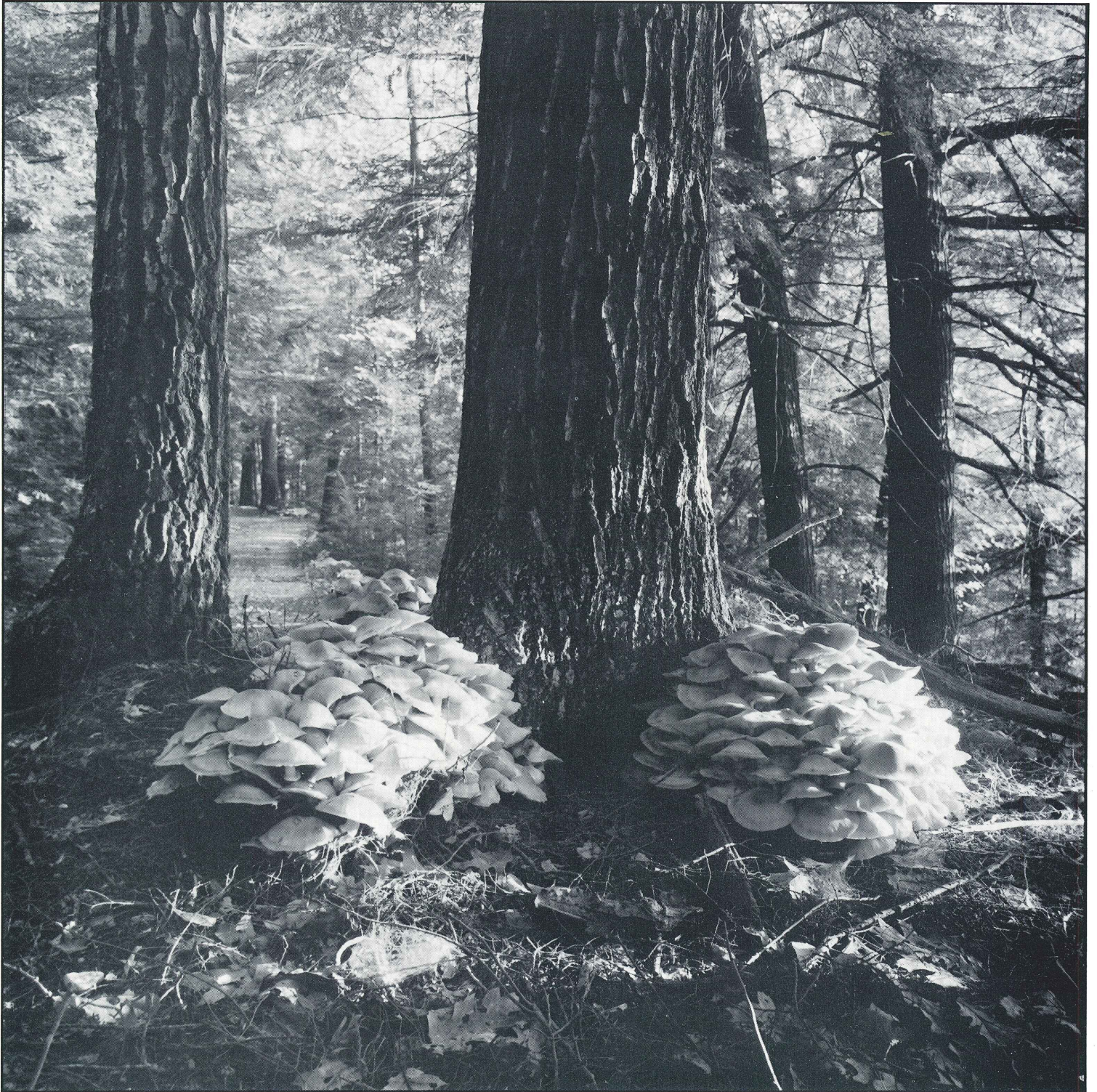


THE HARVARD FOREST 1992 - 93

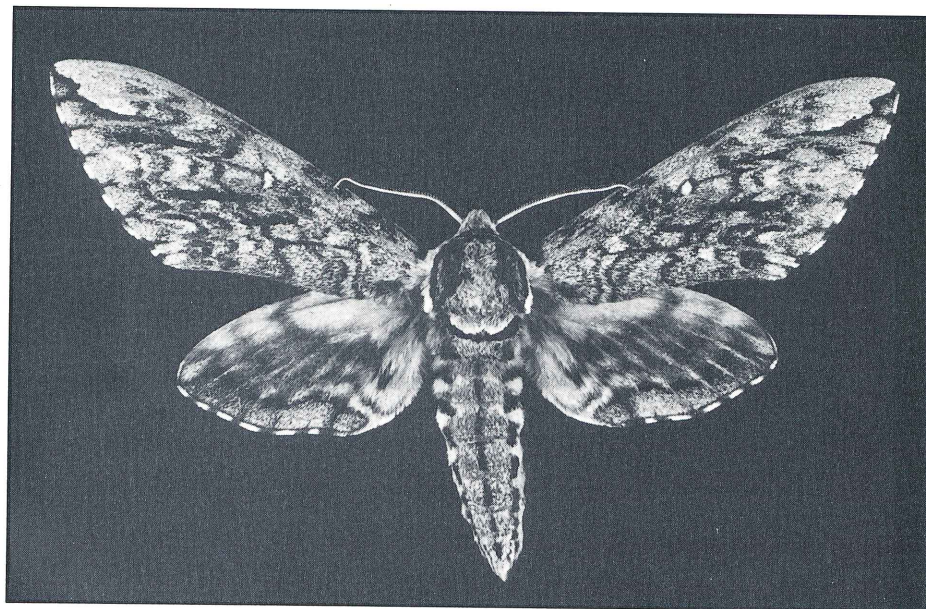
Harvard University



ANNUAL REPORT OF THE HARVARD FOREST 1992-1993

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Photography by Marcheterre Fluet

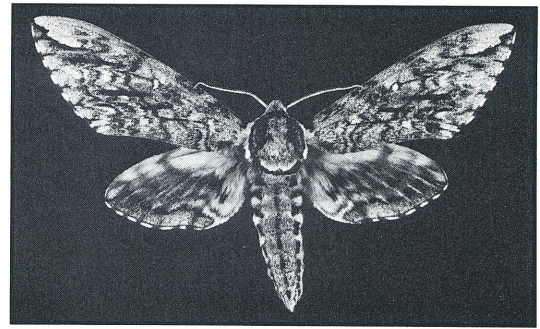
PERSONNEL AT THE HARVARD FOREST 1992-93

Taber D. Allison
 Wendy Anderson
 Richard D. Boone
 Emery R. Boose
 Jeanne M. Boutelle
 Jeannette M. Bowlen
 Gary C. Carlton
 Jan Cermak
 Lloyd Demetrius
 Sean M. Divoll
 Elaine D. Doughty
 Natalie Drake
 John A. Edwards
 Enos Esikuri
 Ned Fetcher
 Marcheterre Fluet
 Barbara J. Flye
 David R. Foster
 Lisa George
 Fritz Gerhardt
 Steven P. Hamburg
 Deborah Y. Hebert
 Donald E. Hesselton
 Douglas A. Hesselton
 Steven R. Holmes
 Dai P. Huynh
 Kathleen M. Keith
 Oscar P. Lacwasan
 Richard A. Lent
 Ann L. Lezberg
 Catherine M. Mabry
 Glenn R. Matlack
 Ellen G. Moriarty
 Glenn H. Motzkin
 John F. O'Keefe
 Gloria Rapalee
 Hugh M. Raup

Charles C. Spooner
 Russell D. Stafford
 Lynne Stopen
 Victor K. Teplyakov
 C. Dana Tomlin
 P. Barry Tomlinson
 John G. Torrey

Meegan Wallace
 Gordon G. Whitney
