Frontiers of Plant Science

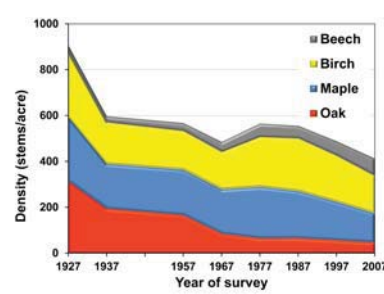
A REPORT FROM THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

IN THIS ISSUE

American chestnut bur with nuts

Seedling of Charter Oak

This picture shows our first field day in Hamden in 1910 with some of the attendees who may have just gotten off the trolley



Stand density (stems/acre) by species group and survey year for Old-Series plots in central Connecticut

Volume 58
Number 1
Summer 2010
ISSN: 0016-2167
www.ct.gov/caes

History of Chestnut Research at The Connecticut Agricultural Experiment Station

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American chestnut trees were once well-known in the eastern United States as valuable timber trees. The wood resists rotting and was made into telegraph poles, railroad ties, and fencing. A photograph that I have often used to illustrate how these mature trees looked was made in the town of Scotland in 1905, and the notes say that it was 83 feet tall, 27 inches in diameter, and 103 years old (Figure 1). This was published in 1906 in The Connecticut Agricultural Experiment Station (CAES) Bulletin #154, as part of a forestry project on improving the privately-owned woodlots in the state [1]. In 1910, chestnut was the most important hardwood tree in Connecticut, comprising approximately half of all of the timber in the state. Chestnut wood was also used extensively in building materials and woodwork, and in many other products (Table 1) [2].

Farmers frequently left a single chestnut tree in their fields. These provided shade for cattle and a source of nuts, since the tips of the branches were exposed to full sun, which led to increased nut production on the tree (Figure 2). In contrast, chestnuts planted too closely together have limited exposure to the sun at branch tips so they do not produce as many nuts as those with full sun exposure. Large orchards of chestnut trees, primarily consisting of European species, were planted in New Jersey and Pennsylvania; several small orchards were also planted by nut growers in Connecticut [3].

Unfortunately, in the summer of 1904, some of the American chestnut trees in the New York Zoological Park were found to be suffering from a bark disease that resulted in the wilting and death of all the twigs, branches, or trunks beyond the cankered bark areas [4]. Small trees in the nursery of the New York Botanical Garden, adjacent to the Zoo, were also killed by this disease, which seemed to be caused by a fungus. William Murrill of the New York Botanical Garden used spores of this fungus to inoculate small chestnut trees in the greenhouse, and thus proved that the disease seen on the larger trees was caused by the same fungus [5]. Samples were sent to the U. S. Department of Agriculture (USDA) in June of 1905 for identification, and mycologist Flora Patterson determined that the fungal pathogen was in the genus *Cytospora*. There were no previous reports of members of this genus causing disease on chestnut trees [6]. Lethal bark cankers continued to develop on native chestnuts and on European chestnut trees grown in this country for their nuts.

By 1910, this disease was found throughout New York City, on Long Island, in New Jersey, along the Hudson River as far north as Poughkeepsie, as well as in Connecticut, Massachusetts, Maryland, Washington, D.C., and Virginia. Large trees that had been left in fields for shade and nut production were killed, as were trees planted for shade near homes, trees in woodlots, and trees planted in orchards for nut production.

George P. Clinton was a plant pathologist at CAES from 1902 to 1937 (Figure 3), and he strongly maintained that this bark disease was caused by a native, not an introduced fungus. He speculated that it was killing trees because of the unusually dry weather that besieged the eastern United States for several years [7]. His was a minority opinion. Clinton recorded the results of scouting for the bark disease throughout Connecticut and produced maps that showed that chestnut trees in the southwestern part of the state were found to have the disease in 1908. By 1912, the disease was found throughout Connecticut (Figure 4) [7]. No efforts to control this disease were effective; no chemical sprays were useful and cutting and burning trees at the edges of infected woodlots or in forests did not stop the spread of this deadly pathogen.

Early papers referred to this disease as chestnut bark disease, but we know it now as chestnut blight disease. Murrill formally named the fungus *Diaporthe parasitica* in 1906, after extensive research on the growth of the pathogen [8]. Paul J. Anderson (Figure 5) studied this disease for his thesis at Cornell University in 1913, and renamed it *Endothia parasitica* [9]. Anderson worked as a field pathologist for the Pennsylvania Tree Blight Commission before taking a position at the University of Massachusetts where he worked on rose canker and tobacco diseases. He then moved to Connecticut to become head of the CAES Tobacco Research Station in Windsor, where he worked until 1953. The name of the chestnut blight disease pathogen was changed to *Cryphonectria parasitica* by Margaret Barr from the University of Massachusetts in 1978 [10].

The chestnut breeding project in Connecticut was started by plant pathologist Arthur H. Graves (Figure 6). He obtained his first Asian chestnut trees from the USDA in 1929, and, in 1930, began making crosses with Japanese chestnut trees on Long Island using American chestnut pollen from Washington, D.C. Graves was soon joined in this project by Donald F. Jones, a well-known geneticist at CAES and head of the Genetics Department (Figure 7). Jones planted chestnuts at the CAES laboratory property in New Haven, at the CAES research farm, Lockwood Farm, in Hamden, and at his home in Hamden. Graves retired from his job at the Brooklyn Botanical Garden in 1947 and began to work full time with Jones on chestnut breeding. In 1949, Graves sold 8.3 acres of his land in Hamden to the Sleeping Giant Park Association, who then gave it to the State of Connecticut, stipulating that the property was to be used by CAES for tree breeding experiments. Graves and Jones supervised the graduate research of two Yale University students: Hans Nienstaedt (Figure 8), who made chestnut crosses and wrote his doctoral thesis on chestnuts in 1951, and Richard A. Jaynes (Figure 9), whose thesis work on chestnut (1961) continued when he joined the staff of CAES in 1961. Graves continued to plant imported trees and hybrids on the land he had given to the State of Connecticut; this land became known as “The Chestnut Plantation at Sleeping Giant.” This is probably the finest collection of species and hybrids of chestnut in the world. Jaynes and Graves released several superior nut-producing cultivars to the nursery industry from their breeding program [11].

While Jaynes continued the breeding program, work on the fungus that caused chestnut blight disease was revived by Peter Day (Figure 10), who became head of the CAES Genetics Department in 1964. Plant pathologists John Elliston (Figure 11) and Neil Van Alfen (Figure 12) then studied the pathology of the disease, and John Puhalla (Figure 13) worked on the genetics and physiology of the pathogen [12]. I worked with Puhalla on the blight fungus and with Jaynes on chemical control of blight (Figure 14) [13]. I was given responsibility for the tree breeding project when Jaynes retired in 1983.

A significant breakthrough on chestnut blight disease came with the discovery of a weakened form of the fungus in Italy. French scientist, Jean Grente, isolated hypovirulent strains (that is, strains of the pathogen with less than normal virulence) from recovering chestnut trees in Italy and studied them in his laboratory in Clermont-Ferrand, France [14a, b]. Grente sent some hypovirulent strains to me at CAES in 1972, and Jaynes and I conducted tests on American chestnut seedlings in the greenhouse. Our studies showed that this biological control worked on American strains of the chestnut blight fungus [15]. The next test was on American chestnut trees growing outside.

A small orchard of American chestnut trees was planted by Jaynes at the CAES Lockwood Farm in Hamden in 1976. By 1978, blight cankers had developed on these trees. Hypovirulent strains of the blight fungus were introduced into these cankers from 1978 through 1981. No treatments have been made since 1981, and about 15% of the trees never died back to the base, although they are disfigured by cankers that extend from the ground to near the crowns (Figure 15).

Laboratory tests showed that the hypovirulent strains all contained viruses [17]. These viruses only affect the fungus, and do not seem to be able to exist outside of the fungal mycelium (the threadlike “body” of the organism). They do not kill the fungus, but greatly reduce its vigor and can change the pigment (color) of the mycelium. We soon learned that by introducing virus-containing strains into blight cankers, the virus could be transferred into the fungus causing the canker. Once the hypovirulent, weakened strain was introduced, the tree was able to form callus tissues that limited the spread of the fungus and kept the trees alive. Either there are slight differences in resistance between the trees that survive, or there are differences in their ability to survive when hypovirulent strains of the blight fungus are introduced into the population. Virus-containing strains of the fungus can still be recovered from the new cankers that continue to form on the trees [16].

This biological control works well in an orchard, but these trees cannot compete in a forest setting when other nearby tree species grow tall enough to shade them [18].

Even though this is not a solution to restoring chestnut timber trees to the forest, it has allowed our research to make the next step. After timber harvests in Connecticut forests, native American chestnut trees sprout and begin to grow rapidly. If we treat developing cankers with virus-containing, biocontrol strains, a percentage of the native sprouts will survive. When we plant blight-resistant timber chestnut trees from the CAES breeding program around the sprouts, natural cross pollination will occur as the trees mature and flower. The next generation of chestnut trees in the plot will inherit all of the diversity that evolved with the trees growing in that niche, and resistance to chestnut blight disease from the planted trees [19].

Seed orchards of chestnuts from the CAES breeding program have been planted at our Valley Laboratory in Windsor and at our Griswold Research Center in Griswold to provide the trees for future forest improvement for Connecticut and the Northeast. Selection of superior orchard trees with more nutritious nuts also continues [20]. A list of the information available about registered cultivars of chestnut is posted on the CAES website (www.ct.gov/caes). Growers and nurserymen can use this information to choose which cultivars to grow or sell, and breeders can see whether their favorite name for their new selection has already been attached to a cultivar [21]. Our website also has a key to the species of chestnut with color pictures [22].

Chestnut research at CAES continues, following our tradition of attending to the needs of the people of the state and pushing back the frontiers of science (Figure 16).

