From Primitive Woods to Cultivated Woodlots

Thoreau and the Forest History of Concord, Massachusetts

by Gordon G. Whitney and William C. Davis

Until very recently most American plant ecologists adhered to the concept of the forest as a stable self-replicating entity composed of the more shade-tolerant species. As Raup noted, the climax or the relatively undisturbed, pristine presettlement forest was taken as a biological baseline against which various forest management practices were evaluated.[1] Like the pendulum, however, which swings from one extreme to another, ecological theory of late has shifted attention from stable forest systems to "forest history," seen as a chronicle of various "disasters" in the life of a given forest.[2] Today forests are often depicted as mosaics of even-aged woodland patches in various stages of recovery following disturbance. The ecological literature is replete with studies of the impact of fire, windthrows, and other natural disturbances on the structure of the forest,[3] but ecologists have paid considerably less attention to the effects of routine or repetitive human activities on the composition of the forest, or have taken these effects for granted as the background for ecological analysis.

Despite their seemingly tranquil nature today, most American forests have had a long history of human use. Superimposed upon one another, the resulting uses of the land have often formed a veneer that obscured the broader control of the forests by climate and soils. We have attempted to peel away this veneer and to reconstruct the forest history of a limited area in southern New England—Concord, Massachusetts—from the colonial period to the present. Disturbances, particularly those caused by humans, were a very real part of the life of Concord's forests in the nineteenth century and the pre-European period. Fortunately Henry David Thoreau recognized their importance, and his comments and observations can help us to clarify the confusing quiltwork pattern of Concord's forests today.

Concord (42° 27′ N, 71° 19′ W), an area of approximately twenty-seven square miles on the suburban fringes of Boston, Massachusetts, is an interesting study site for several reasons. Concord was the first inland town established in the Massachusetts Bay Colony in 1635. It possesses a rich store of documentary materials about its history and environment. Concord was also the home of Henry David Thoreau. Although Thoreau was noted primarily for his philosophy, he was also an acute observer of the natural scene, much more than his self-appointed title, "inspector of snowstorms and rainstorms," might suggest.[4] As a practical ecologist, surveyor, and husbandman, Thoreau was intensely interested in the history and management of Concord's woodlots in the nineteenth century. His journals and his manuscripts are filled with a number of penetrating comments on the history, composition, and dynamics of

The authors thank Ray Angelo for sharing his knowledge of Concord's present flora, Marcia Moss and the Concord Free Public Library for access to Thoreau's surveys and the Ancient Record Books of Concord, William Howarth and Beth Witherell of the Thoreau Textual Center at Princeton University for access to Thoreau's manuscript on the dispersion of seeds, D. M. Smith for a number of insights on New England's forests, and the Yale School of Forestry and Environmental Studies for logistical support during the course of the study.

1. Hugh M. Raup, "American Forest Biology," *Journal of Forestry* 65 (November 1967): 800–803.

2. F. Herbert Bormann and Gene E. Likens, "Catastrophic Disturbance and the Steady State in Northern Hardwood Forests," *American Scientist* 67 (November–December 1979): 660–69.

3. Peter S. White, "Pattern, Process, and Natural Disturbance in Vegetation," *The Botanical Review* 45 (July–September 1979): 229–99.

4. For a review of Thoreau's scientific contributions, note Raymond Adams, "Thoreau's Science," *Scientific Monthly* 60 (May 1945): 379–82; Philip and Kathryn Whitford, "Thoreau: Pioneer Ecologist and Conservationist," *Scientific Monthly* 73 (November 1951): 291–96.

Concord's woodlots.[5] They provide an on-the-site evaluation of the human forces at work in the nineteenth century and they serve as a benchmark for some of the more recent studies on Concord's flora and land-use practices.[6]

The Presettlement Forests

The Puritan historian Edward Johnson (1654) was the first individual to describe Concord's early landscape. Johnson reported that the colonists, on their first visit to the townsite in 1635, had found an open plain, full of ragged bushes and sweet fern.[7] A petition to the General Court of Massachusetts in 1651 similarly depicted much of the area as poor, barren pine land affording very little feeding for cattle.[8] Both descriptions suggest a fire-prone type of vegetation, characteristic of gravelly plains or coarse textured soils throughout the Northeast.[9] Concord was the site of one of the principal villages of the Massachusetts tribe. Early town histories state that the Indians frequently burned and cultivated the plains lying between the Assabet and Sudbury rivers and the Great Fields to the south of the Concord River.[10] Surface fires were common and well documented throughout the more densely populated sections of southern New England before major European settlement.[11] Fires consumed the debris left after the trees had been destroyed and provided a rich coating of wood ashes for the Indians' planting fields. Surface fires also eliminated much of the underwood and rubbish and maintained the relatively open hunting ground or deer pastures favored by the Indians.[12]

Although several investigators have recently questioned the regular and widespread use of fires by Indians, most evidence suggests that fires were important agents of change locally along the more densely populated coastal sections of southern New England.[13] Not surprisingly, fires do not appear to have been nearly as common in the cooler, moister, more sparsely populated upland areas of southern New England.[14] Local site conditions and existing vegetation together helped to determine the outcome of repeated burning. Timothy Dwight (1821), for instance, noted that the Indians traditionally burned grounds that were covered with oak, chestnut, and pitch pine because they alone were sufficiently dry in ordinary years for burning.[15] As a result, very dry sites close to Indian villages were the most likely areas to sustain a fire-related "subclimax" form of vegetation.

Forest Structure in the Early Colonial Period

The colonial land records represent another valuable source that forest ecologists have rarely tapped for information on New England's early landscape and vegetation. In 1652 Concord was divided into three parts or "quarters" for the purposes of distributing the remaining land. The Ancient Records of Concord still contain records of land grants in the various quarters and information about the type of land (meadow, upland, woodland, swamp, planting field, pine land, etc.), acreage, geographical location, and abutting properties. A representative example of the format employed in the earlier (1653) land grants is provided by part of George Heward's second division land in the south quarter: "22 acres on pine plaine by brooke meadow: bounded on the n. with sp[ruce] swamp: with the highway on the se: on the south with Th Stow: on the w. withe Luke Potter."[16]

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5. See Kathryn Whitford, "Thoreau and the Woodlots of Concord," *The New England Quarterly* 23 (September 1950): 291–306, and Kurt Kehr, "Walden Three: Ecological Changes in the Landscape of Henry David Thoreau," *Journal of Forest History* 27 (January 1983): 28–33 for earlier analyses of Thoreau's interests in the field of forest ecology.

6. Richard J. Eaton, *A Flora of Concord* (Cambridge: Special Publication no. 4, Museum of Comparative Zoology, Harvard University); William P. MacConnell and Marcia Cobb, *Remote Sensing 20 Years of Change in Middlesex County, Massachusetts, 1951–1971*, Research Bulletin no. 622 (Amherst: Massachusetts Agricultural Experiment Station, 1974).

7. Edward Johnson, *Wonder-Working Providence of Sions Saviour in New England* (1654, reprinted in *Massachusetts Historical Society, Collections*, series 2, vol. 3 [Boston, 1815]): 156–57.

8. Charles H. Walcott, *Concord in the Colonial Period* (Boston: Estes and Lauriat, 1884), p. 16.

9. E. Lucy Braun, *Deciduous Forests of Eastern North America* (1950, reprint edition, New York: Hafner Publishing Company, 1967), pp. 223 and 270; John Winthrop, Jr., "Of the Manner of Making Tar and Pitch in New England," in Thomas Birch, *The History of the Royal Society of London*, vol. 1 (London: A. Miller, 1756–57), p. 99.

10. Lemuel Shattuck, *A History of the Town of Concord* (Boston: Russell, Odiorne, and Company, 1835), p. 3; Walcott, *Concord in the Colonial Period*, p. 17.

11. Gordon M. Day, "The Indian as an Ecological Factor in the Northeastern Forest," *Ecology* (April 1953), pp. 329–46, and Howard S. Russell, *Indian New England Before the Mayflower* (Hanover, New Hampshire: University Press of New England, 1980), pp. 121, 125, 179.

12. Roger Williams, one of the more reliable observers of the Indians and their customs, noted that the natives possessed great game parks by virtue of their burning "up all the underwoods in the country, once or twice a year" for purposes of hunting (*The Complete Writings of Roger Williams*, vol. 2 [New York: Russell and Russell, 1963], pp. 46–47).