 John S. Wisniewski
 Steven C. Wofsy

Paleoecologist
 Summer Cook, 1992
 Soil Ecologist
 Computer Scientist
 Custodian
 Accountant
 PhD Candidate, OEB
 Charles Bullard Fellow
 Charles Bullard Fellow
 Woods Crew (part-time)
 Laboratory Assistant (part-time)
 Palynologist (part-time)
 Forest Manager
 Charles Bullard Fellow
 Charles Bullard Fellow
 Research Assistant
 Librarian/Secretary
 Director of the Harvard Forest
 PhD Candidate, OEB
 MFS Candidate
 Charles Bullard Fellow
 Summer Cook, 1993
 Woods Crew
 Woods Crew (part-time)
 Woods Crew (part-time)
 Woods Crew (part-time)
 Research Assistant
 Custodian
 Data Manager/Ecologist
 Research Assistant
 Research Assistant
 Charles Bullard Fellow
 Graphic Artist (part-time)
 Research Assistant
 Museum Coordinator
 GIS Assistant
 Charles Bullard Professor of
 Forestry, *Emeritus*
 Woods Crew
 MFS Candidate
 Woods Crew (part-time)
 Charles Bullard Fellow
 Associate of the Harvard Forest
 E. C. Jeffrey Professor of Biology
 Charles Bullard Professor of
 Forestry, *Emeritus*
 Historical Ecologist (part-time)
 Historical Ecologist
 Woods Crew
 Associate of the Harvard Forest