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Sandra L. Anagnostakis, was born in Coffeyville, Kansas and attended college at the University of California at Riverside, where she received a Bachelor's degree in the spring of 1961. In graduate study at the University of Texas at Austin, she worked with C. J. Alexopoulos in mycology studying the genetics of slime molds. After receiving a Master's degree in Botany she joined the staff of The Connecticut Agricultural Experiment Station in the Department of Genetics (1966). She completed her Doctor of Agronomy degree at Justus-Liebig University in Giessen, West Germany in 1985, working with Professor J. Kranz. She is an Agricultural Scientist in the Department of Plant Pathology and Ecology.

Sandra has been working on chestnut blight disease (caused by *Cryphonectria parasitica*) since 1968. After completing basic studies with the fungus she imported Hypovirulent (virus containing) strains from France (1972) and demonstrated that they could be used in the U.S. for biological control of the disease. She has worked on the ecology of the blight fungus and its control by hypovirulence, and studies of virulence in the fungus and resistance in the trees. She continues the Experiment Station project on chestnut tree breeding experiments to produce better timber and orchard trees. Plantings in CT State Forests are underway to evaluate the potential for reintroducing timber chestnut trees in the state and throughout the north east.

Figure 1. An American chestnut tree (*Castanea dentata*) photographed in Scotland, CT in 1905. The tree was 83 feet tall, 27 inches in diameter, and 103 years old.

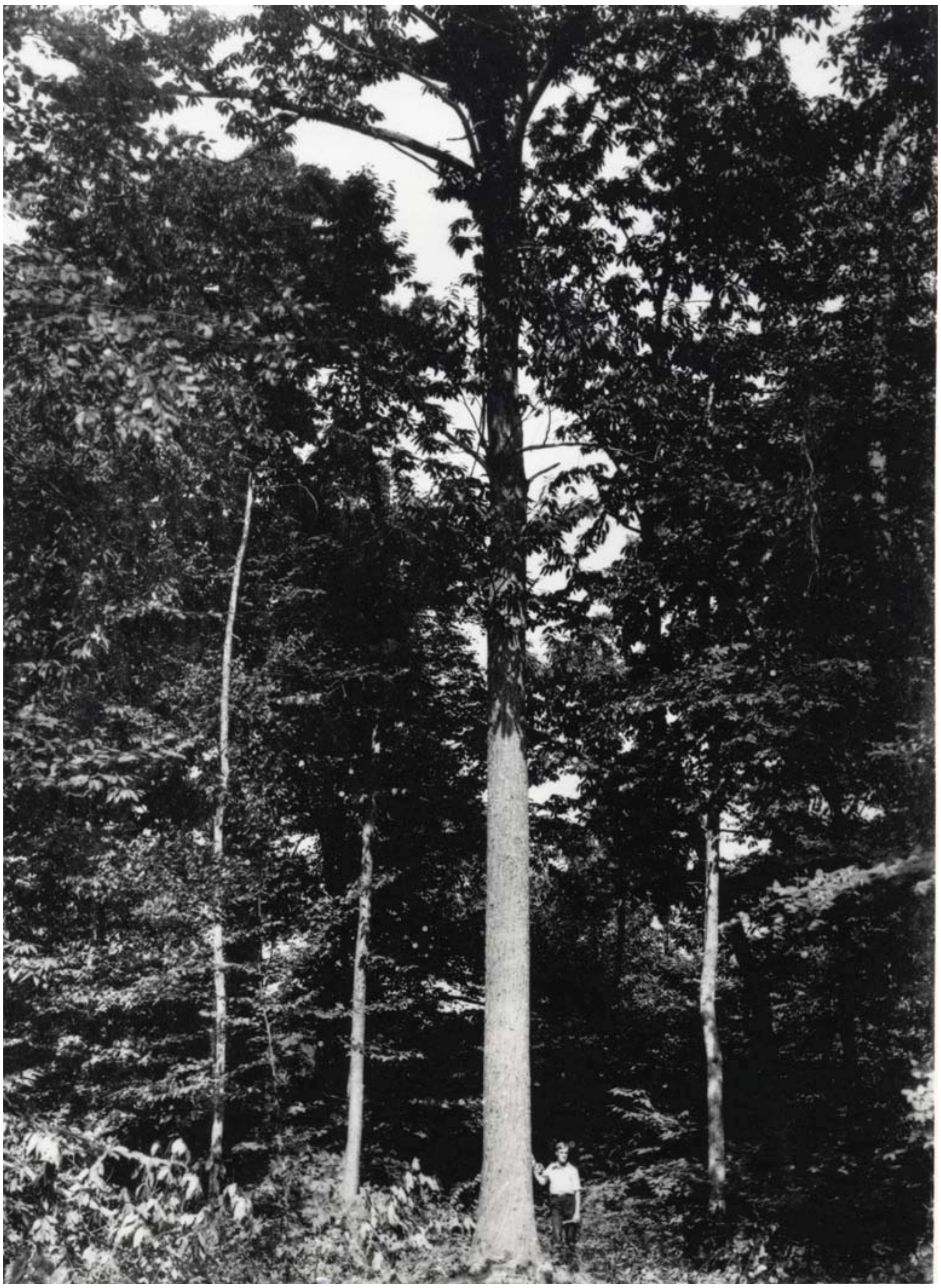


Table 1. Some of the many uses of chestnut wood in the state of Connecticut in 1913.

TABLE IV. CONNECTICUT INDUSTRIES USING CHESTNUT.

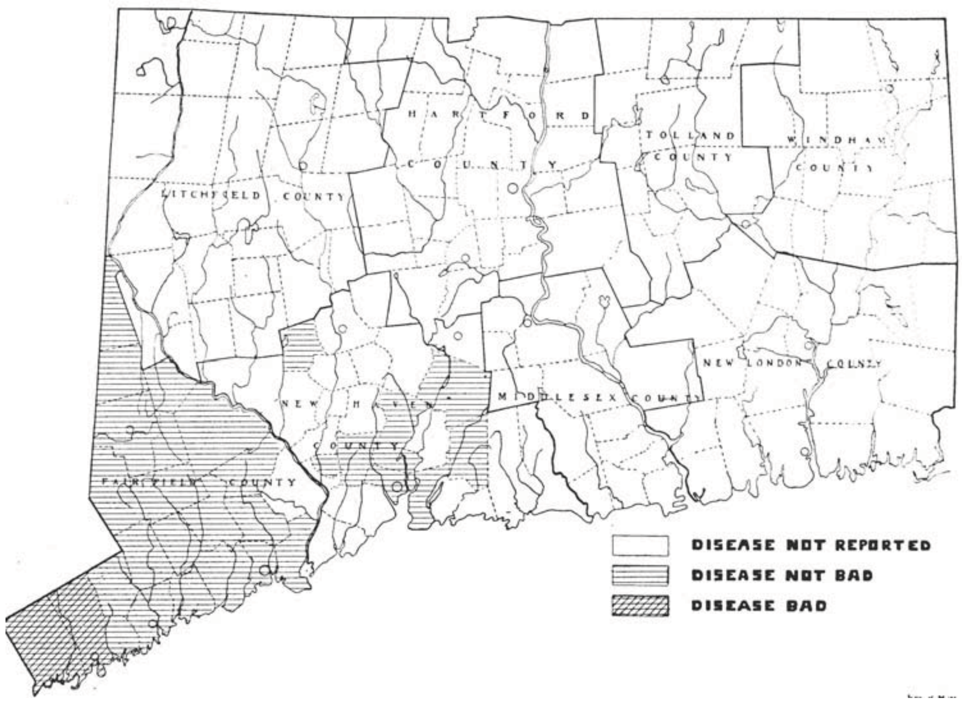
NAME OF INDUSTRY	Quantity		Cost	
	Feet b. m.	Per cent.	Average per 1000	Total
Musical instruments	3,559,000	49.1	$21.58	$76,815.50
Planing mill products	839,500	11.6	46.48	39,017.00
Sash, doors, blinds and general mill work	683,480	9.4	37.61	25,704.15
Ships and boats	546,645	7.6	23.54	12,866.71
Miscellaneous	440,000	6.1	22.68	9,980.00
Clocks	285,000	3.9	19.02	5,420.00
Fixtures	245,500	3.4	23.20	5,696.50
Prof. and scientific instruments	161,000	2.2	18.07	2,910.00
Boxes and crates	142,500	2.0	14.82	2,111.50
Wooden ware	135,000	1.9	13.56	1,830.00
Furniture	78,000	1.1	22.27	1,737,00
Machinery and apparatus, not electrical	44,975	.6	23.84	1,072.30
Patterns	20,000	.3	22.00	440.00
Laundry appliances	17,500	.2	22.29	390.00
Agricultural implements	15,000	.2	20.00	300.00
Vehicles and vehicle parts	12,800	.2	25.00	320.00
Handles	10,000	.1	18.00	180.00
Printing materials	5,800	.1	35.00	203.00
Electrical machinery and apparatus	3,000	*	20.00	60.00
	7,244,700	100.0	$25.82	$187,053.66

* Less than .1 of 1%.

Figure 2. A single American chestnut tree in a pasture in Portland, CT in 1905.

Figure 3. George P. Clinton (1867-1937) was a plant pathologist at The Connecticut Agricultural Experiment Station from 1902 to 1937.

Figure 4. Chestnut blight disease found in Connecticut in the surveys conducted by George Clinton in 1908 and 1912.