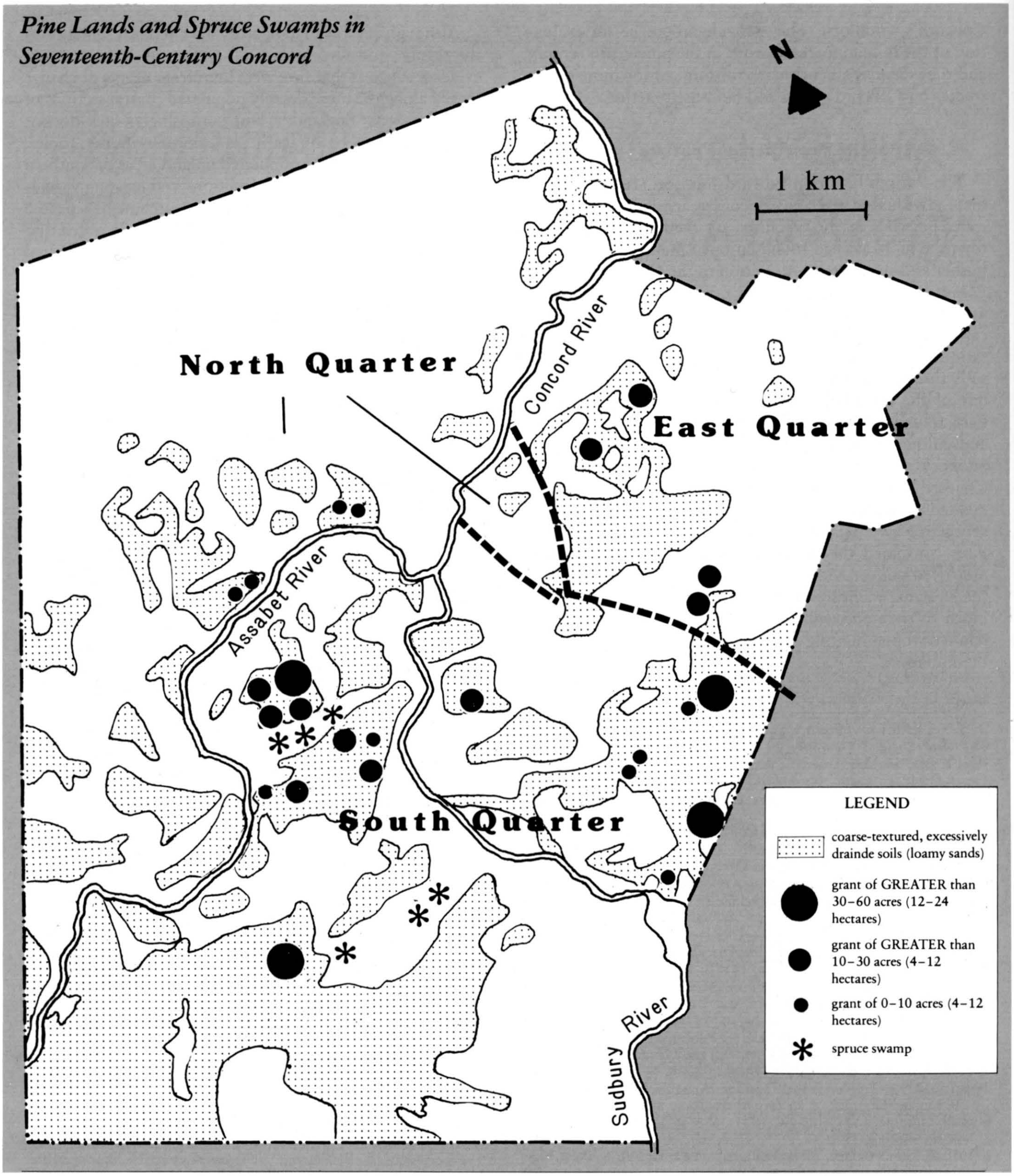
13. Emily W. Russell has criticized the "Indian burning hypothesis": see her article, "Indian-set fires in the forests of the northeastern United States," *Ecology* (February 1983): 78–88, and Emily W. Russell and Richard T. Forman, "Indian Burning, 'The Unlikely Hypothesis,'" *Bulletin of the Ecological Society of America* 65 (Summer 1984), pp. 281–82. Two studies that have supported that hypothesis are William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York: Hill and Wang, 1983), pp. 49–51, and William A. Patterson III and Kenneth E. Sassaman, "Indian Fires in the Prehistory of New England," in George Nicholas, ed., *Cultural Responses to Environmental Change: Ecological Models and Paleoenvironmental Approaches* (Taunton, Massachusetts: Baywood Press, in press). Cronon's analysis is based largely on historical documents. Patterson and Sassaman utilize counts of charcoal fragments in lake sediment cores to support the Indian burning hypothesis.

14. Andrew E. Backman, "1000-year Record of Fire-vegetation Interactions in the Northeastern United States: A Comparison Between Coastal and Inland Regions," (M.S. thesis, University of Massachusetts, 1984), pp. 87–92.

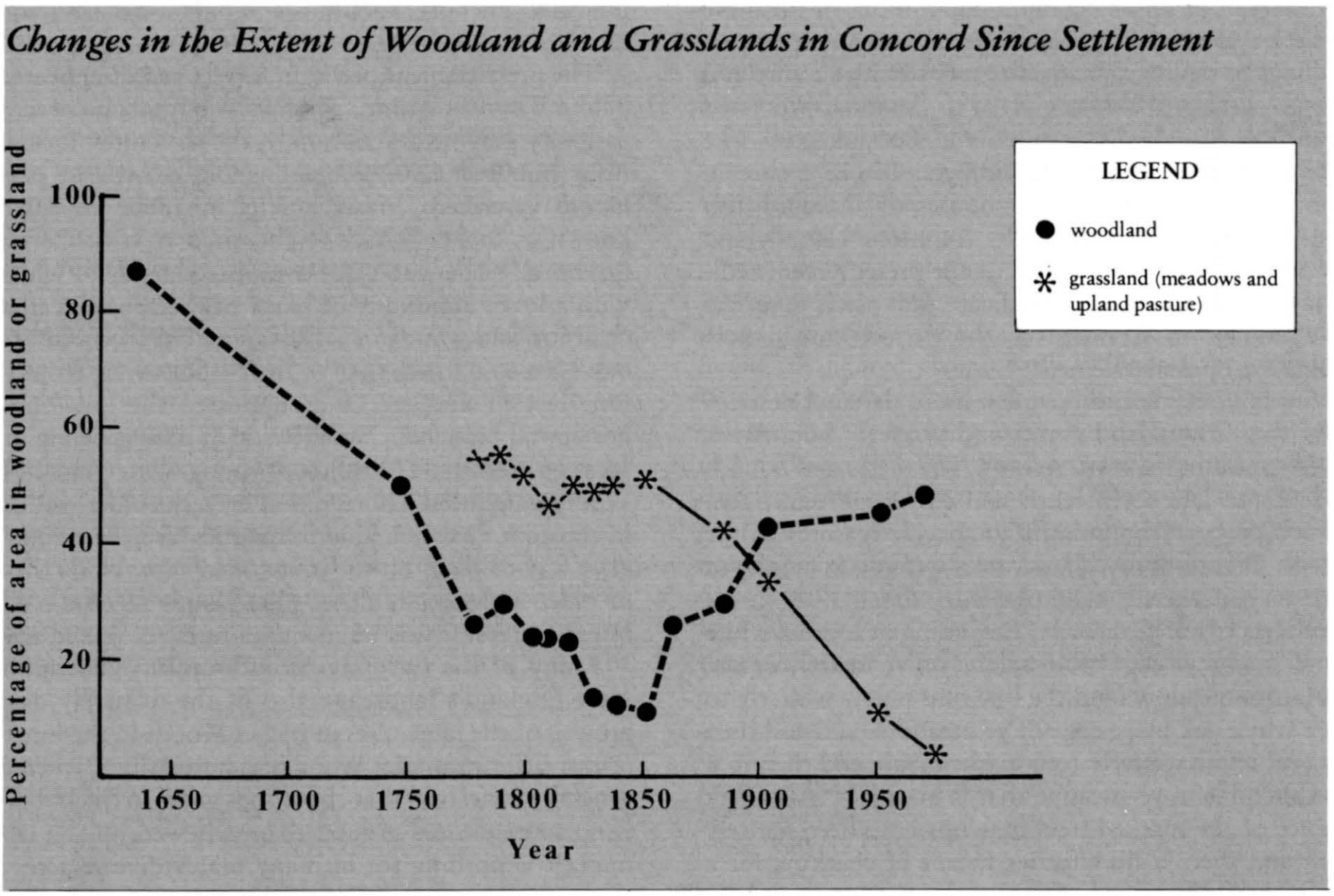
15. Timothy Dwight, *Travels in New England and New York*, vol. 1 (1821, reprinted Cambridge: Harvard University Press, 1969), p. 72.