INTRODUCTION TO THE HARVARD FOREST

Since its establishment in 1907 the Harvard Forest has served as a base for research, education and demonstration in forest biology. Through the years researchers at the Forest have focussed on silviculture and forest management, soils and the development of forest site concepts, the biology of temperate and tropical trees, forest ecology and economics and ecosystem dynamics. Today, this research legacy continues as the research staff and visiting scientists seek to understand historical and modern changes in the forests of central New England resulting from human and natural disturbance processes. This research activity is epitomized by the Harvard Forest Long Term Ecological Research (HF LTER) program, which was established in 1988 through funding by the National Science Foundation (NSF).

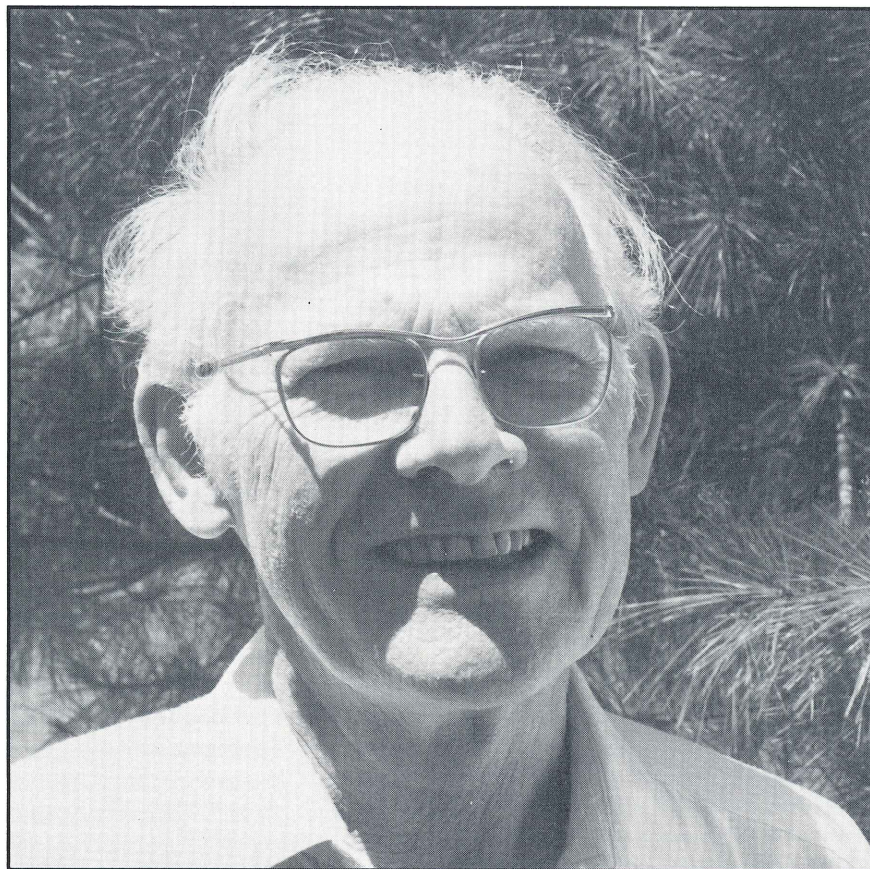
Physically, the Harvard Forest is comprised of approximately 3000 acres of land in Petersham, Massachusetts that include mixed hardwood and conifer forests, ponds, extensive spruce and maple swamps, and diverse plantations. Additional land holdings include the 25-acre Pisgah Forest in southwestern New Hampshire, a virgin forest of white pine and hemlock that was 300 years old when it blew down in the 1938 Hurricane; the 100-acre Matthews Plantation in Hamilton, Massachusetts, which is largely comprised of conifer plantations; and the 90-acre Tall Timbers Forest in Royalston, Massachusetts. In Petersham a complex of buildings that includes Shaler Hall, the Fisher Museum and Torrey Laboratories provide office and laboratory space, computer, greenhouse, and growth-chamber facilities, and a lecture room and lodging for seminars and conferences. An additional six houses and apartments provide housing for staff, visiting researchers and students. Extensive records of plant research, long-term data sets and historical information are maintained in the Harvard Forest archives.