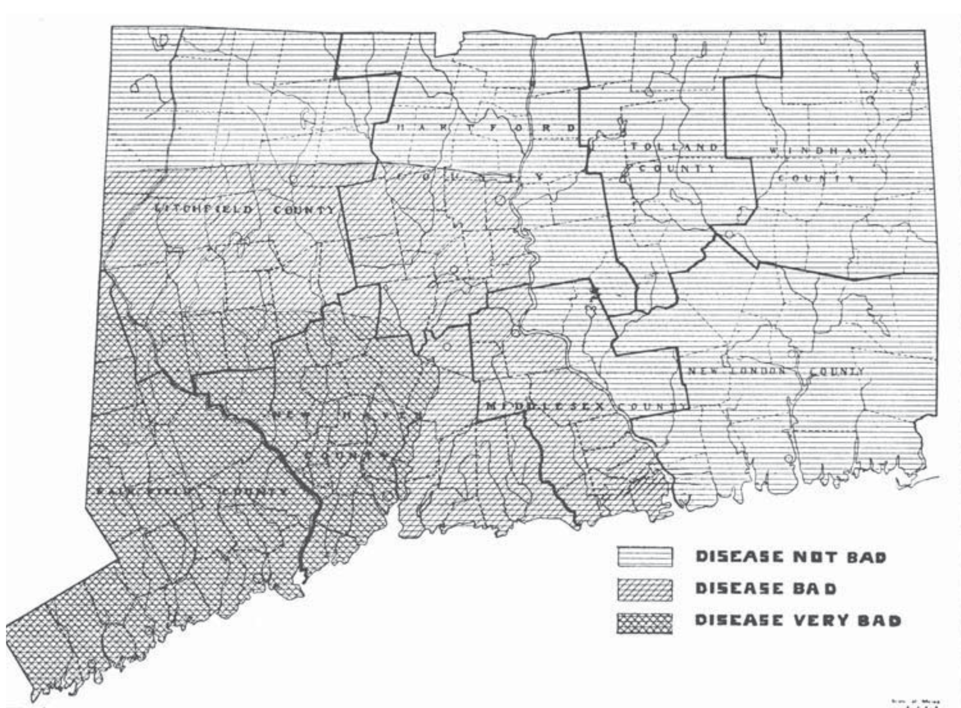


Figure 5 a. Paul J. Anderson (1884-1971) photographed while he worked on his doctoral thesis and for the PA Tree Blight Commission. This photograph was published in October of 1912 in the report of the PA Tree Blight Commission.

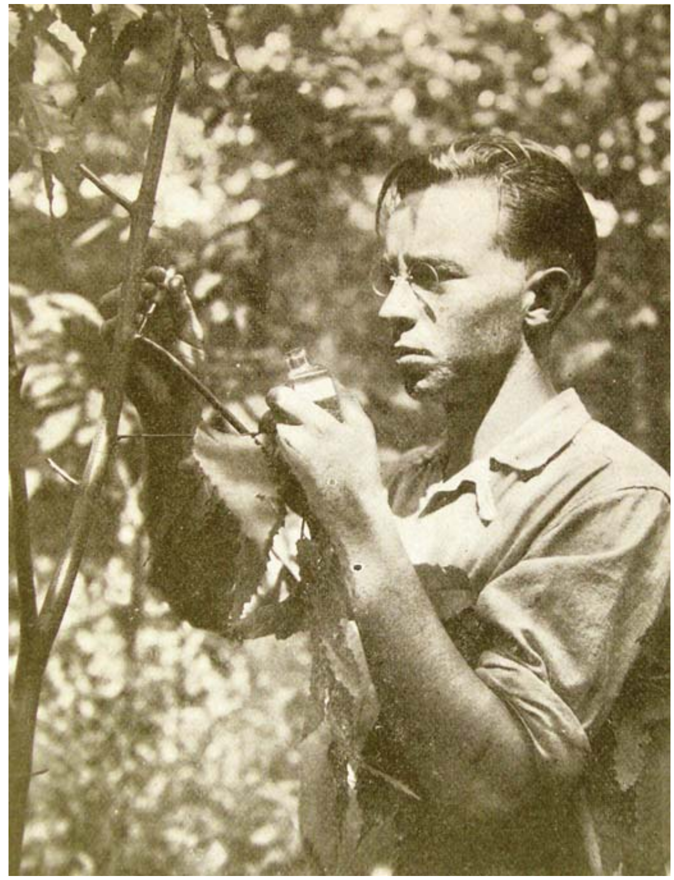


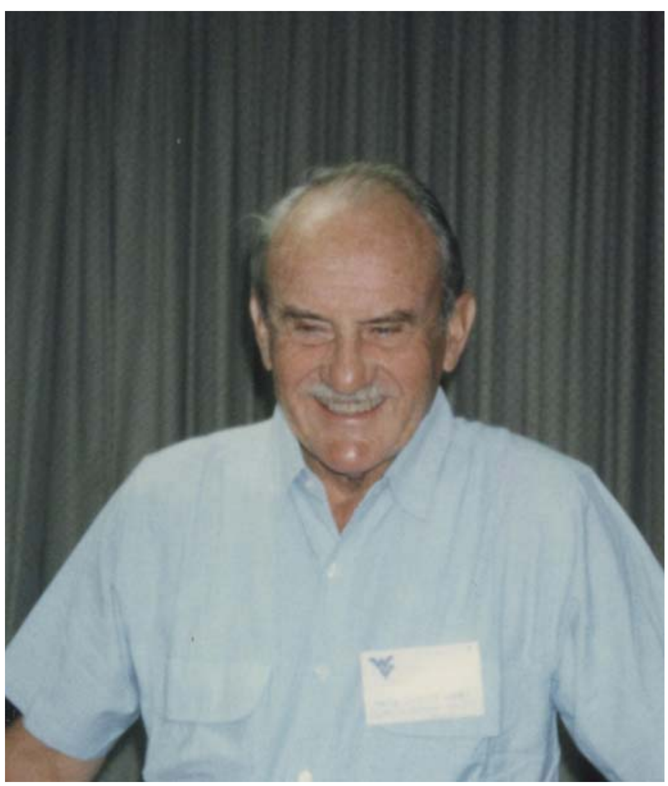
Figure 5 b. Paul J. Anderson became the head of the Tobacco Research Station of CAES (now the Valley Laboratory in Windsor) in 1925 and retired in 1953.

Figure 6. Arthur H. Graves (1879-1962) started the chestnut breeding project in Connecticut, planting trees on his family land in Hamden adjacent to the Sleeping Giant State Park. These 8.3 acres became The Chestnut Plantation at Sleeping Giant, owned by the state and maintained by CAES.

Figure 7. Donald F. Jones (1890-1963), head of the Genetics Department at CAES from 1915 to 1960, planted chestnut trees in New Haven and Hamden, and helped with the chestnut breeding project.

Figure 8. Hans Nienstaedt wrote his master's thesis (1948) and doctoral thesis (1951) at Yale University under the direction of D. F. Jones and A. H. Graves.

1948



1992

Figure 9. Richard A. Jaynes completed his doctoral thesis (1961) at Yale University under the direction of D. F. Jones and A. H. Graves, and then joined the staff of CAES in the Genetics Department.

Figure 10. Peter R. Day became head of the Genetics Department at CAES in 1964, and spearheaded the expanded work on chestnuts and their problems until his retirement in 1979.

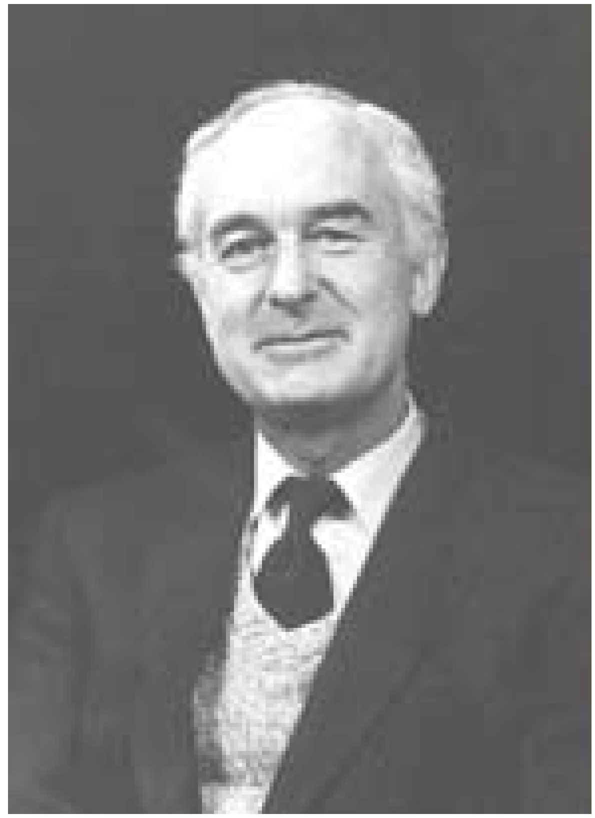


Figure 11. John E. Elliston (1944-2001) was a plant pathologist at CAES from 1975 to 1988 working on the interaction of chestnut trees and the blight fungus.

Figure 12. Neal Van Alfen worked at CAES from 1972 to 1976 in the Plant Pathology Department.

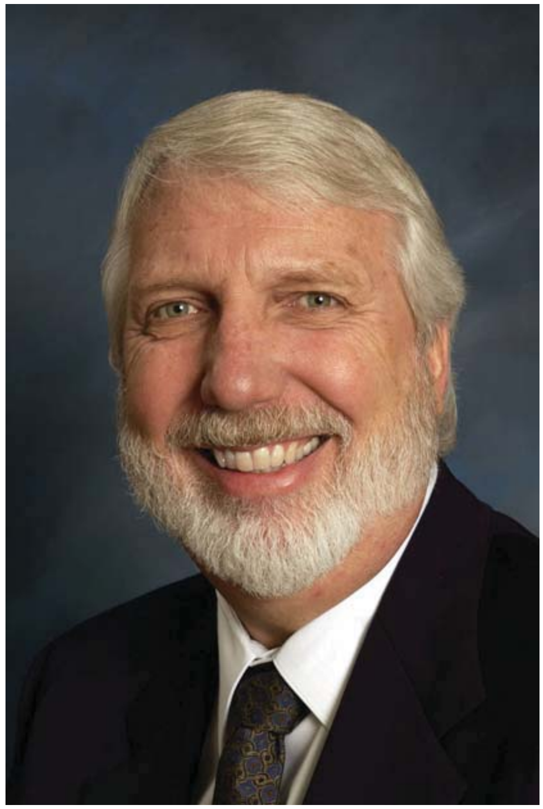


Figure 13. John E. Puhalla, a fungal geneticist, studied the genetics and physiology of the chestnut blight fungus while working at CAES from 1965 to 1970.

Figure 14. Sandra L. Anagnostakis began working at CAES in 1966 and continues to work on chestnut trees and their diseases and pests.