16. Transcripts of the Ancient Records of Concord, vol. 1, 1663–1784 (hereafter cited as Ancient Records), p. 39a, Concord Free Public Library.

Pine Lands and Spruce Swamps in Seventeenth-Century Concord



SOURCES: Information on the soils and the surface geology was extracted from the unpublished 1977 USDA Soil Conservation Service "Soil Map of Concord, Massachusetts," available at the SCS office in Littleton, Massachusetts, and from C. Koteff, "Surficial Geology of the Concord Quadrangle, Massachusetts," *U.S. Geological Survey Map GQ-331*. Colonial grants of pine stands or pine plains are cited in volume 1 of the Ancient Records of Concord. Town boundaries are those of the twentieth century. Due to the difficulty of locating several of the grants, the map does not include 7 acres of pine land in the north quarter, 45 acres of pine land in the south quarter, and 57 acres of pine land in the east quarter.



SOURCES: Lemuel Shattuck, *A History of the Town of Concord* (1835), p. 213; Massachusetts Secretary of the Commonwealth, *Statistical Information Relating to Certain Branches of Industry in Massachusetts for the Year Ending May 1, 1865* (1866), pp. 346–47; Massachusetts Bureau of Statistics of Labor, *The Census of Massachusetts: 1885*, vol. 3 (1887), pp. 754–55; Massachusetts Bureau of Statistics of Labor, *Census of the Commonwealth of Massachusetts, 1905*, vol. 4 (1909), pp. 280–81 and 306–307; William P. MacConnell and Marcia Cobb, *Remote Sensing 20 Years of Change in Middlesex County, Massachusetts, 1951–1971*, Research Bulletin no. 622 (1974), pp. 78–79; and Robert A. Gross, "Culture and Cultivation: Agriculture and Society in Thoreau's Concord," *Journal of American History* 69 (June 1982): 42–61.

Pollen counts and early historical records suggest that oaks dominated southern New England's arboreal flora.[17] As a result, it is probably safe to assume that the grants designated as woodlands or uplands were oak woods. Pine and spruce represented a rarer, much more distinctive type of woods. The pines were very closely associated with excessively drained, coarse-textured soils formed from contact with glacial ice or meltwater (technically, kame terraces, kame deltas, and outwash plains). Although the species of pine was not specified, several lines of evidence suggest that a majority of the pine was pitch pine. Only two species of pine, pitch pine and eastern white pine, occur naturally in the Concord area today. In 1935 Bromley noted that southern New England's pine plains, the plains "so frequently mentioned by the early writers, were for the most part composed of pitch pine." [18] John Winthrop, Jr., one of the more active observers of the early New England scene and a charter member of the Royal Society of London, regarded the pitch pine plains as common enough to warrant an account on "the manner of making tar and pitch in New England." [19] Pitch pine tolerates drought well and has always been associated with the light sandy soils of the "more barren plains" of Massachusetts.[20] Fire, however, was probably the major factor responsible for the maintenance of the pine plains.[21] Pitch pine's thick bark and its

17. Margaret B. Davis, "Phytogeography and Palynology of [the] Northeastern United States," in H. E. Wright and D. G. Frey, eds., *The Quaternary of the United States* (Princeton: Princeton University Press, 1965), p. 378; John Smith, *A Description of New England* (London: Humfrey Lownes, 1616), p. 16; Thomas Morton, *New English Canaan* (1637, reprinted Boston: Prince Society, 1883), p. 183. Marjorie Winkler, a palynologist at the Center for Climatic Research at the University of Wisconsin, has recently analyzed the sediments in Walden Pond. Oak was also the dominant species in the pollen count of the presettlement horizon (personal communication).

18. Stanley W. Bromley, "The Original Forest Types of Southern New England," *Ecological Monographs* 5 (January 1935): 62–89.

19. Quoted in Birch, *The History of the Royal Society of London*, vol. 1, p. 99.

20. Ibid., p. 99; W. B. Brierly, "The Relation of *Pinus rigida* to physiographic and soil types in central Massachusetts," *Rhodora* 40 (February 1930): 72–73.

21. Bromley, "Original Forest Types of Southern New England," p. 68.

ability to resprout following injury make it one of the more fire-resistant species in the Northeast. White pines, at least as seedlings or saplings, are much more sensitive to fire and as a result were probably restricted to the more protected sites, such as Concord's swamps and floodplains.[22] The occurrence of large pitch pine timbers, 15–16 inches in diameter, in one of the earliest houses of Concord also suggests that these pines were very common.[23] Finally and more conclusively, pollen counts of the presettlement sediment layers in Walden Pond indicate that pitch pine was more abundant in Concord in the period immediately preceding European settlement.[24]

By the late seventeenth century more detailed descriptions of the various land grants and property boundaries began to appear in the town records. The metes and bounds surveys of the late seventeenth and early eighteenth centuries tied property boundaries to specific features of the landscape. On unimproved land, trees were often employed as boundary markers,[25] as in one entry dated 1700 in the Ancient Records of Concord: "Beginning at a great white oake marked by ye edge of ye upland on ye easterly corner of sd Hardys meadow land the line runs partly westerly to another white oak by ye edge of ye meadow land and then starting on a line westerly to a markt maple and then to a great white pine in ye swampe that is markt."[26] Although the choice of the marked trees may not have been entirely random and there is no effective means of checking for a surveyor's bias, the records do provide a more quantitative measure of the composition of the forest.[27] Of the 319 trees utilized as survey markers in the Ancient Records of Concord from 1675 to 1750, approximately two-thirds were oaks, of which white oak and black oak formed the majority. Hickory, chestnut, and pine were also frequently recorded.[28]

The presettlement or virgin forests had disappeared long before Thoreau's time. Thoreau's journal, however, gives us a very graphic description of the structure of the largest (four hundred acres) remaining old-growth or *primitive woods* in eastern Massachusetts in 1860: an oak wood known as Inches Woods, eight miles west of Concord in Boxboro.[29] The wood was composed largely of white oaks with a lesser admixture of black oak, red oak, scarlet oak, chestnut, and white pine. The largest oaks were of "pasture oak" size and form, that is, their trunks were from two to four feet in diameter and supported the low, spreading horizontal branches characteristic of oaks growing in open areas or pastures. The influx of young white pines in Inches Woods convinced Thoreau that even the older woods were in constant flux. In a kind of natural "crop rotation," oaks gave way to pines on the more open sites, while the shade of older and already dense pine woods favored oak seedlings. The result was frequently a forest of mixed woods.[30]

Many of the early seventeenth-century descriptions of New England's landscape also fit the relatively dispersed growth of the large oaks in Inches Woods in the nineteenth century. For example, Wood had stated that "whereas it is generally conceived that the woods grow so thick that there is no more cleared ground than is hewed out by labor of man, it is nothing so, in many places diverse acres being clear so that one may ride ahunting in most places."[31] Edward Johnson likewise described the woods as relatively "thin of Timber in many places, like our Parks in England."[32] Although the oak woods were not as open as the fire-maintained oak savannahs of the Midwest, Thoreau implied that the large, spreading oaks may have owed their existence to the same factor—the oaks' relative resistance to the surface fires regularly set by Indians.[33]

22. Bromley, "Original Forest Types of Southern New England," pp. 67 and 72; William A. Niering and Richard H. Goodwin, "Ecological Studies in the Connecticut Arboretum Natural Area. I. Introduction and a Survey of Vegetation Types," *Ecology* 43 (Winter 1962): 41–54.