Administratively, the Harvard Forest is a department of the Faculty of Arts and Sciences (FAS) of Harvard

University, with the Director reporting to the Dean of FAS. The Harvard Forest administers the Graduate Program in Forestry that awards a Masters degree in Forest Science. Faculty at the Forest offer courses through the Department of Organismic and Evolutionary Biology (OEB), which awards the PhD degree, and through the Freshman Seminar Program. Close association is maintained with the Department of Earth and Planetary Sciences and the Graduate School of Design (GSD) at Harvard and with the Department of Forestry and Wildlife Management at the University of Massachusetts, the Ecosystems Center (Marine Biological Laboratory, Woods Hole), and the Complex Systems Research Center at the University of New Hampshire.

The staff of approximately 40 work collaboratively to achieve the research, educational and management objectives of the Harvard Forest. A sub-group of researchers meet monthly to discuss current activities and to plan future programs. Regular meetings with the HF LTER science team and with the Harvard Forest Advisory Committee provide for an infusion of outside perspectives. Forest management and physical plant activities are undertaken by our three-man Woods Crew and directed by the Forest Manager. The Coordinator of the Fisher Museum oversees many of our educational and outreach programs.

Funding for the base operation and staff at the Harvard Forest is derived from endowments, whereas research activities are supported with grants primarily from the federal government. Major research support comes from the National Science Foundation, Department of Energy (National Institute for Global Environmental Change), U.S. Department of Agriculture, and the Andrew W. Mellon Foundation. Our Summer Program for Student Research is supported by the National Science Foundation, the Northeastern Consortium for Undergraduate Science Education (Pew Charitable Trust) and the R. T. Fisher Fund of Harvard Forest.



JOHN G. TORREY 1921 - 1993

The Harvard Forest suffered a great loss in January with the death of John Torrey, Professor and Director, *Emeritus*. As a Harvard faculty member for 30 years and a member of the National Academy of Sciences, John led a brilliant scientific career in the field of plant development and microbial symbioses. More importantly, he was a great mentor and teacher who guided the personal development of students, colleagues and friends through his wise understanding of science and people and his balanced approach to life.

John's last achievement in biology was an unexpected one. As Director of Harvard Forest from 1984 to 1990, John reoriented the Forest towards field biology and

ecological studies and served as principal investigator on the LTER proposal and project. John's ability to work with people and the University administration provided the impetus and foundation for the interdisciplinary and multiple-institution program that has developed at the Harvard Forest. This accomplishment, in a field well outside his own, is one of many testaments to his special abilities.

Following retirement John directed his energies toward his other passion: art collecting, particularly 19th Century British and American etchings. His family, colleagues, and the Harvard Forest group were kept entertained and challenged by his new discoveries and writings until his untimely, though peaceful passing at home shortly after Christmas.

In a Stand of Trees

*We leave your body in a stand of pines
to nourish the soil with sifting white ash,
strong bone turned to fresh dust.
Once you fertilized this forest
with the gifts of your mind.
Now, in leaving, your body takes over.*

*We gaze into dioramas of centuries ago,
reliving the history of the Forest
when these acres were the province
of deer and squirrel,
untouched by curious minds.*

*How would a diarama commemorate you?
A man in a beige fishing hat
and short-sleeved cotton shirt
with eyes the light grey-blue
of certain skies,
kneeling to study the roots of a small plant
and explain to a visitor
what he knows.*

*Son of Puritans,
a man of hidden feelings and
many daughters,
he filled the word Integrity
with flesh and blood.*

*Never simply playing at life,
he found substance and humor
in out of the way places.
One had to know him a little,
to catch his passions,
like the gleam of a fish
caught in sunlight.*

*Furthering Science with the
fruits of his research,
now he gives to the soil
his own body.*

*In the still heat of this
August day,
we lay him to full rest,
sorry that he is not
here with us, hat in hand,
to point up into the trees,
or down at the earth,
sharing his faith
in that which grows.*

Joanna Torrey

RESEARCH ACTIVITIES

Research at the Harvard Forest addresses basic questions concerning the development and dynamics of all components of forest ecosystems, with an emphasis on eastern North America. These studies take advantage of the excellent research facilities and detailed histories of the 3000-acres of forest that comprise our main study area. We involve scientists and students from other institutions to bring additional perspectives to our research program, and we place results from studies in Petersham into a broader context through regional investigations and comparative research in other ecosystems.