Figure 15. Seedling American chestnut trees from Michigan and Wisconsin were planted at The Experiment Station's Lockwood Farm in Hamden, CT in 1976. Chestnut blight cankers were treated with a mixture of hypovirulent (biocontrol) strains of the blight fungus from 1978 through 1982. Some of the trees continue to die back from chestnut blight cankers, and about 15% never died back even though they have cankers from the base up nearly to the crown. This suggests that there are subtle genetic differences between American chestnuts in their ability to resist the blight.

Figure 16. American chestnut bur with nuts.

The Charter Oak Lives On at the Griswold Research Center

Robert Durgy
Farm Manager, Research Farm Supervisor, Griswold Research Center

This year marked the 375th anniversary of Connecticut. In fact, this date refers to the founding of Hartford in 1635. Settlers, led by Thomas Hooker, left Massachusetts intending on establishing a commonwealth that had more democratic governance. Hooker believed strongly that an established government should be elected and represent all the people of the commonwealth, an idea that leaders in aristocratic Boston did not support. Soon others followed, settling Windsor and Wethersfield. The foundation of the Connecticut colony was born.

Within a few years, leaders from these towns wrote a document that would later be recognized as the template of our nation's constitution and one of the launching points for democracy. The Fundamental Orders described a representative form of government, a judicial system and an administration similar to that in Massachusetts with only a few major changes, such as term limits for the Governor and no religious test or devotion requirement. It was unique because it was the first written constitution which describes the functioning of government from the start.

The colony was first recognized by England in 1662 when a royal charter was signed by King Charles II, recognizing Connecticut as independent. By this time, it included Saybrook and New Haven as well as other towns along the shore and the Connecticut River. It allowed Connecticut to run things on its own without much say from England. But this freedom would not last and a new king would soon force changes.

While extending royal charters to Connecticut, Rhode Island and Massachusetts, King Charles wasn't really happy with the colonies. He had become displeased with New England for personal and political reasons. New England harbored and refused to turn over two men accused of killing his father. They disregarded English laws that limited trade and manufacturing of colonial goods. They conducted the Indian wars without guidance or approval from England.

He probably would have attempted to revoke their charters years earlier had it not been for the Dutch sailing up the Thames and threatening London.

In 1686, after Charles' death, King James II appointed Edmund Andros governor of New England, in essence dissolving the individual colonies. He was a despotic ruler who disbanded governments and confiscated land to reduce the power of the colonies. He created laws and taxes on the people without the elected legislatures. Specifically, Andros was ordered to revoke and confiscate the New England charters.

Finally we come to the story of the Connecticut Charter Oak. Andros came with troops to Hartford in October, 1687 to seize the Charter. Arguing with representatives into the night, suddenly the candles were doused and the room went dark. The Charter was spirited out a window by Joseph Wadsworth and hidden in a hollow tree nearby. When the candles were relit the Charter was gone. This defiant act did not change things. Andros took over anyway and the Dominion of New England was created.

An exciting story but not one based on many verifiable facts. In fact, there is evidence that the Charter Andros tried to take was a fake copy all along and the original had been hiding in the oak tree since the summer. Regardless of what actually happened, no tree holds such a prominent position in Colonial history as the Charter Oak. It was and is an enduring symbol of our desire for self-governance. The original Charter Oak was blown over in a storm in 1856. Considering it was already hollow one hundred and eighty years earlier, it is surprising it survived that long.

In commemoration of Connecticut's anniversary, several people from different state agencies contacted the Experiment Station to inquire about Charter Oaks at the Griswold Research Center. I've been told that at one time the State Nursery did produce Charter Oaks from acorns collected from the many descendents of the original that grow throughout the state. Although several different species of trees from the DEP State Nursery operation still remain at the Center, there are no Charter Oaks.

Left with the prospect of not satisfying these requests, several station scientists suggested that, being a farm after all, we can grow them ourselves. Email messages were circulated to determine a source of acorns from known descendants of the original Charter Oak. While gathering information about trees in state parks, town greens and historic locations all over Connecticut, someone suggested contacting the true source of knowledge about historic Connecticut trees.

Glenn Dreyer is the director of the Connecticut College Arboretum and author of the book "Connecticut's Notable Trees". After speaking with him about the project, we decided it would be best to collect acorns from the trees with the most documented history, the Charter Oaks of Bushnell Park in Hartford. Two first generation oaks currently reside in the park. With these trees, we not only get seed from first generation descendants, but we are also sure of one tree because of a plaque describing a brief history. Many second generation Charter Oak descendants exist throughout the state but very few are marked.

The most famous Charter Oak in Bushnell Park is the Foot Guard Oak. This first generation tree sits next to Elm St. at the Clinton St. intersection, across from the DEP building. It was transplanted in 1875 to replace another first generation Charter Oak that had died. The first was planted in 1871, on the 100th anniversary of the Governor's Foot Guard, thus the Foot Guard oak. It has a huge trunk and wide spread typical of white oaks as old as this.

Prior to visiting this tree, we were warned that finding acorns would prove difficult, not because the tree isn't productive, but because the squirrels are voracious. This was certainly true. Though the acorn production of white oaks seemed to be quite good this year, the number of usable acorns from the Foot Guard Oak totaled only twelve in two trips. But for the purposes of this project, it is important to have acorns from the closest descendant to the original.

The second tree we collected from in Bushnell Park is called the Hoadley Oak, named for its proximity to the Hoadley gate on the corner of Jewell and Wells Streets. The Hoadley Oak is also a first generation tree. It was sprouted from a Charter Oak acorn in 1847 and transplanted to its current location in 1867. The squirrels again limited our harvest, though there were a few more than the Foot Guard.

The final tree we collected from is second generation, planted in 1902 from an acorn obtained in Bushnell Park, but it is not known from which tree. It is planted just one block away in the front yard of Center Church, at the corner of Gold St. and Main St. This tree had copious acorns, seemingly untouched by the squirrels, probably due to its close proximity to Main St. and a busy bus stop right in front of the church.

The acorns were planted at the Griswold Research Center on October 4th and, as seen in the photo, the plants are well on their way. We have about fifty trees in the ground that should be ready for transplanting in the spring. The Experiment Station is proud to continue this tradition of cultivating our historic Charter Oak.

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Robert J. Durgy was born in Danbury, Connecticut and graduated the University of Connecticut with a BS in Biology in 1990. His career in agricultural research began in 1992 as a research assistant with the field corn management program at the University of Connecticut. Between 1995 and 2004 he worked with the Integrated Pest Management team on a variety of different projects including vegetable crop production, soil fertility, organic production practices and watershed protection. In 2004 he became the horticultural diagnostician for the UConn Home and Garden Education Center. Here he built an accredited labortory for participation with The National Plant Diagnostic Network. He has been the Research Farm Supervisor at The Connecticut Agricultural Experiment Station's Griswold Research Center since 2008. The Griswold Research Center is a 26-acre field station at which field studies in horticulture, forestry, entomology and plant pathology are conducted.

Lockwood Farm and the History of Plant Science Day

Dr. Kirby C. Stafford III
Vice Director, Chief Scientist, State Entomologist
Department of Entomology

In 2010, The Connecticut Agricultural Experiment Station celebrated the 100th anniversary of its first research farm field day at the Lockwood Farm in Hamden, Connecticut. This article is based on a talk presented on Plant Science Day on August 4, 2010 to mark the occasion.

The story of our annual summer Field Day begins at our main laboratories in New Haven whose grounds were purchased from Eli Whitney Jr. in 1882. The property had a house, which became known as the Whitney Building, and a carriage barn. A laboratory was promptly constructed and chemical analysis work began in the spring of 1883. Today, this building is the Osborne Library, possibly the oldest State Agricultural Experiment Station building in existence. Another building was added in 1888 that housed two departments: Mycology, which soon became Botany (today's Department of Plant Pathology and Ecology) and Entomology. Early Experiment Station research plantings were provided at garden plots on these main grounds (Fig. 1), in a greenhouse attached to the botanical building, and plots at various cooperating farms such as the one in the Spring Glen area of Hamden (now a shopping center) owned by James H. Webb, a member of the Station's first Board of Control. Another very useful adjunct to the Station's work was the experimental field a little further north in the Centerville area of Hamden where experimental breeding work with corn and tobacco, testing of lime-sulfur summer sprays on fruit trees, and the handling of a number of field crops was conducted. I will get back to this farm momentarily.

A new chemical laboratory was built in 1905, and a brick and concrete addition was begun in October of 1909 on the west side of the original building. Then, to quote from the 33rd Annual Report of the Station, "On the 10th of August 1910, a field meeting was held at the Station, to informally dedicate the new building, named the Johnson Laboratory, at which more than four hundred farmers and their wives were present. In the afternoon, this company went from the Station to the Centerville field and inspected and informally discussed the work there. It was intended to hold this summer meeting each year" (Fig. 2) (Hopson 1910). A story by Ernest M. Stoddard, a Plant Pathologist who started work at the Station in 1909 and who wrote in the Station's Frontiers of Plant Science upon his retirement in 1959, clarifies the location of the Centerville Farm: "…it was 49 years ago that a small group of farmers gathered at the old Farm (which is now Norwood [Avenue] at the intersection of Whitney and Washington Avenues in Hamden) for the first Field Day. Need we say that on that first Field Day there was no tent, no tractor tours, no committees, and no automobiles. The staff and guest came on the trolley or drove a horse" (Stoddard 1959). The trolley ran from New Haven to the Centerville area of Hamden and was expanded north to Mt. Carmel in 1903 (Lehman 2010).

Late in 1910 or early 1911, the Experiment Station bought nearly twenty acres above Whitney Avenue in Mount Carmel from Annie McLaughlin for $6,000 with monies provided by the Lockwood Trust, which was willed to the Station by William R. Lockwood of Norwalk, CT in 1896. This farm included an old orchard, a barn, and a small house for the caretaker. A new orchard of apples and peaches was planted for the use of the Entomology Department. Experiments were begun by the Botany Department on the handling of an old and neglected orchard, and other experiments were begun on the effect both on the crop and on the soil of fertilizers and manures. In 1911, corn and tobacco breeding work, as well as other experiments, were wrapped up, and "hereafter, this work will be concentrated on our own fields at Mount Carmel" (Hopson 1912). The Centerville Farm was vacated in the spring of 1912.