23. Thoreau in his journal stated that the timbers of Tommy Wheeler's house told of Concord's "primitive forest" (Bradford Torrey and Francis Allen, eds., *The Journal of Henry D. Thoreau*, [New York: Dover Publications, 1962; hereafter cited as *Journal*], vol. 3, p. 160). Thoreau apparently felt that this building was typical of houses and therefore of the available timber for the early period.

24. Marjorie Winkler, personal communication.

25. Although metes and bounds surveys have traditionally been associated with the indiscriminate location surveys of the South, William Pattison notes they were also employed in New England in the early eighteenth century: *Beginnings of the American Rectangular Land Survey System, 1784–1800* (Columbus: Ohio Historical Society, 1970), pp. 80–81. The more publicized rectangular survey system was more representative of New England in the later half of the eighteenth century; Amelia C. Ford, *Colonial Precedents of Our National Land System as it Existed in 1800* (Philadelphia: Porcupine Press, 1976), p. 26.

26. Ancient Records, vol. 1, pp. 230a, 230b.

27. Most investigators feel the early land survey records are of value in reconstructing the vegetation of the colonial period. See Robert P. McIntosh, "The Forest Cover of the Catskill Mountain Region, New York, as Indicated by Land Survey Records," *The American Midland Naturalist* 68 (October 1962): 409–23, and Herbert I. Winer's conclusion that "with due allowance for bias and stratification, [these records] may properly be considered as a sample of the town as a whole" ("History of the Great Mountain Forest, Litchfield County, Connecticut," Ph.D. diss. [Yale University, 1955], p. 97).

28. Unfortunately the earliest surveys did not distinguish pines according to species. For the reasons cited earlier, however, a majority of the pines were probably pitch pines.

29. Thoreau, *Journal*, vol. 14, pp. 224–49.

30. Ibid., pp. 183, 229–30, and 247. See also Thoreau's "The Succession of Forest Trees," in Robert Sattelmeyer, ed., *Henry David Thoreau: The Natural History Essays* (Salt Lake City: Peregrine Smith, 1980), p. 78. Kurt Kehr, "Walden Three: Ecological Changes in the Landscape of Henry David Thoreau," p. 31, notes that this essay by Thoreau was first published in the New York *Tribune* (6 October 1860). White pine's association with the more open areas of the woods has been corroborated in more recent studies. See David E. Hibbs, "White Pine in the Transition Hardwood Forest," *Canadian Journal of Botany* 60 (October 1982): 2046–53.

31. William Wood, *New England's Prospect* (1634, reprinted, Alden T. Vaughan, ed., Amherst: University of Massachusetts Press, 1977), p. 38.

32. Edward Johnson, *Wonder-Working Providence of Sions Saviour in New England, 1628–1651* (1654, reprinted, J. Franklin Jameson, ed., New York: Charles Scribner's Sons, 1910), p. 85.

33. Thoreau, *Journal*, vol. 7, p. 133. The greater fire resistance of the oaks has been noted by a number of contemporary investigators. See Dilwyn J. Rogers, *Some Effects of Fire in Southern Wisconsin Woodlots*, University of Wisconsin Forestry Research Note no. 51 (Madison, 1959), p. 2; James H. Brown, Jr., "The Role of Fire in Altering the Species Composition of Forests in Rhode Island," *Ecology* 41 (April 1960): 310–16.

Forest Composition and Dynamics in the Nineteenth Century

The gradual decline of Concord's woods can be traced in old maps, provincial tax records, and state census records.[34] During Thoreau's lifetime, the percentage of the town in woodlands dropped to its lowest level (10.5 percent in 1850). Concord's original forests were destroyed so rapidly that by 1860 Thoreau could state that "of the primitive wood, woodland which was woodland when the township was settled . . . I know of none."[35] The remaining woods in the nineteenth century were exploited extensively for timber, fuel, and pasturage. Many were carelessly managed. Thoreau noted, "the history of a woodlot is often, if not commonly, here, a history of cross-purposes, —of steady and consistent endeavor on the part of Nature, of interference, and blundering with a glimmer of intelligence at the eleventh hour on the part of the proprietor."[36] Partly out of curiosity and partly from more utilitarian motives, Thoreau spent many of his last years attending to the history of Concord's woodlots. Thoreau's article on the succession of forest trees, his journal entries, and his unpublished manuscript on the dispersal of seeds provide a graphic picture of Concord's forests in the middle of the nineteenth century. Thoreau's classification of Concord's woodlots and his schematic concept of their development anticipated the more detailed successional diagrams of the twentieth century.

Thoreau's categories were an attempt to merge the normal processes of forest succession with the more retrogressive influences of man's activities. *Wood pastures*, *copsewoods*, *primitive woods*, *primitive woodlands*, and *new woods* all figured prominently in Thoreau's vocabulary.[37] *Wood pastures* were old oak woods that had gradually been thinned out by grazing until they became "open, grassy, and park-like."[38] Woodland areas which had been cut or thinned from time to time, yet always maintained their continuity with the presettlement forest, fell under the heading of *primitive woodlands*.[39] *Copsewoods*, stands of oaks that had been cut off repeatedly for fuel, formed a large share of the area's primitive woodland in the nineteenth century. Much of Concord's local supply of wood

34. See the legend for the graph of "Changes in the Extent of Woodland and Grasslands in Concord Since Settlement," which accompanies this article.

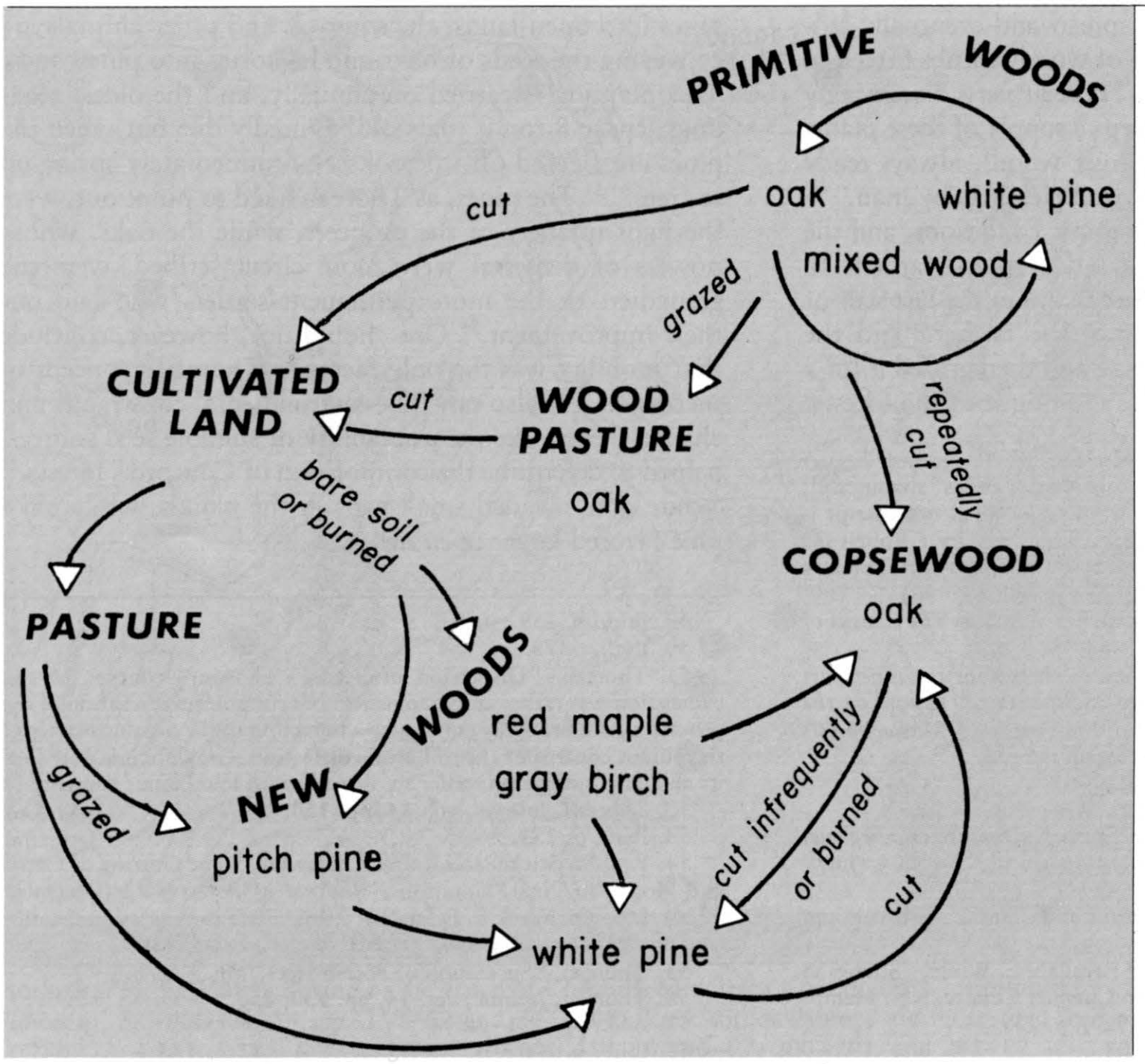
35. Thoreau, *Journal*, vol. 14, p. 158.