Regional Studies of Vegetation and Ecosystem Dynamics

Over the past 500 years the landscape of central New England has undergone tremendous changes through vegetation response to natural processes such as climate change, windstorms and fire and to human impacts such as forest clearance, logging and agriculture. Thorough understanding of these changes is critical to the interpretation of the modern vegetation and its potential for change in the face of future natural and human disturbance. In order to provide this information for central New England we have developed a coordinated research effort that involves paleoecologists, soil scientists, and community, population and ecosystem ecologists in studies that combine two approaches: (1) the use of historical techniques to place our modern studies in a broader temporal context, and (2) the analysis of landscape to regional processes to place our intensive experimental studies at the Harvard Forest in a broader spatial context. The major emphasis of this work has been on the impact of land-use and wind-damage on forest ecosystems.

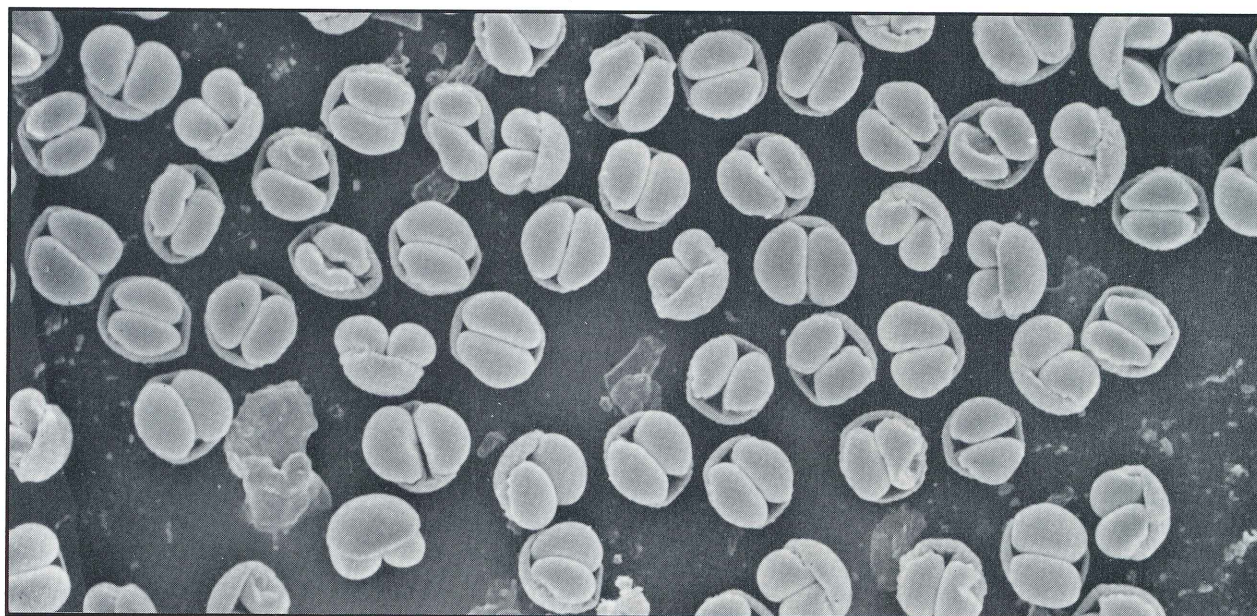
Paleoecological Studies

The analysis of pollen and other fossil plant and animal remains in lake sediments, wetlands and forest soils provides a long-term record of changes in upland and aquatic ecosystems. We are currently analyzing these records to assess the natural characteristics and dynamics of the central New England landscape during a 500-1000 year period before European settlement and to contrast this with conditions resulting from human land-use. A network of twelve small lakes are being investigated across the region by T. Allison, N. Drake and E. Doughty to understand broad scale patterns. Mike Binford of the Graduate School of Design at Harvard is analyzing the chemistry and physical characteristics of the lake sediments in order to reconstruct the responses of the lake systems to changes on the uplands. In a related study D. Foster, T. Allison and others are analyzing pollen in humus soils of older growth forests at Harvard Forest to examine stand-level responses to natural and human disturbance.



Taber Allison, Wenda Luff and Elaine Doughty

Results to-date depict regional variation in pre-settlement forest composition, fire frequency and vegetation dynamics that parallel regional gradients in climatic variables, Indian activity and European settlement patterns. Pollen records and early historical records depict a great abundance of oak, hickory and pitch pine in the Connecticut River Valley and more beech, hemlock, maple and birch at higher elevations. Beech, hemlock and sugar maple all decreased tremendously following clearing and burning activity associated with European settlement, and lake sediments contain a record of increased erosion commencing at that time. The project is also providing the first assessment of the importance of fire in central Massachusetts. As anticipated, sites investigated in the Connecticut River Valley reveal a history of frequent fires, presumably due to substantial Indian activity, relatively warm conditions, and extensive sand plains and level terrain in the valley. In contrast the hilly uplands of central Massachusetts around Petersham experienced less fire.