The next Field Day was apparently held at the new property in 1913 with 200 guests, where additional land was leased for the various experiments. Already, space was deemed inadequate for the necessary research and an additional 15.4 acres adjoining the original purchase were acquired in 1915. Some activities were held at the barn by Kenwood Avenue and others at a tent erected at the farm (Fig 3 a, b). This barn is still present today, although it has been expanded over the years. Field day activities were mainly centered in and by the tent (Fig. 4), which in the early years appeared to be placed at various parts of the farm. People gathered under the tent to hear talks and have lunch, but would also visit various field plots just as guests do today (Fig. 5). Later, the tent was located in front of the lower barns along Kenwood Avenue (Fig. 6). People would bring their own picnic lunches or purchase a lunch. Over the years, the Board of Control purchased additional land and today the farm encompasses 75 acres.

The program for 1940 listed 32 plots, refreshments, and designated parking (Fig. 7). The barn exhibits were placed in the barn along Kenwood Avenue. Other exhibits were located in the insectary building. A field insectary was built at Lockwood Farm in 1923. A portable insectary built in Westville for work on the oriental beetle was later moved and added to the existing insectary at the farm. A small frame laboratory was built in connection with these two insectaries in the late 1930's (Turner 1974). There was no field day in 1925. The Board of Control voted to omit the usual field day because an exhibit was to be sent to the Charter Oak Fair and because of the Station's celebration of its 50th anniversary held on October 12th of that year. A special Field Day with the Connecticut Vegetable Growers' Association and the New Haven County Farm Bureau was held the following year with 400 guests in attendance. There was no field day during the war years of 1942-1944, when 16 staff were serving in the Armed Forces. After 4 years without a field day, attendance exceeded 1,000 people in 1945 and again in 1946. No mention is made of Field Day in 1950 with the celebration of the Station's 75th anniversary in New Haven in September. There were a few other years when it appears that the field day may not have been held, at least it is not mentioned in the annual report, so there were probably around 90 actual summer field days held since 1910. A tractor-trailer tour was added in 1949 that held 25 people (Fig. 8). Today, we use an air-conditioned bus for the farm tour. During the 1950s, the upper barns had been added and field day became centered on this area of the farm (Fig. 9).

Mt. Carmel Field Day was first called Lockwood Farm Field Day in 1960 and for eight years after that, was called "Science at Work Day". Our Field Day was first referred to as Plant Science Day in 1969. Over the course of our many field days, four Connecticut governors have addressed the guests at the farm: Wilbur L. Cross in 1931 and again briefly in 1934; John N. Dempsey in 1961; Ella T. Grasso in 1975; and Lowell P. Weicker, Jr. in 1990. Only one field day was held on a Saturday (August 16, 1958), surprisingly to a reported "smaller crowd", although the number of attendees is not provided. Attendance in the early decades generally ran around 300-500 and has increased to around a 1,000 most years since the late 1980s. There have been 31 field days where the number of visitors exceeded 1,000 and four occasions where over 1,500 people came to hear the feature talk, which today is called the Samuel W. Johnson Memorial Lecture. These were for Governor Cross, Governor Dempsey, and in 2002, Roger Swain, who is best known as the host of PBS's The Victory Garden from the mid-1980s to 2001.

There have been a number of additions to the farm in the past couple of decades and changes to Plant Science Day. These include a Bird and Butterfly Garden, designed by members of the Federated Garden Clubs of Connecticut and constructed in the fall of 1996 (Fig. 10); handicap parking and wheel-chair access to restrooms; a cell phone tower; a cottage; a new insectary, and an ebb and flood greenhouse. In 1997, the Board of Control purchased the cottage and 2 acres of land adjacent to the farm with Lockwood Trust funds. This 1920's era summer cottage, originally ordered from the Sears, Roebuck Catalog, was renovated with new siding, kitchen, and bathroom facilities (Fig. 11) (Walden 2002). The cottage can hold small meetings of agricultural and environmental groups of 30 or less. In 2002, the small insectary was torn down and a new 1,800 square foot insectary, a mosquito, tick and bed bug facility, was constructed. In collaboration with Geremia Greenhouses in Wallingford, a new greenhouse with an ebb and flood watering system was installed in 2006 where one can provide partial saturation of the root medium through the base pot and avoid waste of water and fertilizer.

It is not possible in the space available to cover all the work conducted here at Lockwood Farm in the past few years, much less that over the nearly 100 years that our farm has been in operation. Earlier agricultural work at the farm focused largely on experiments in plant breeding, spraying, and fertilizing of orchard, field, and garden crops. However, the story of Lockwood Farm would not be complete without mentioning the development of hybrid corn by Dr. Donald F. Jones. A chemist and geneticist, E. M. East initiated a corn-breeding program at the Station in 1905 before moving on to Harvard in 1909. Donald Jones, who briefly taught at Syracuse University, and was then a graduate student at Harvard, came to New Haven in February of 1915 and took charge of the Connecticut corn program. Against genetic dogma of the time, he conducted trials in 1917 and 1918 at Lockwood Farm, taking two crosses of corn, making a cross of those two crosses, and producing what became the double-cross hybrid, which resulted in substantial increases in yield. He published his method in 1919. Even after his landmark discovery, Dr. Jones continued to make substantial contributions to corn breeding. In Figure 12, Dr. Jones is shown with his corn plots on Field Day, August 18, 1931. In 1955, the Mount Carmel Field Day was declared Donald F. Jones Day to celebrate the 40th anniversary of his discovery of hybrid corn (Horsfall 1992). By 1959, more than 95% of U.S. corn acreage was planted with hybrid corn. Today, his corn is grown around the world.

Orchards, cornfields, Chestnut trees, and vegetable plots have been a part of the farm landscape for many years. Chestnut plantings and breeding at Lockwood Farm began in the late 1930s and early 1940s with Dr. Jones. Efforts to control chestnut blight with a hypovirulent strain of the chestnut blight pathogen began at Lockwood Farm in 1972. Today, some of the chestnut trees at the farm are over 70 years old, still going strong, and being used to produce hybrids that are resistant to the blight yet retain most of the characteristics of our native chestnut trees. The New Crops Program was established in 1984 and has evaluated cultivars of many vegetables, ethnic crops, and specialty fruits over the years, providing our farmers with a diversity of crops that can be grown in Connecticut. Vineyards are a more recent addition. Some grapes were planted back around 1986 and other vineyards were added in 1992. Newer plantings of hybrid and vinifera wine grapes were put in place in 2004, 2007, and 2008. The various wine grape studies include cultivar evaluation, examination of cultural practices and pruning systems, and integrated pest management. Other recent studies include composting, corn pollen aerial dispersal, numerous studies on the control of plant diseases, phytoremediation to clean contaminated soil, and measuring pesticides in pollen and nectar. The list goes on, which reflects the wide diversity of research conducted at Lockwood Farm.

The number of plots or listed stations in the Plant Science Day program has increased from 32 in 1940 to 90 in 2009 and 2010 (Fig. 13), including new research and activities for Plant Science Day (Fig. 14). Additions to the program include the passport for kids program, the participation of other governmental, agricultural and environmental groups, the Experiment Station Associates, and expanded stations such as the question and answer and demonstration tents. Nevertheless, the basic format and mission of the open house to present the work of the Experiment Station's scientists and staff have remained the same and relatively consistent over the years. The event provides an opportunity for the public to meet scientists, discover what we are doing, and provide input into the research needed to address Connecticut's problems. Our motto of putting science to work for society is as relevant today as it was when the Experiment Station was founded.

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Figure 1. Early garden plots at the main laboratories on Huntington Street in New Haven (photo is undated).

Figure 2. This picture shows our first field day in Hamden in 1910 with some of the attendees who may have just gotten off the trolley.

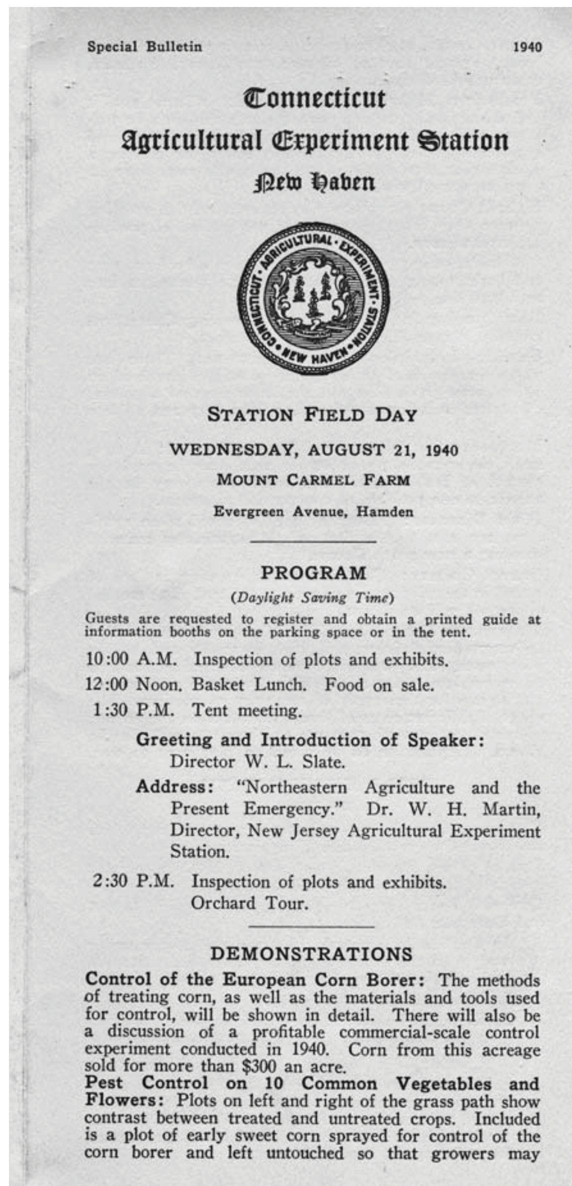
Figure 3. A) Field Day, 1914.