36. Ibid., p. 132.

37. For Thoreau's formal system of wood classification, see his *Journal*, vol. 14, pp. 158–59.

38. Ibid., p. 219.

39. Ibid., p. 159.



Patterns of Forest Succession in Nineteenth-Century Concord

SOURCE: Based on Thoreau's journal entries

was eventually destined for the maw of the wood-burning locomotive or the fireplaces of Concord and Boston.[40] Data taken from the Massachusetts Agricultural Census for the Concord area suggest the coppice cycle, or the interval between cuttings, varied with the different species.[41] The rapidly growing birch was harvested on a ten- to twenty-year cycle, but maples were cut at twenty- to twenty-five-year intervals. Oak woods were generally harvested three times during the course of a century.[42] If the interval exceeded fifty to sixty years, the oak sprouts were feeble or failed entirely and the wood reverted to pines.[43]

Thoreau's journals and manuscripts provide a wealth of information on the response of the ground vegetation to coppice management in the nineteenth century. The earliest phases of the coppice cycle, recently cut oak woods or land dominated by sprouting oaks, frequently supported a rather transient community of weedy, sun-loving plants.[44] Cinquefoil and blackberry grew from seeds that had lain dormant on the forest floor. The light seeds of fireweed, hawkweed, goldenrod, and senecio were blown into the forests by the wind from the surrounding countryside.[45] The alternation of light and shade also encouraged the more gradual rise and fall of another group of relatively shade-intolerant species. Some, such as black cherry, flourished for a short time after the woods were cut but were soon shaded out by the rapidly growing oak sprouts.[46] Other species, notably the blueberries and the huckleberries, maintained a very precarious position under the closed forest canopy. Cutting the trees helped such plants to spread and eventually culminated in a dense ground cover of woody shrubs fifteen to thirty years after the felling.[47] Thoreau very discerningly commented that "nature thus keeps a supply of these plants in her nursery (i.e., under the larger wood), always ready for casualties, as fires, windfalls, and clearings by man."[48]

Soil exhaustion, changing economic conditions, and the attraction of richer lands in the Midwest led farmers to abandon some of Concord's cleared land in the last half of the nineteenth century. Frequently the farmer "laid the exhausted field down" as a pasture and then grazed it for a period of time before finally abandoning it to the forests. *New woods* sprang up on land which had been cultivated or cleared long enough to kill all the roots in it.[49] Mineral soil or land that had been plowed recently favored light-seeded, wind-dispersed species like gray birch and red maple. If the seed fell on plowed soil, if cultivation was discontinued after the seed germinated, and if cattle were kept out, a maple wood soon appeared.[50] If the soil was exhausted, it came into a birch wood.[51] Old fields or abandoned pastures, covered with turf, favored a different array of plants. Pitch pines were the first species to invade such fields. White pine then seeded in under the older pitch pines.[52] As Thoreau explained these shifts,

> The custom with us is to let the pines spread thus into the pasture, and at the same time to let the cattle wander there and contend with the former for the possession of the ground, from time to time coming to the aid of the cattle with a bush-whack. But when, after some fifteen or twenty years, the pines have fairly prevailed over us both, though they have suffered terribly and the ground is strewn with their dead, we then suddenly turn about, coming to the aid of the pines with a whip, and drive the cattle out.[53]

Grazing restricted the development of the more palatable hardwoods to an even greater degree and was probably responsible for the conversion of many mixed woods to pine.[54]

The inhabitants of Concord frequently queried Thoreau as to why oaks sprang up where pines had been cut down. He replied that "while the wind is conveying the seeds of pines into open lands, the squirrels and other animals are conveying the seeds of oaks and hickories into pinewoods. This planting is carried on annually, and the oldest seedlings [those 8 to 10 years old] annually die; but when the pines are cleared off, the oaks . . . immediately spring up to trees."[55] The pines, as Thoreau liked to point out, were the light infantry or the pioneers, while the oaks, whose powers of dispersal were more circumscribed, were the grenadiers or the more permanent settlers who laid out their improvement.[56] One should not, however, conclude that mobility was the only factor in Thoreau's concept of succession. He also saw that environmental constraints and chance events, like the availability of suitable seed sources, helped to determine the composition of Concord's forests.[57] White pine invaded small gaps in the woods, while pitch pine favored larger openings.[58]

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40. Transcript of Thoreau's "The Dispersion of Seeds" manuscript, Thoreau Textual Center, Princeton University (original manuscript is part of the Berg Collection, New York Public Library); Robert A. Gross, "Culture and Cultivation: Agriculture and Society in Thoreau's Concord," *Journal of American History* 69 (June 1982): 50.

41. See Massachusetts Bureau of Statistics of Labor, *The Census of Massachusetts: 1885*, vol. 3 (Boston, 1887), p. 875.

42. The rotation periods for the various species for the most part substantiate the values cited in George B. Emerson, *A Report on the Trees and Shrubs Growing Naturally in the Forests of Massachusetts* (Boston: Dutton and Wentworth, 1846), pp. 25–26.

43. Thoreau, *Journal*, vol. 14, pp. 212–13.

44. Ibid., pp. 122 and 222; Thoreau, "Dispersion of Seeds."

45. Peter Del Tredici, "The Buried Seeds of *Comptonia peregrina*, the Sweet Fern," *Bulletin of the Torrey Botanical Club* 104 (July–September 1977): 270–75.

46. Thoreau, "Dispersion of Seeds," and *Journal*, vol. 14, pp. 122–23.

47. Thoreau, "Dispersion of Seeds"; Wallace E. White, "Studies in Natural Reproduction of White Pine in Cheshire County, New Hampshire," (Ph.D. diss., Yale University, 1929), p. 159.

48. Thoreau, *Journal*, vol. 14, p. 103.

49. Ibid., p. 159.

50. Ibid., p. 73.

51. Thoreau, "Dispersion of Seeds." Thoreau's concept of soil exhaustion was rather ambiguous. A more current interpretation of the process would probably emphasize a reduction in the organic matter or the humus content of the soil after cultivation. Gray birch is noted for its ability to survive on rather sterile soils with low humus content.

52. Thoreau, *Journal*, vol. 14, pp. 150, 192.

53. Ibid., p. 151.

54. Paul W. Stickel and Ralph C. Hawley, "The Grazing of Cattle and Horses in Pine Plantations," *Journal of Forestry* 22 (December 1924): 846–60; Frank E. Egler, "Berkshire Plateau Vegetation, Massachusetts," *Ecological Monographs* 10 (April 1940): 145–92.