Pollen grains of *Pinus mugo*, Scanning Electron Micrograph to show their preferred orientation when floated in water. Photography by Michael Schnitzlen, University of Massachusetts.

Hurricane Impacts to Forest Ecosystems

Recognizing the important role that catastrophic wind plays in controlling the structure of many ecosystems in eastern North America and the Caribbean, Harvard Forest researchers have undertaken a major study of hurricane impacts on forests. At the broadest scale Emery Boose has developed a meteorological model that enables the reconstruction of tropical storms and an exposure model that allows meteorological output to be used to assess landscape-level damage patterns from individual storms. Based on reconstructions of the 1938 hurricane in New England and Hurricane Hugo in Puerto Rico, Emery, D. Foster and M. Fluet have completed a manuscript on hurricane effects on forest ecosystems. David presented an overview of temperate and tropical hurricane disturbance regimes with Emery at the IUFRO conference on wind damage held in Edinburgh in August. Current efforts involve reconstructing the wind conditions for all historical hurricanes in northeastern New England and Puerto Rico in order to understand regional and landscape-level variation in exposure to hurricane winds. To further these efforts Emery has modified his meteorological model to treat land and water sites differently and to predict both sustained wind and peak gust speeds.

Intensive studies of simulated hurricanes (pulldowns) on the Tom Swamp and Prospect Hill tracts are providing detailed information on damage patterns, plant survival, reproduction and physiology, micrometeorology and ecosystem response. A. Lezberg is coordinating efforts to assess damage patterns and vegetation development.

Significant results include the observation of extensive survival of uprooted and damaged plants and the importance of vegetative reproduction in vegetation development. Interspecific variation in survival and sprouting is quite high; overall there is a very rapid recovery of continuous leaf cover across the area.

Reproduction by seedlings is also important and G. Carlton and F. Bazzaz are coupling ecophysiological studies of tree seedlings with measurements of microsite environments and surveys of seed dispersal and germination to produce a population-level model of tree regeneration following hurricanes. Studies of white, black and yellow birch show that white birch has the highest light-saturated photosynthetic rates and attains greatest biomass and height when growing on tip-up mounds. Observations suggest that many of the birch trees on tip-up mounds originated as saplings growing near the base of the canopy trees that were subsequently uprooted by the wind.

The rapid rate of re-leafing and vegetation development results in quite rapid recovery of the biotic control of ecosystem processes following wind disturbance. In studies of trace gas fluxes on the blowdown by R. Bowden of Allegheny College and M. Castro and P. Steudler of the Ecosystem Center-MBL it was revealed that soil fluxes of methane, carbon dioxide and nitrous oxide were no different than in the adjoining intact forest. The integrated study of physiology, community and ecosystem response is revealing that temperate forests are extremely resilient to damage from what appears to be catastrophic disturbance events.

Land-use Impacts in Central New England

To interpret the impact of deforestation, agricultural activity, reforestation and logging activity on our forests D. Foster and R. Boone are coordinating a project consisting of three parts: (1) assessment of regional changes in forest cover and composition, 1650-present; (2) analysis of modern forest conditions in relationship to historical and environmental factors; and (3) evaluation of long-term changes in soils and ecosystem function. For the regional analysis M. Wallace worked with David to compile quantitative data on tree composition from surveys records made for each town at the time of first settlement. G. Motzkin, C. Mabry, G. Rapalee and M. Wallace transcribed and digitized historical maps of forest cover for 1830 and 1937 and C. Mabry coordinated the sampling of the modern vegetation across a 36-township region to complete the data base. When combined with other historical data and the paleo-ecological record this information should provide a concise picture of regional vegetation change since European settlement.

Analysis of the relationship between the modern vegetation and environmental and historical factors involves the following projects: detailed analysis of Prospect Hill (C. Mabry, G. Motzkin), the Montague sand plain (G. Motzkin, J. Harrod), and the town of Petersham (F. Gerhardt) and broader-scale analysis of the greater Petersham area by G. Whitney. For each of the detailed studies extensive soil analysis has been undertaken by K. Keith, M. McCall and A. Allen in conjunction with R. Boone. Analyses indicate that groups of plant species display specific affinity to

particular land-uses and that these tendencies may be explained on the basis of plant life-history characteristics. For example, species restricted to old forest sites that were never cleared for agricultural use tend to be characterized by poor dispersal and low germination rates.