B) Field Day by lower barn along Kenwood Avenue, 1914.

Figure 4. Mt. Carmel Field Day on August 6, 1924.

Figure 5. Guests under the tent listen to a talk, August 6, 1924.

Figure 6. The main tent in front of the lower barns on field day in 1940.



Special Bulletin 1940

Connecticut
Agricultural Experiment Station
New Haven

STATION FIELD DAY

WEDNESDAY, AUGUST 21, 1940

MOUNT CARMEL FARM

Evergreen Avenue, Hamden

PROGRAM

(Daylight Saving Time)

Guests are requested to register and obtain a printed guide at information booths on the parking space or in the tent.

10:00 A.M. Inspection of plots and exhibits.

12:00 Noon. Basket Lunch. Food on sale.

1:30 P.M. Tent meeting.

Greeting and Introduction of Speaker: Director W. L. Slate.

Address: "Northeastern Agriculture and the Present Emergency." Dr. W. H. Martin, Director, New Jersey Agricultural Experiment Station.

2:30 P.M. Inspection of plots and exhibits.
Orchard Tour.

DEMONSTRATIONS

Control of the European Corn Borer: The methods of treating corn, as well as the materials and tools used for control, will be shown in detail. There will also be a discussion of a profitable commercial-scale control experiment conducted in 1940. Corn from this acreage sold for more than $300 an acre.

Pest Control on 10 Common Vegetables and Flowers: Plots on left and right of the grass path show contrast between treated and untreated crops. Included is a plot of early sweet corn sprayed for control of the corn borer and left untouched so that growers may

Figure 7. Cover from the program for the Station Field Day in 1940.

Figure 8. The tractor-trailer tour that was added to the field day activities in 1949.

Figure 9. A view of the upper barns at Lockwood Farm and Sleeping Giant State Park (July 10, 1961).

Figure 10. The Bird and Butterfly Garden, designed by members of the Federated Garden Clubs of Connecticut, and constructed in the fall of 1996.

Figure 11. The 1920-era cottage that was acquired in 1972 and renovated for use by the Station and small meetings of agricultural and environmental groups.

Figure 12. Dr. Donald F. Jones with his corn plots on Field Day on August 18, 1931.

Figure 13. Number of plots or stations listed in the Plant Science Day program, 1977-2010.

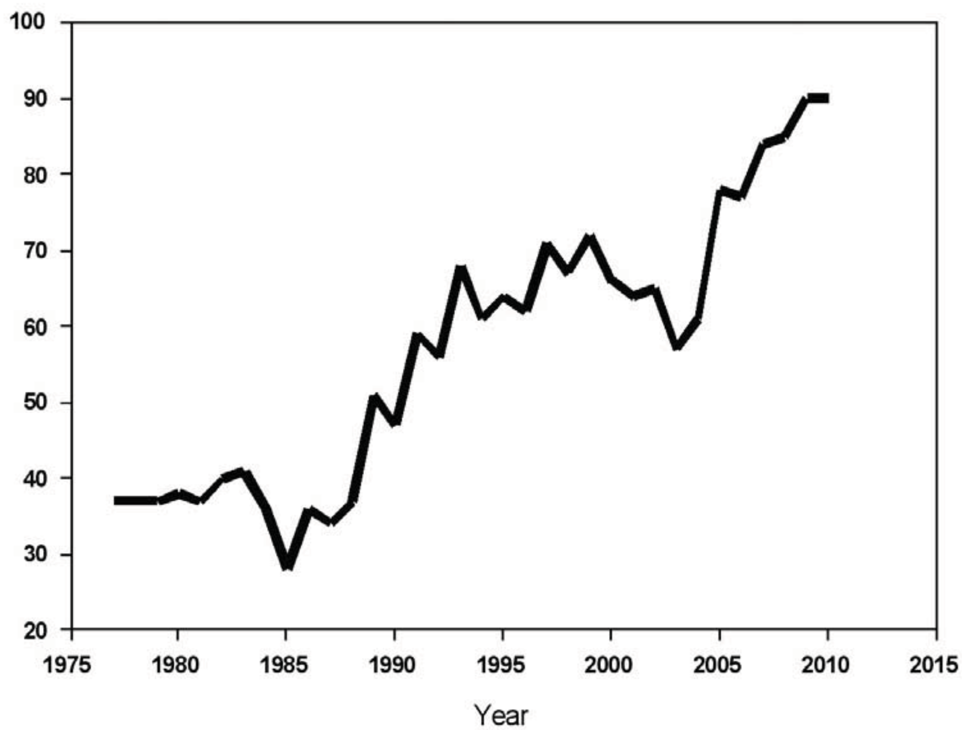


Figure 14. A. Families enjoying Plant Science Day, 2007.

B. Visitors learn about research at a field plot, 2008.

Kirby C. Stafford III, Ph.D. grew up in Colorado and received his B.S. in entomology at Colorado State University, his M.S. in veterinary entomology from Kansas State University, and his Ph.D. in medical-veterinary entomology from Texas A&M University, where he also taught veterinary entomology in the Department of Entomology and the College of Veterinary Medicine. After working as a postdoctoral researcher at Penn State, he joined The Connecticut Agricultural Experiment Station in 1987 and is currently Vice Director, Chief Entomologist (Head) of the Department of Entomology and State Entomologist. His research area is the ecology and control of the blacklegged tick with a recent focus on natural and biological tick control. He has authored or co-authored 52 articles in peer-reviewed scientific journals, 35 other articles and factsheets, two review chapters on tick management in two books, produced a Tick Management Handbook and Fly Management Handbook, and, since 1987, has made over 1,000 presentations and interviews to the public, at professional meetings, and to the public media.

The Dynamic Connecticut Forest

Dr. Jeffrey S. Ward
Chief Scientist
Department of Forestry & Horticulture

Most of Connecticut appears as a sea of hills cloaked with trees when viewed from a high overlook. This seemingly never-changing cloak of forest is, in fact, a constantly changing assemblage of individual trees. Most of our forest, including the tracts discussed in this report, has arisen after harvesting or farm abandonment in the 1800s (Ward and Barsky 2000). The young saplings which grew on those cutover and abandoned lands are now the large, upper canopy trees in our forests today.

In Connecticut, as in many northeastern forests, we are at the beginning of a second major change in forest composition during the past 100 years. Since the loss of American chestnut in the early 1900s, the Connecticut forest has been dominated by oak. Today, our forest is gradually converting from oak to other species, especially maple, birch, and beech. As with the shift from chestnut to oak forests at the beginning of the century, the emergence of a forest dominated by northern hardwoods will alter the economic, ecological, and aesthetic values of our forest. The consequences of these changes will last well into the 21st century.

Ultimately, forest stand development is the aggregate of the birth, growth, and demise of many individual trees. Understanding the causal factors that affect the future growth and survival of individual trees will lead to better comprehension of how these factors influence forest succession. An invaluable tool for understanding the "why" of these changes is long-term monitoring. For over eighty years, scientists at The Connecticut Agricultural Experiment Station have been conducting one of the oldest and most comprehensive studies of forest dynamics in the world – The Old-Series Plots. This study provides a benchmark of natural changes against which forest management practices can be compared. The study also provides insights into how disturbances (e.g., wildfire, insect defoliation) and soil types have shaped the forests we know and will affect the composition of the forests that will be known to future generations.

The study was begun in the Turkey Hill plot of Cockaponset State Forest in Haddam, CT in 1926. Reeves, Cox, and Cabin plots of Meshomasic State Forest in Portland, CT were added the following year. North-south transects 16.5 feet wide and 660-1320 feet long were established on each plot. The combined transects were over 36,000 feet long and covered 13.8 acres. The 1926-1927 inventories recorded the location of all trees greater than 0.6 inches dbh (diameter at 4.5 feet aboveground) together with the tree's diameter, species, and crown class (the relative position of a tree's crown in the canopy) on strip maps. The second inventory was completed in 1937. Beginning with the 1957 inventory, the minimum diameter was lowered to 0.5 inches dbh. Inventories have subsequently been repeated in 1967, 1977, 1987, 1997, and 2007 (Fig. 1).

Figure 1. Field crew for survey in 2007 (l-r) J.P. Barsky, D.V. Tompkins, and C.O. Ariori.

The four Old-Series plots have had three distinct disturbance regimes. Three plots in Portland had multi-year episodes of moderate to severe defoliation (>25%) in 1961-63 and 1971-1972, and a single year of defoliation in 1981 due to gypsy moth *(Lymantria dispar* L.), canker worm (*Paleacrita vernata* Peck.), and elm spanworm (*Ennomos subsignarius* Hbn.). Moderate to severe defoliations at the Turkey Hill plot were limited to single year episodes in 1964, 1972, and 1981. A summer wildfire burned approximately 40% of the Turkey Hill plot in 1932. The burned area was inventoried in 1934 to note which trees survived the fire. Areas adjacent to roads, trails, and other human disturbance were excluded from this analysis. More details on study protocols and disturbances can be found in Ward et al. (1999).

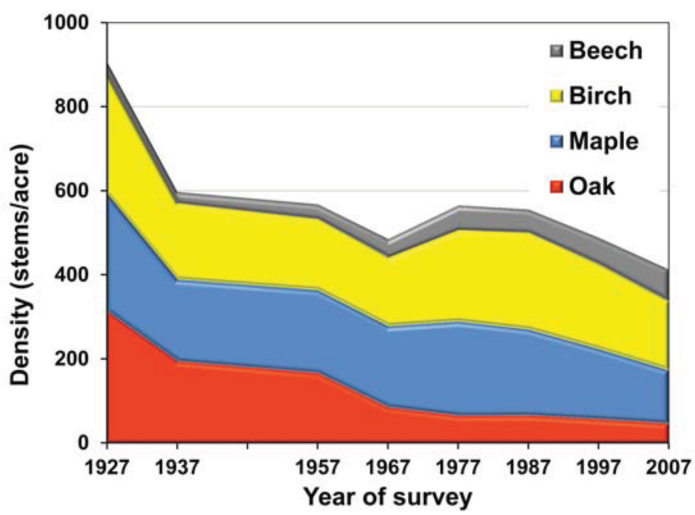


Figure 2. Stand density (stems/acre) by species group and survey year for Old-Series plots in central Connecticut.