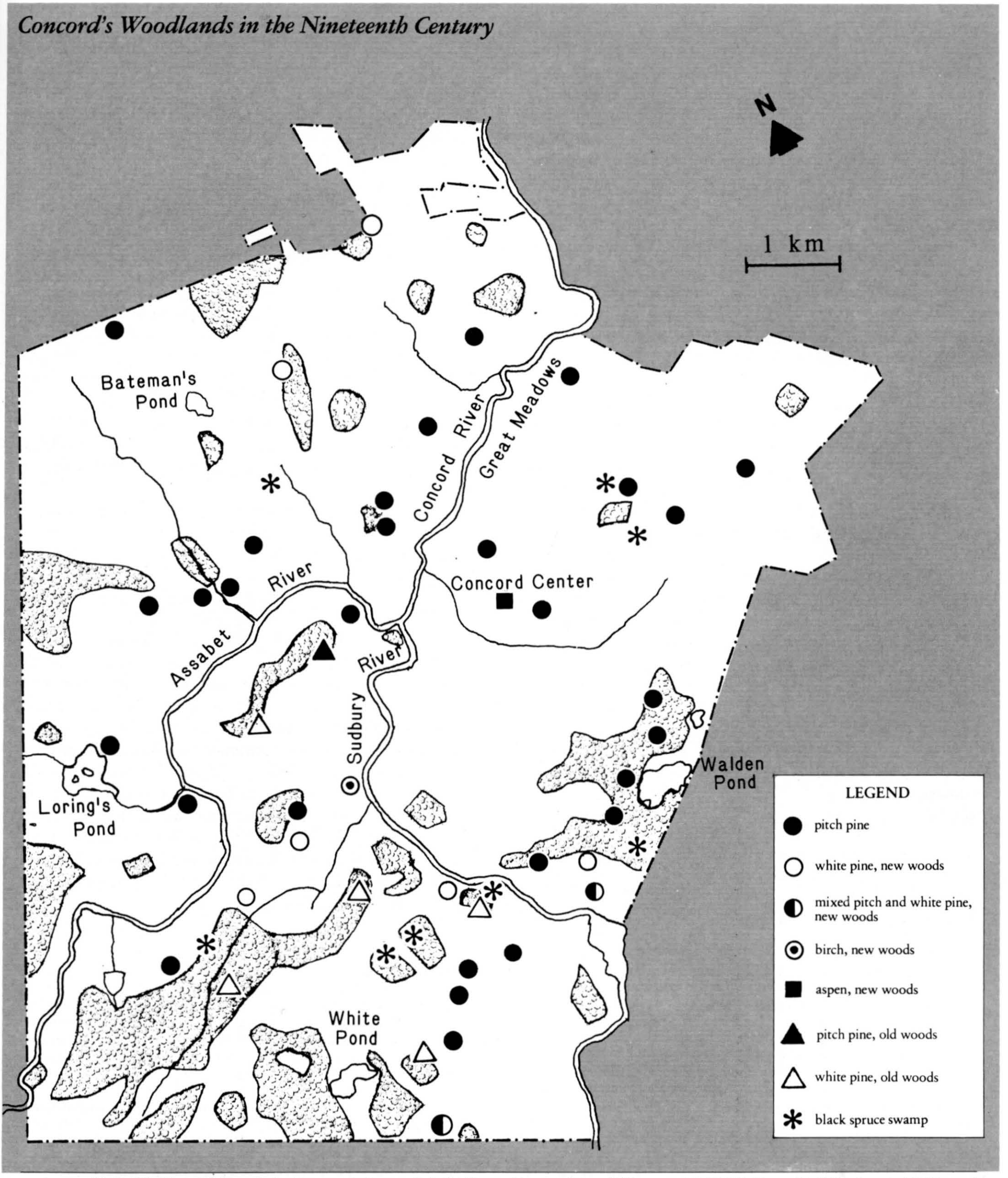
55. Thoreau, "Succession of Forest Trees," pp. 77, 78.

56. Thoreau, *Journal*, vol. 14, pp. 130, 150.

57. Ibid., pp. 131–32.

58. Ibid., p. 200.

Concord's Woodlands in the Nineteenth Century



SOURCES: H. F. Walling, "Map of the Town of Concord, Middlesex County Mass." (Boston: H. F. Walling, Civil Engineer, 1852), and Thoreau, *Journal*, vol. 14, pp. 159–62 and 207–208. Black spruce swamps are those cited in Thoreau's *Journal*, volumes and pages 1:270–72, 4:231, 5:185, 6:22 and 54, 7:108 and 414, 10:196–97, 200–201, and 281–82.

Thoreau's analysis gives us much less information about the extent and abundance of Concord's forest cover than about the factors contributing to its formation. By combining Walling's map of the woodlands of Concord and Thoreau's comments on the various types of woodlots, however, one can construct a map of Concord's woods in the 1850s.[59] Thoreau stated "to speak from recollection . . . I should say that our woods were chiefly pine and oak mixed, but we have also . . . pure pine and pure oak woods."[60] Surrounding the older framework of primitive oak and pine woodlands were a number of newly formed woods. Thoreau systematically listed many of the new woods, entering notes as to their origin, composition, and location.[61] The new woods were composed overwhelmingly of pitch pine. Thoreau attributed pitch pine's abundance to its very "seedy" nature, i.e., its ability to bear a reliable crop of cones at a very early age.[62]

One of Thoreau's major occupations was the surveying of woodlots, and his surveys and field notebook contain a number of references to trees that marked the boundaries of property lines.[63] Counting the number of trees by species produces at least a crude estimate of the composition of Concord's woodlots in the 1850s. Although the question of the surveyor's biases often arises, the results of Thoreau's surveys closely parallel information on the relative abundance of the various species of trees in his journal.[64] Oaks and pines, particularly pitch pine, predominate with a scattering of other hardwood species. Several species that normally occur early in succession, such as red maple and gray birch, also appear in at least moderate numbers.

Current Status of Woodlands in Concord

Concord's integration into the economic life of the larger Boston metropolitan area significantly altered the area's agricultural practices and land-use patterns. Generally the shift from dairy farming in the nineteenth century to market gardening in the twentieth century entailed a shift from grazing on the uplands to more intensive agriculture on the river terraces and meadows.[65] Many of the pastures in the shallow, stony upland areas reverted to woodland. Although Concord is a suburb of Boston and was part of the building boom after World War II, woodlands still cover 50 percent of the town. Approximately 58 percent of the woodland acreage is in mixed hardwoods and conifers, 36 percent is in hardwood stands, and only 5 percent is covered by conifer stands (largely eastern white pine).[66]

Table 1 summarizes the species composition of the woodlands in Concord, based on a plotless sampling scheme used in 1981 at thirteen sites originally surveyed by Thoreau. The sites, which were used to construct column 3 of the table, represent a wide range of topographic and moisture conditions.[67]

Table 1.
Representation of Trees in Early and Recent Land Surveys of Concord (as Percentages of Trees Mentioned)

	Ancient Records of Concord, 1676–1750	Thoreau's survey, 1849–1860	Recent[1] survey, 1981
Oaks			
Unspecified oaks[2]	0	20.9	0
White oak	27.3	14.4	8.9
Black and scarlet oak	26.3	3.6	20.8
Red oak	7.2	1.4	19.2
Scrub oak[3]	0.3	1.4	0
Swamp white oak	0.6	1.4	0
Oak total	*61.7*	*43.1*	*49.6*
Other hardwoods			
Miscellaneous hardwoods[4]	1.9	11.5	5.7
Hickory	9.4	3.6	0.8
Chestnut	3.8	5.0	0
American elm	1.2	4.3	1.8
Birch (largely gray)	0.6	5.0	2.6
Red maple	2.8	13.0	16.0
Pines			
Unspecified pines[2]	18.2	0.7	0
Pitch pine	0	8.6	0.2
White pine	0.3	5.0	23.1
Pine total	*18.5*	*14.3*	*23.3*
Sample size or no. trees recorded in survey	319	139	569

1. These data were collected along a transect at each of thirteen sites. Each transect consisted of five sample points spaced at approximately eighty-foot intervals (twenty-five meters). Sampling at each point followed the Bitterlich or point sampling technique for all trees with a diameter at breast height (dbh) greater than five inches. Basal area values were determined for each diameter size class and converted to density values by dividing the total basal area value for each size class by the average basal area per tree for that size class. The resulting density values summed over all the size classes were then averaged over the thirteen sites and converted to relative density values, i.e., (number of individuals of a species ÷ total number of individuals of all species) × 100.

2. Entries listed simply "oak" or "pine."

3. Includes *Quercus ilicifolia* and *Quercus prinoides.*

4. Includes sugar maple, white ash, black cherry, hop-hornbeam, sassafras, aspen, and willow.

59. See the legend for the map of "Concord's Woodlands in the Nineteenth Century," which accompanies this article.

60. Thoreau, *Journal*, vol. 14, p. 183.

61. Ibid., pp. 159–61.

62. Thoreau, "Dispersion of Seeds."

63. The field notes have been published in facsimile in Kenneth W. Cameron, *Thoreau's Canadian Notebook and Record of Surveys* (Hartford: Transcendental Books, 1967). The surveys are maintained in the Concord Free Public Library. For a review of the holdings, see Marcia Moss, *A Catalog of Thoreau's Surveys in the Concord Free Public Library* (Geneso, New York: Thoreau Society Booklet no. 28, 1976).

