indicated that some clones had originated in the pre-colonial forest. The combined ages

of dead stumps and the live trees perched on them were conservatively back-dated to the forest of the earliest local white settler.

The ages of large, live trees perched and otherwise closely related to uprooting mounds were determined, and the disturbances tentatively dated. The time involved for the trees which had been uprooted to have grown to the proportions demanded by the degree of disturbance evidenced on the ground of necessity designated them as having been components of the pre-colonial forest.

Evidence on the ground also suggested that the area had been used for livestock grazing. On the top of the hill and on the opposite slope directly east of the research area, an old-field pine stand was destroyed by the hurricane of 1938. The absence of a wall or fence between these two distinct areas suggested that livestock was permitted to graze freely over both.

Observations on the ground indicated, therefore, that the area which was finally selected as the site for the present investigation had not only been in continuous forest since pre-colonial time, it had also been used intentionally for its wood products and forage. These observations were corroborated and supplemented later by a more intensive investigation.

Nevertheless, the application and interpretation of simple, widely recognized observations of the modifications and introductions to the primeval landscape by man permit the reconstruction of a general land-use history of a specific wooded area.

Source: Earl Stephens, ca 1955, from Harvard Forest 1955-4 Folder 1

FIGURE LEGEND

- Figure M-A-1. Narrow wall. Notice open-grown form of large red oak in right background. Tree is at least 200-years-old.
- Figure M-A-2. Wide wall.
- Figure M-A-3. Stone pile. Large tree is white pine.
- Figure M-A-4. Strands of wire fence are completely enveloped by red oak tree. Increment boring indicates fence was erected at least 20 years ago. Scale is one foot long.
- Figure M-A-5. Cellar hole. Ages of trees indicate abandonment for at least 90 years.
- Figure M-A-6. Red maple sprout clump. Present sprouts are 98-years-old and represent at least the second generation. Age of root section is 125 years. Pruning saw has 14 inch blade.
- Figure M-A-7. A 21-year-old coppice stand of red maple. Present sprouts represent at least the third generation. On a per acre basis, stand as 2,269 stems one inch and larger in d.b.h., basal area of 90.442 sq. ft., and 8 cords of wood. Average height of dominant trees is 35 ft. Scale is one foot long.
- Figure M-A-8. White pine stump 105-years-old. Perched black birch is 50-years-old. The stump resulted from a logging operation 98 years ago. Scale is one foot long.
- Figure M-A-9. Ridge of organic matter created by prostrate white pine bole. The ridge, barely discernible, extends diagonally across photograph from lower left toward upper right corner. Shovel is erected in center of ridge. Two large trees in background behind shovel are black birches which are growing on the stump of prostrate pine. Stump is 24 inches in diameter and at least 100-years-old. Black birches are 85 and 80 years of age. Age of hemlock tree in front of shovel is 84 years. Pine bole has been on ground for at least 150 years.

Figure M-A-10. A black birch tree perched on a mound created by an uprooted tree. Black birch is 136-years-old. Tree that was uprooted to form mound was a white pine. Uprooting probably occurred during hurricane of 1815. Scale is one foot long.

Figure M-A-11. Mound and pit microrelief in a pasture. Cape Breton, Nova Scotia.

Figure M-A-12. Old-field hardwood stand bisected by new road. Large white ashes in foreground are relics of old pasture. They are at least 125-years-old. Smaller trees which came in after abandonment are mostly sugar maple and are 60 to 70-years-old.

Figure M-A-13. Prostrate juniper under canopy of 45-year-old hardwood stand which followed the logging of an old-field pine stand. Present stems of juniper represent at least the third generation of sprouts, are 2 inches in diameter at the base, and are 20-years-old. Present condition is generally suppressed.

Figure M-A-14. Aggressive crown of red oak. Note how red oak crown has developed to the disadvantage of the nine white ash trees surrounding it. Stand followed a clear-cutting of old-field hardwoods with standards in 1910-11. Trees in photograph are same age. Soil is Gloucester and Sutton.

Figure M-A-15. Red pine plantation on old-field. Surficial features of mounds and pits have been destroyed by plowing, while parts of their internal features are still discernible. Plow line occurs at about 10 inches below surface. Dark layer at approximately 20 inches is concentration of ash and charcoal which represents buried surface of pre-uprooting forest floor. Scale is one foot long.

Figure M-A-16. Differential in elevation between two sides of stone wall. Field to right of wall had been plowed in the past. Approximately 2 feet difference in elevation exists.