The present database includes 44,787 stems distributed over 69 species of trees, shrubs, and vines. To simplify analysis of changes over the past eighty years, four species groups were examined in this report: **Maple** (*Acer saccharum*, *A. rubrum*), **Oak** (*Quercus rubra*, *Q. velutina*, *Q. coccinea*, *Q. alba*, *Q. prinus*), **Birch** (*Betula alleghaniensis*, *B. lenta*), and **Beech** (*Fagus grandifolia*). These ten species account for over two-thirds of trees observed during this study.

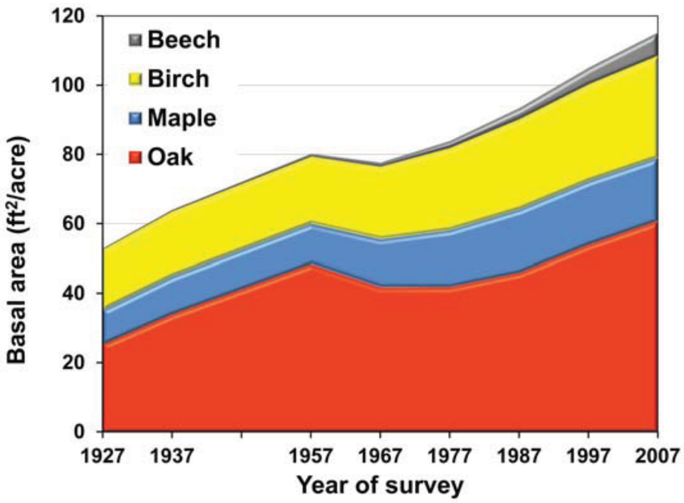
Tree density (stems/acre) has been steadily declining since 1927 except for a slight increase between 1967-1977 after the initial period of defoliation (Fig. 2). This decline was not uniformly distributed among species groups; oak declined by 85%, maple by 55%, birch by 42%, and beech actually increased by over 150%. The more rapid decline of oak than maple and birch is not unique to this study and has been observed in other unmanaged forests (Ward 2005). Oak seedlings require more sunlight to reach the forest floor than do maple and beech. Recent research has highlighted the need for disturbance, often including prescribed burning, if oak is to be maintained as a component of the eastern deciduous forest (Brose et al. 2006). This will be explored further in the DISTURBANCE AND INGROWTH section below.

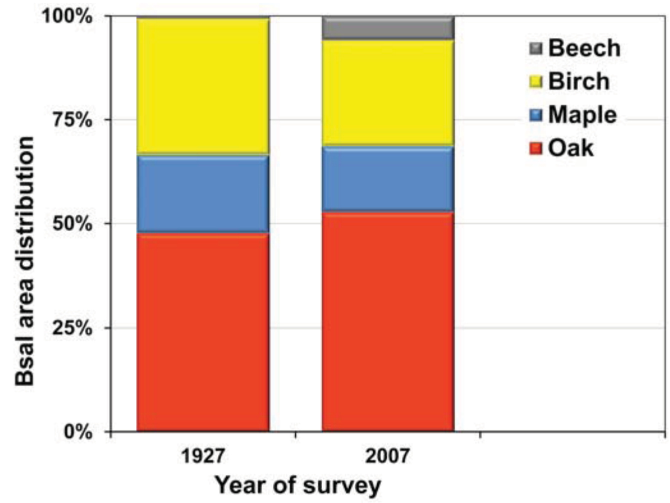
The decreasing number of trees was not indicative of a declining forest; rather it resulted from trees growing larger. Large trees need more resources (light, moisture, and nutrients) than small trees. One or more resources eventually becomes limiting as individual trees grow and utilize more and more resources. Mortality can be especially high for smaller trees growing under their larger neighbors. Because these smaller trees are more numerous, total forest density will decrease as a part of natural stand development.

Live biomass is a better measure than density of how limiting resources are allocated among species and whether species are increasing or declining. Unfortunately, it is very time-consuming and expensive to accurately estimate live biomass. However, there is an easily collected metric that is highly correlated with biomass - basal area. Basal area is the area (feet^2) of the cut surface of a tree at 4.5 feet. Summing the basal area values of all trees provides the basal area of the forest. Basal area is closely correlated with the bulk, or biomass, of the forest and gives more importance to the larger trees. For example, 196 1-inch diameter trees have the same basal area as one 14-inch diameter tree. Basal area is usually expressed as feet^2/acre or meter^2/hectare.

In contrast to density, basal area has continually increased for all species over the past eighty years, except for the 1967-1977 period when defoliation was most severe (Fig. 3). Oak basal area over the past eighty years has increased both absolutely, from 25 to 61 feet^2/acre, and relatively, from 48% to 53%. The increase indicates that oaks have been utilizing more and more of the limiting resources as the forests have grown older, even as the number of oaks has decreased. This apparent contradiction can be readily explained by

Figure 3. (a) Stand basal area (ft^2/acre) by species group and survey year for Old-Series plots in central Connecticut. (b) Relative basal area distribution (%) by species group in 1927 and 2007.





recalling that large trees have much higher basal area than small trees and the observation that the majority of large trees are oak (Fig. 4).

The increasing dominance of oak as measured by basal area (Fig. 3) suggests that future forests will remain dominated by oak, while the decreasing number of oak as measured by density (Fig. 2) suggests that oak will be lost from future forests. Which scenario is true? The first clue can be seen in Figure 4, which shows that there are very few oaks in the smaller size classes. Trees are not immortal; eventually they are toppled by storm damage or succumb after repeated insect and disease attacks. The death of a large tree creates a canopy gap that provides the opportunity for one of two smaller trees to grow and become part of the upper forest canopy.

Trees in the smaller diameter classes form the pool of individuals from which future canopy trees will arise. Therefore, we can predict the composition of the future forest by examining their relative abundance (Fig. 4). Our observations suggest that over time the large oaks will slowly be replaced by maple, birch, and increasingly, by beech. This mixture of species is much more characteristic of central New England than southern New England.

DISTURBANCE AND INGROWTH

There is a hitherto unexamined factor that can alter this inexorable shift from oak dominated forests to the maple-birch-beech forests more common with central New England – disturbance. As mentioned earlier, these research forests have had three distinct disturbance types: repeated multi-year defoliations (**Multi**), repeated single-year defoliations (**Single**), and wildfire in 1932 (**Fire**). The availability of these data facilitated an examination of the impact of different disturbance regimes on forest ingrowth. Ingrowth is defined as those trees that grew large enough between surveys to be measured for the first time, i.e., new trees. With the passage of time, some of the ingrowth will survive and grow into the upper canopy in the future forest.

Each of the three disturbance types had strikingly different ingrowth patterns over the past eighty years, but had merged to similar values by the 1997-2007 period (Fig. 5). The plot that had the wildfire in 1932 had

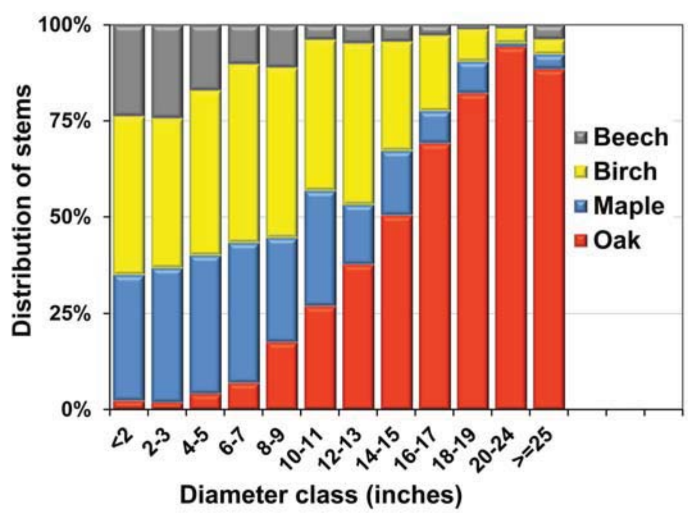


Figure 4. Distribution of stems among diameter classes in 2007 for Old Series plots in central Connecticut.

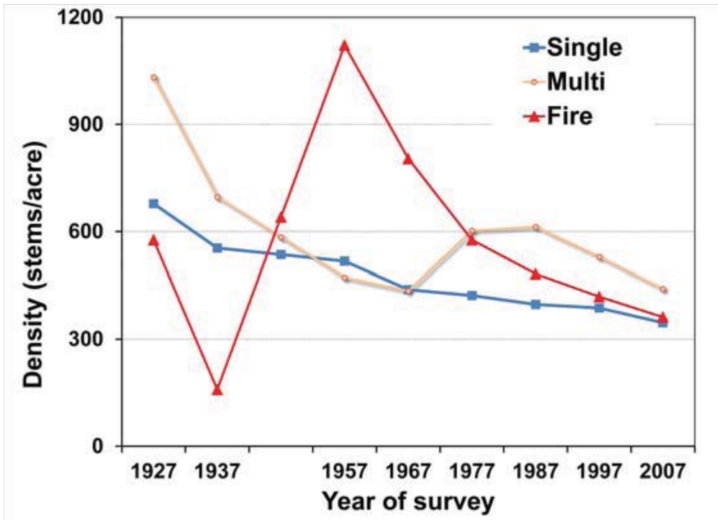


Figure 5. Changes in total stem density by disturbance type and survey year. Single: single-year defoliation events, Multi: Multi-year defoliation events, Fire: wildfire in 1932.

a very sharp pulse of ingrowth to nearly 800 SA^{10} (stems per acre per decade) between 1937-1957 before falling to less than 70 SA^{10} in the subsequent decades. This pulse of ingrowth was not unexpected as the wildfire killed 82% of stems, providing abundant growing space for new trees (Ward and Stephens 1989).