On the basis of physical soil characteristics it is possible to discriminate former pasture and former plowed land from continuously wooded sites; current efforts are directed towards evaluating chemical and biological soil characteristics that may result from these different land uses. On an ecosystem level the major changes in forest cover over the past 300 years have exerted a pronounced impact on carbon dynamics in the New England landscape that may be important on a global scale. S. Wofsy recently published results from the atmospheric-biosphere monitoring program that documents a high rate of net carbon storage by our forests. Ongoing studies seek to evaluate carbon uptake rates in forests of different land-use and to distinguish the relative importance of above and below-ground carbon storage.

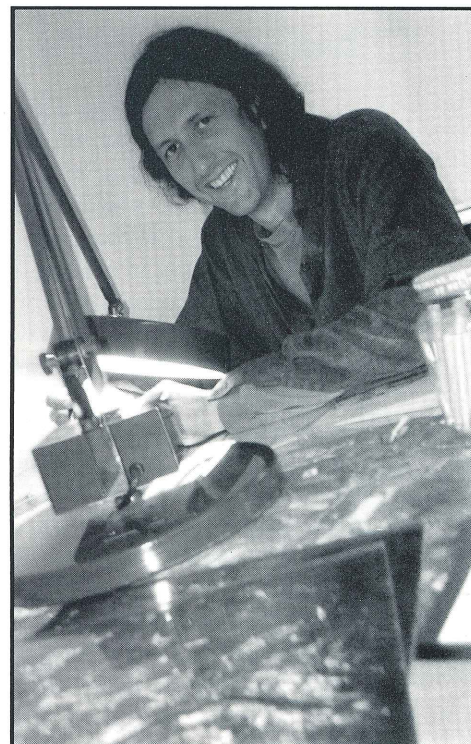
Further extension of the land-use research involves studies of human impacts on the population ecology of animal species, primarily birds, butterflies and moths. In this project T. Allison and R. Lent hope to determine the effect of deforestation and subsequent successional changes on several species of *Lepidoptera* and their host plants. This project was initiated during the past summer by collecting data on *Lepidoptera* distributions in fields throughout Petersham.