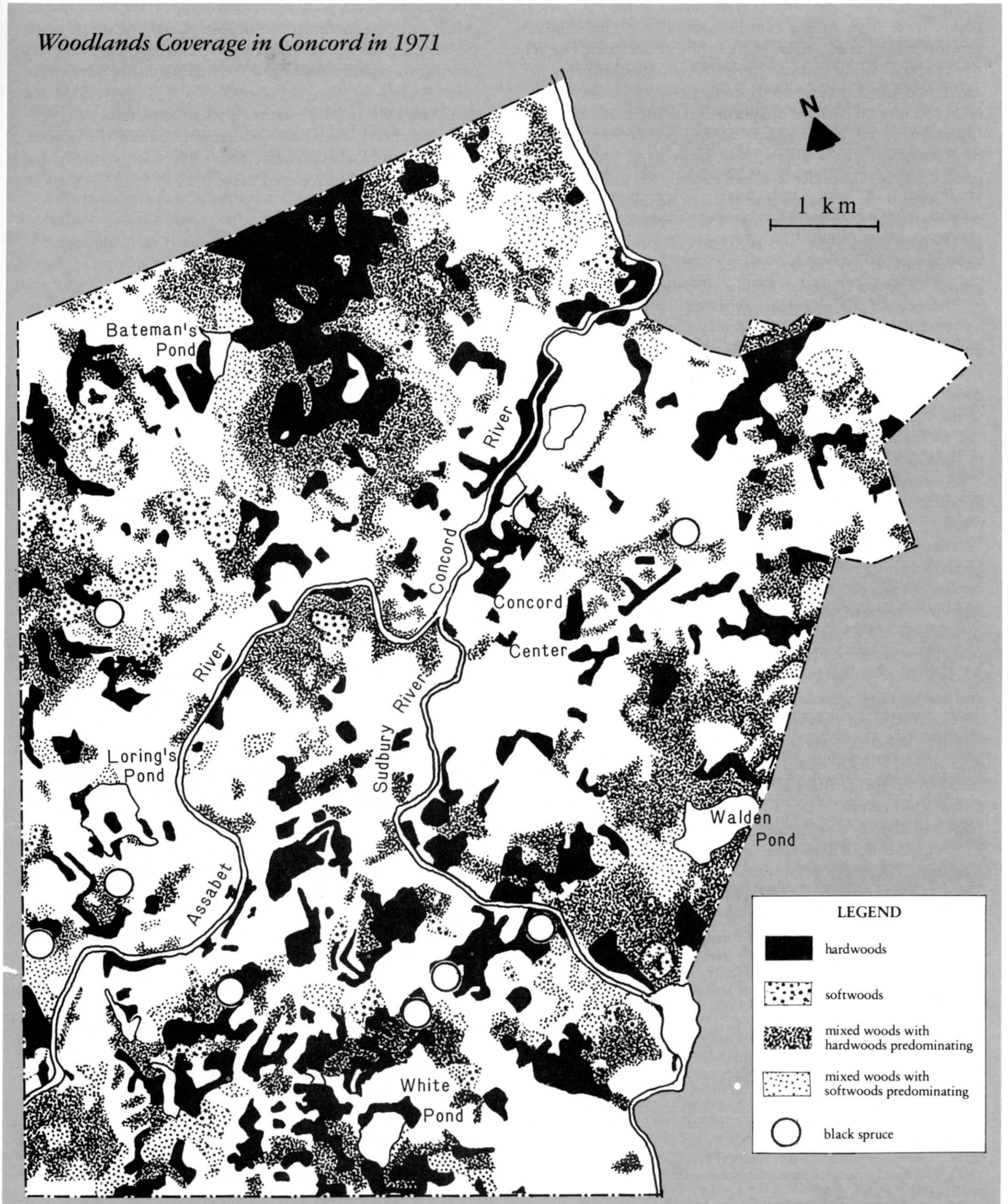
64. Thoreau, *Journal*, vol. 14, p. 134.

65. Edward Ackerman, "Sequent Occupance of a Boston Suburban Community," *Economic Geography* 17 (January 1941): 61–74; Ludlow Griscom, *The Birds of Concord* (Cambridge: Harvard University Press, 1949), pp. 58–59.

66. MacConnell and Cobb, *Remote Sensing 20 Years of Change in Middlesex County, Massachusetts, 1951–1971*, p. 79.

67. See the note accompanying table 1 for details of the sampling scheme.

Woodlands Coverage in Concord in 1971



SOURCE: William P. MacConnell and Marcia Cobb, *Remote Sensing 20 Years of Change in Middlesex County, Massachusetts, 1951–1971*, Research Bulletin no. 622 (Amherst: Massachusetts Agricultural Experiment Station, 1974).

Although oaks and pines still dominate Concord's landscape, there have been a number of shifts in the relative proportions of the species. White pine's "meteoric rise to prominence" in the last one hundred years can probably be attributed to its prolific seed production, its ability to invade abandoned or semi-abandoned pasture land, and the initiation of an active policy of fire prevention.[68] Pitch pine, in contrast, is a relatively short-lived species and cannot regenerate under a closed canopy. Stands of pitch pine begin to deteriorate rapidly after one hundred years.[69] Although pure stands of pitch pine were relatively common in Thoreau's time, they are extremely rare today; the only one of any extent occurs on extremely coarse textured glacial deposits south of Second Division Brook, in the southwestern corner of the town.[70]

The cessation of fires probably facilitated the spread of another fire-sensitive species: red oak. Red oak can tolerate shade fairly well and therefore characterizes the later stages of succession on well-drained sites throughout Massachusetts.[71] Table 1 substantiates Eaton's claim that red oak is one of the more abundant, if not the most abundant, oak in the Concord area today.[72]

Concord's flora includes a number of relatively rare northern species, notably black spruce and tamarack, which reach their southernmost limits in the peat swamps and "kettle hole" (depressions formed by melting blocks of glacial ice) bogs of southern New England. Although less is known of their absolute abundance, several lines of evidence suggest that both the numbers and the acreage of black spruce and tamarack have declined dramatically over the years. The numerous references to spruce "swamps" in the Ancient Records of Concord suggest that cold sphagnum and spruce bogs were among the more prominent features of Concord's early landscape. Some were "mined" for fertilizer and others were drained and converted to pasture or cropland.[73] Although Thoreau could still speak of Concord's black spruce bogs as "oases of wildness in the desert of our civilization," several of the larger, more accessible bogs had already disappeared by his time.[74] In his journals Thoreau mentioned several sites where black spruce was common. Gleason's photograph of one of the bogs and Thoreau's description of several others suggest that many of the sites were relatively open areas supporting a number of moderately shade-intolerant shrubs.[75] Only one of the bogs, Gowing's black spruce "swamp," currently approaches its nineteenth-century description. The remainder have either been drained or have developed into heavily wooded red maple and white pine swamps with an understory of high-bush blueberry and alder-buckthorn.[76] Like the spruce, tamarack and Atlantic white-cedar have also virtually disappeared from the Concord area.[77]

Conclusions

Thoreau once wrote that

> no one has yet described for me the difference between the wild forest which once occupied the oldest townships, and the tame one which I find there to-day. The civilized man not only clears the land permanently to a great extent, and cultivates open fields, but he tames and cultivates to a certain extent the forest itself. By his mere presence, almost, he changes the nature of the trees as no other creature does.[78]

Clearly, human activities have greatly altered the landscape and by implication the species composition of New England's forests. It is important to emphasize, however, that the resulting product may vary from one location to the next and can only be addressed by a combination of ecological fieldwork and archival research at a specific site. The current study, as well as Raup's and Carlson's classic analysis of land use on the Harvard Forest in central Massachusetts, suggest we are dealing with "not one but innumerable local histories."[79]

Concord lies on the eastern edge of an area traditionally known as the white pine region or the transition hardwoods–white pine–hemlock region. White pine, red oak, and to a lesser degree red maple are among the more representative species of this association or region.[80] Yet the transition white pine–northern red oak–red maple forest type in Concord may largely be a creation of the last 150

68. See Hugh M. Raup, "Recent Changes of Climate and Vegetation in Southern New England and Adjacent New York," *Journal of the Arnold Arboretum* 18 (April 1937): 79–117, for white pine's rise, and Stephen H. Spurr, "Forest Associations in the Harvard Forest," *Ecological Monographs* 26 (July 1956): 245–62, for some of the factors responsible for its increase.