Ingrowth rates on the single- and multi-year plots were similar during the 1927-1967 periods. Mortality was much higher between 1957-1977 on the plots that multi-year defoliations than on the plot that had single-year defoliation (Stephens 1981). Similar to the wildfire, albeit at lower intensity, the increased mortality initiated by defoliation lead to an increase of ingrowth to 348 SA^{10} during the 1967-1977 period by releasing growing space and limiting resources. With the appearance of the gypsy moth fungus (*Entomophaga maimaiga*) in 1989 that has mostly controlled gypsy moth (*Lymantria dispar*), increased mortality caused by large-scale defoliation has ceased (Ward 2007) and ingrowth rates declined to 60 SA^{10} for the 1997-2007 period. Without a disturbance that dramatically increased mortality, ingrowth rates have fluctuated between a high of 146 SA^{10} between 1937-1957 and a low of 52 SA^{10} between 1997-2007 on the plots that had only single-year defoliation episodes.

Not only did each of the three disturbance types have different ingrowth patterns over the past eighty years, the species composition of ingrowth differed by disturbance type (Figs 6a-c). On the plot that had had only single-year defoliations, maple has been the most predominant ingrowth species for every period over the past eighty years (Fig 6a). Birch and maple had similar ingrowth rates prior to the defoliation episodes on the plots where there were multi-year defoliations, but subsequently; birch ingrowth has been much higher than maple (Fig. 6b). There is also evidence that these defoliations permanently increase beech ingrowth rates.

A very different species response was observed on the plot that had the wildfire (Fig. 6c). In contrast to the other plots, oak was the predominant ingrowth species. Other studies have also noted that oak responds well to fire (Ward and Brose 2004, Brose et al. 2006). Indeed, fire or a fire-surrogate such as mowing or herbicide may be necessary to obtain adequate oak regeneration.

SUMMARY

Disturbances have long-term impacts on forest composition and structure. I conclude by showing the long-term impacts of difference disturbance types on forest composition and how we use that information to predict future forest composition.

The single, intense wildfire in 1932 caused a pulse of oak-dominated ingrowth. Seventy-eight years later, oak density on the wildfire plot is double that of the plots that did not have a fire (Fig. 7a). However, both oak ingrowth and density have continued to decline in the absence of another fire. Based on this finding, maintaining oak will require active management, such as prescribed burning, mowing, or herbicide to reduce the competition to oak from sapling maple, birch, and other species. Until there is change towards more active management, oak will continue to decline in Connecticut and our forests will become increasingly dominated by northern hardwood species, such as maple, birch, and beech.

As with the shift from chestnut to oak forests in the early 1900's, the emergence of a forest dominated by northern hardwoods will alter the economic, ecological, and esthetic values of our forest. The consequences of these changes will last well into the 21st century. Oak is more economically important than maple and birch for its higher value, lower cull rates, and higher per acre volume growth. The shift from oak will also affect

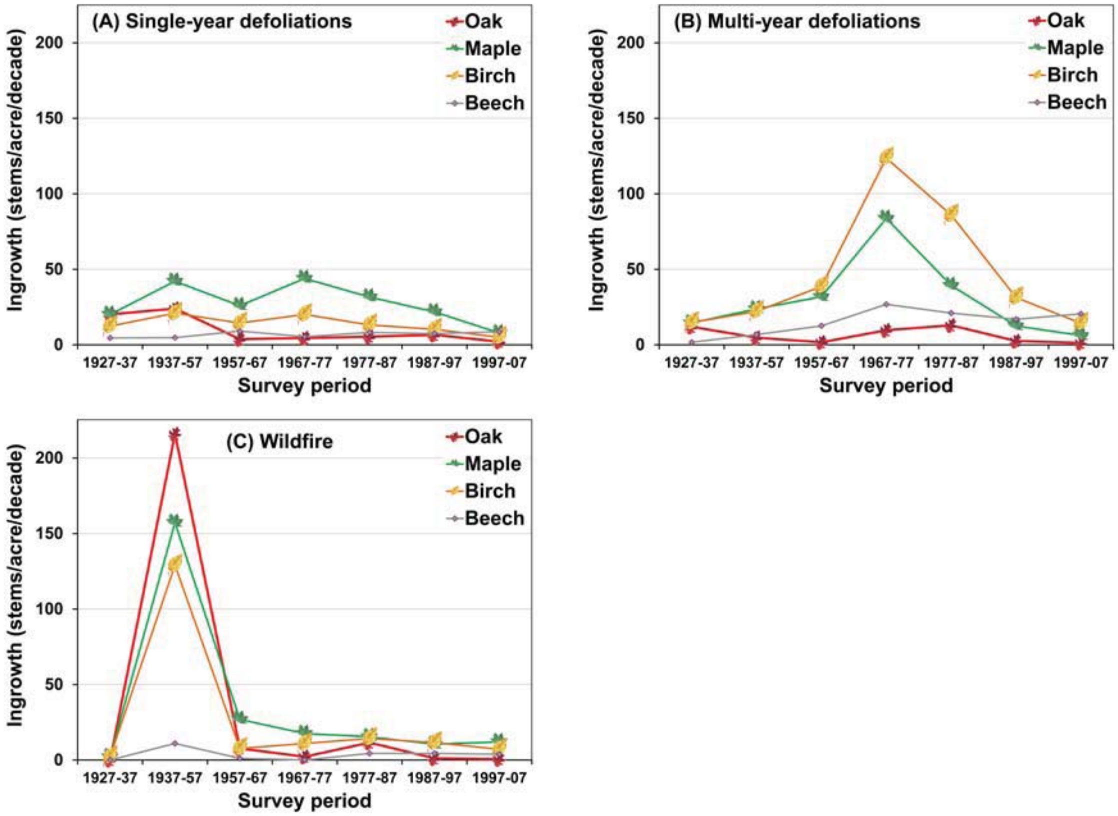
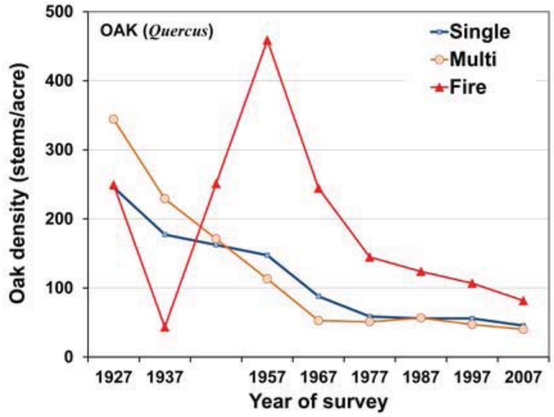


Figure 6. Ingrowth (stems/acre/decade) by species group and survey year for three distinct disturbance types: (A) repeated single-year defoliations, (B) repeated multi-year defoliations, and (C) wildfire in 1932.

many wildlife and insect populations - discriminating against those species dependent on oak and favoring those species associated with northern hardwoods. Changes in esthetic values are important because of increased public utilization of the forested landscape for both home sites and recreation. The leaves and flowers of maple and birch are more colorful than oak. However, faster growing oaks and pines are more likely to have the “big tree” characteristics that the public associates with mature forests.

By contrast, increases of birch ingrowth (Fig. 6b) and density (Fig. 7b) were associated with mortality of upper canopy trees following defoliation episodes due to gypsy moths between 1957-1977. The number of trees killed by defoliation was similar to that removed during partial cutting. Both defoliation-induced mortality and partial cutting create a patchwork of small to medium-sized gaps that result in new birch regeneration (Ward 1992, Ward and Stephens 1996). Because public sentiment is largely opposed to clearcutting, most cutting on public and private lands in Connecticut is partial cutting. The result of the shift to partial cutting will be that our forests will become increasingly dominated by birch in the coming decades.

Viewed across the landscape, the vast forests covering our hillsides and valleys seem as though they have always been there. A different story emerges, however, when you walk along a trail and discover evidence of human impact on the land from earlier generations: overgrown stone walls, a charcoal mound, or a sunken cellar. The resilient Connecticut forest has undergone dramatic changes over the past 400 years, including large-scale land clearing for agriculture, wildfire, hurricanes, and repeated harvesting.



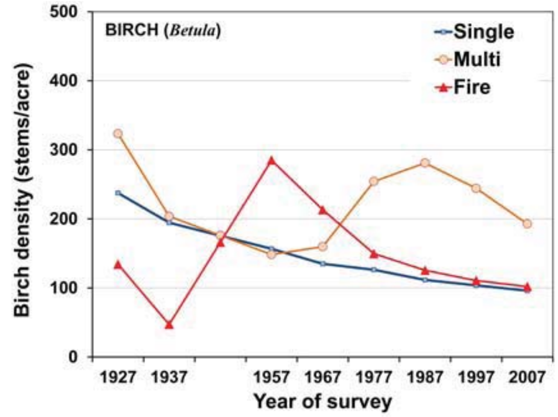


Figure 7. Changes in oak and birch density (stems/acre) by disturbance type and survey year. Single: single-year defoliation events, Multi: Multi-year defoliation events, Fire: wildfire in 1932

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Jeffrey S. Ward, Ph.D. was raised in Milan, Ohio, the birthplace of Thomas A. Edison. He received his BS (forest biology) and MS (silviculture) at The Ohio State University, and after time in the Peace Corps (Guatemala), he received a PhD (forest ecology) at Purdue University. He has been in the Department of Forestry & Horticulture at The Connecticut Agricultural Experiment Station since 1987 and is currently the Chief Scientist. His early research focused on long-term population dynamics in unmanaged forests. His more recent work has included control and impact of invasive species such as Japanese barberry, alternative forest management practices, forest health indicators at watershed scales, and examining the impact of deer damage in unmanaged forests. He is the author or co-author over 80 papers and averages over 30 presentations per year to the public and natural resource professionals.

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The mission of The Connecticut Agricultural Experiment Station is to develop, advance, and disseminate scientific knowledge, improve agricultural productivity and environmental quality, protect plants, and enhance human health and well-being through research for the benefit of Connecticut residents and the nation. Seeking solutions across a variety of disciplines for the benefit of urban, suburban, and rural communities, Station scientists remain committed to “Putting Science to Work for Society”, a motto as relevant today as it was at our founding in 1875.

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