69. Joseph S. Illick and John E. Aughanbaugh, "Pitch Pine in Pennsylvania," Pennsylvania Department of Forests and Waters Research Bulletin no. 2 (Harrisburg, 1930), pp. 28, 32.

70. Ray Angelo, personal communication. Angelo, one of the more knowledgeable botanists of the area, has written several guides to the woody plants of the region, including *Concord Area Trees* (1976) and *Concord Area Shrubs* (1978), published by the Concord Field Station of the Museum of Comparative Zoology, Harvard University.

71. Stephan H. Spurr, "Forest Associations in the Harvard Forest," pp. 256–61.

72. Eaton, *A Flora of Concord*, p. 106.

73. Shattuck, *A History of the Town of Concord*, pp. 197–98; Griscom, *The Birds of Concord*, p. 62.

74. Thoreau, *Journal*, vol. 9, p. 44.

75. Herbert W. Gleason, unpublished photograph, taken 10 July 1900, of the Holden Swamp, also known as the *Kalmia glauca* Swamp. The photograph is in vol. 4, second series, of a collection of photographs entitled "Thoreau's Photographs" on file in the Concord Free Public Library. For the location and description of the bogs see Thoreau, *Journal*, vol. 4, p. 231; vol. 7, p. 108; and vol. 10, pp. 196–97 and 200–201. Labrador-tea, bog-rosemary, leatherleaf, bog laurel (*Kalmia glauca* now *Kalmia polifolia*), and cranberries were characteristic of the bogs.

76. Alder-buckthorn (*Rhamnus frangula*) is a European species that was introduced early in the twentieth century and is now thoroughly naturalized throughout the wetlands of Concord.

77. Eaton, *A Flora of Concord*, pp. 62–63.

78. Henry David Thoreau, *The Maine Woods* (1864, reprint edition, Boston: Houghton and Mifflin, 1893), pp. 205–206.

79. Clarence J. Clacken, *Traces on the Rhodian Shore* (Berkeley: University of California Press), p. 336. Although there are similarities between the conclusions drawn here about Concord's forests and the findings of Hugh M. Raup and Reynold E. Carson, "The History of Land Use in the Harvard Forest" *Harvard Forest Bulletin no. 20* (Petersham, 1941), pitch pine and fires were apparently not as prevalent in the early forests of Petersham.

80. Note map in Marinus Westveld, et al., "Natural Forest Vegetation Zones of New England," *Journal of Forestry* 54 (May 1956): 332–38.

years. None of these species (white pine, red oak, and red maple) approached its current level of abundance in the presettlement forests of Concord. The Indians' use of low-level surface fires was probably the major reason for the low representation of white pine and red oak in the presettlement and early colonial forest. Conversely the fires probably favored the maintenance of white oak and pitch pine.

The advent of the Europeans set the stage for a new train of events and a shift in forest composition. The interpolation of farmlands between the remnant forest stands and the conscious suppression of fires by farmers permitted the expansion of the more fire-sensitive species on the uplands. Thoreau reported that one of the early eighteenth-century inhabitants of the nearby town of Duxbury had recorded the occurrence of the first white pine in the town. By 1793 an eighth of the woodland was covered with white pine.[81]

Many species were not as successful under the new fire-free conditions. The decline of white oak in the nineteenth and twentieth centuries in Concord was part of a broader pattern of decline only recently documented in the Midwest and the Midatlantic region.[82] The shift from the more fire-resistant white oak to the more fire-sensitive yet shade-tolerant red oak likewise finds a number of parallels in the upper Midwest, where the development of relatively even-aged stands of red oak has been traced to European settlement and the cessation of fires.[83]

From a historical perspective, the European pattern of forest exploitation substituted a disturbance regime based on cutting for a disturbance regime based on fire. Most of the remaining woodlots in Thoreau's time were exploited intensively for fuel and timber. Recurrent fires tended to favor the more fire-resistant species over time, but harvesting tended to reduce the numbers of the more marketable species, beginning with the most valuable—in New England, white pine and white oak—and working toward the less valuable. White pine has always been one of the most sought-after timber species of North America. Thoreau reported that white pine had been harvested so assiduously by his time that individuals ten to twenty inches in diameter were considered large for Concord.[84] Part of white oak's decline in the nineteenth century may be attributed to a similar set of factors. Its strength and durability made it a popular material for shipbuilding, framing, and staves in casks. By 1824 the botanist Jacob Bigelow could state that heavy consumption had made white oak relatively rare in the Boston area.[85] Chestnut had a more mixed history. At least initially, cutting for fuelwood probably favored chestnut, as a prolific sprouter. By the 1860s, however, chestnut had graduated from use as fuel to use in railroad ties and planks, and Thoreau observed that the species was rapidly disappearing.[86]

Pitch pine managed to maintain its dominance at least up to the middle of the nineteenth century, yet now it is a relatively inconspicuous member of Concord's woods. Thoreau's comments suggest that much of the land in Concord in the early nineteenth century was cleared, briefly used for cropland or pasture, and then allowed to revert to woodland.[87] On Concord's poor, sandy soils, the use of a forest fallow was probably more a matter of expediency or necessity rather than part of a conscious long-term conservation strategy. Wood was always a marketable commodity, and extended forest fallows allowed worn-out fields to build up their organic matter and regain their fertility. Pitch pine was the major beneficiary of these rapid shifts in land use because it could bear seed at an early age and grew rapidly on the poorer soils. As Emerson noted, "on sandy plains, too poor for profitable cultivation, and where only a single scanty crop of winter rye could be raised . . . I have observed the pitch pines gradually encroaching on the deserted fields, . . . making an average of twelve or fifteen feet in height in ten years."[88] Pitch pine's long-term maintenance, however, was tied to the production (by regular human intervention in most cases) of disturbed sites. As a result, it is not surprising that the permanent abandonment of the upland pastures late in the nineteenth century saw the development of a new series of woodlands composed of the more shade-tolerant white pine and red maple.[89]

One hundred and twenty years have elapsed since Thoreau roamed the fields and woods of Concord. The woods have regained much of their lost ground. The wall that once separated a pasture from a pine woodlot now divides a pine wood from an oak wood. It is difficult to determine what the next one hundred years will bring, whether the history of Concord's woodlots will still be one of cross purposes or instead of conscious design. Thoreau once stated that "if we attended more to the history of our woodlots we should manage them more wisely."[90] Perhaps a better appreciation of the impact of past management practices will help us to provide better designs for the future. ▲

81. Thoreau's comments are from the "Dispersion of Seeds" manuscript. His source of information was "A Topographical Description of Duxborough, in the County of Plymouth," *Massachusetts Historical Society, Collections*, 1st series, vol. 2 (Boston, 1810): 3–8.

82. Catherine Keever, "Distribution of Major Forest Species in Southeastern Pennsylvania," *Ecological Monographs* 43 (Summer 1973): 303–27; Gordon G. Whitney and William J. Somerlot, "A Case Study of Woodland Continuity and Change in the American Midwest," *Biological Conservation* 31 (no. 3, 1984): 265–87.

83. John B. Marks, "Land Use and Plant Succession in Coon Valley, Wisconsin," *Ecological Monographs* 12 (April 1942): 113–33; Harold F. Scholz, "Age Variability of Northern Red Oak in the Upper Mississippi Woodlands," *Journal of Forestry* 50 (July 1952): 518–21.

84. Thoreau, "Succession of Forest Trees," p. 79.

85. Jacob Bigelow, *Florula Bostoniensis: A Collection of Plants of Boston and its Vicinity* (Boston: Cummings, Hilliard, and Co., 1824), pp. 349–50.

86. Thoreau, *Journal*, vol. 14, p. 137. The introduction of the chestnut blight (*Endothia parasitica*) in 1910–20 virtually eliminated chestnut as a species of any importance in the "sprout hardwood forests" of southern New England.

87. Thoreau, *Journal*, vol. 14, p. 159. Thoreau called such areas "interrupted woodland."

88. Emerson, *Report on the Trees and Shrubs*, p. 70.

89. Marjorie Winkler has also documented the decline of pitch pine and the rise of white pine in her pollen profile of the sediment core taken from Walden Pond (personal communication).

90. Thoreau, *Journal*, vol. 14, p. 126.