Jason Kaye, Rich Boone, Pat Micks and Melinda McCall



Art Allen



Glenn Motzkin

Central Massachusetts Forest Cover

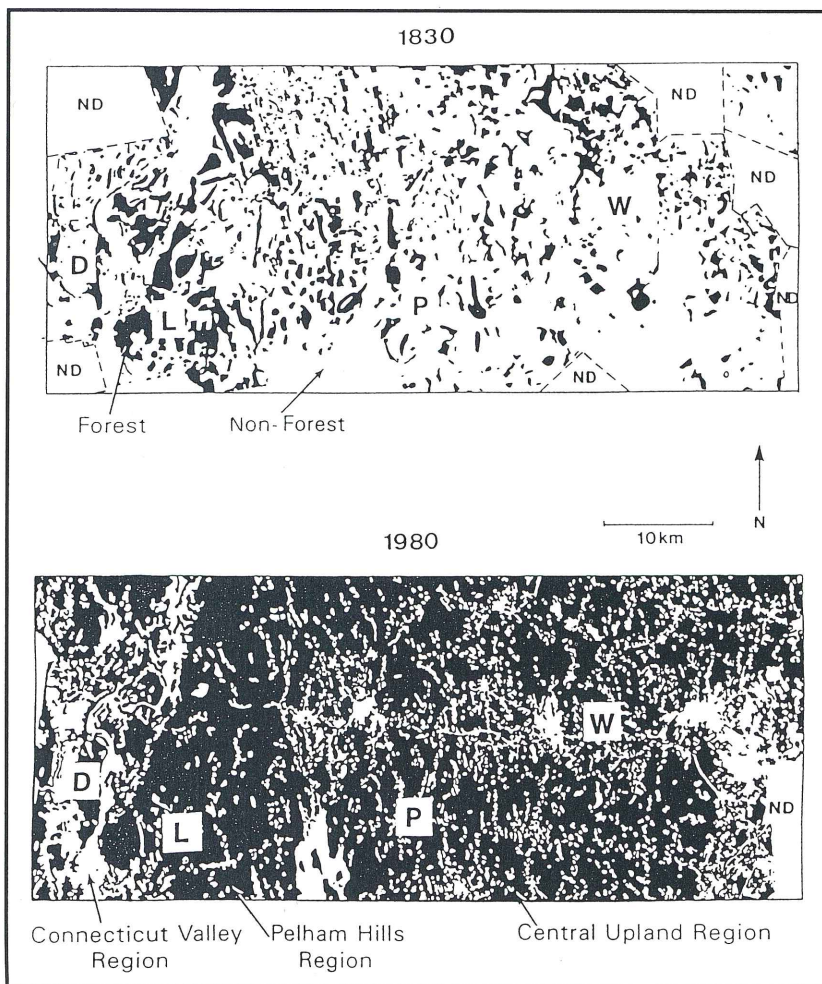


Figure 1. Changes in forest cover in central Massachusetts, 1830 to 1980. Broad-scale deforestation for agriculture through the mid-19th C produced a landscape of scattered woodlots and extensive pastures and fields. Abandonment of agricultural land has resulted in extensive natural reforestation. Visible in the lower figure are the Connecticut River Valley running north-south, Route 2 running E-W and the towns of Deerfield (D), Leverett (L), Petersham (P) and Westminster (W). ND = no data.

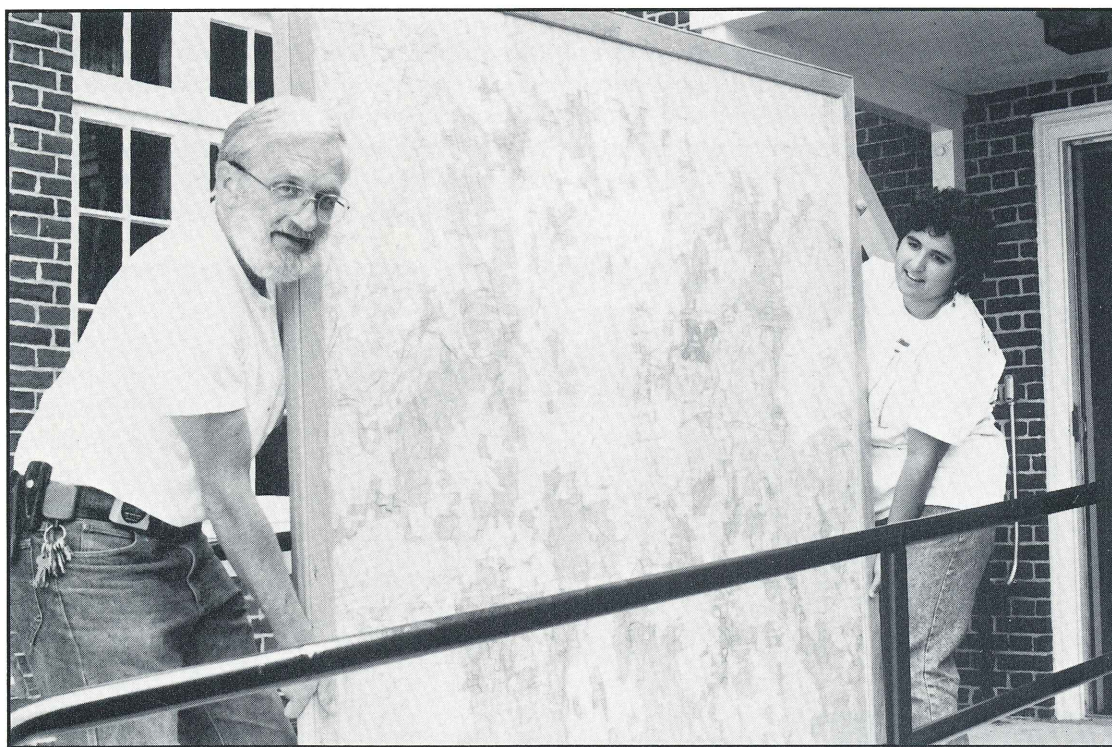
Conservation Biology of Central New England Forests

Responding to the tremendous interest of conservation biologists on the effect of habitat alteration and fragmentation on species distributions, researchers at the Harvard Forest are utilizing their extensive data base on land-use, vegetation change and ecosystem legacies to interpret the effects of historical habitat alteration and to apply this in the conservation of the modern landscape of central New England. On the Montague sand plain G. Motzkin, A. Allen, J. Harrod and D. Foster have determined that the unusual vegetation of pitch pine forests and scrub oak barrens is the result of extensive agricultural activity, forest cutting and frequent burning. An understanding of the history of this vegetation will assist in the interpretation of the rare *Lepidoptera* species associated with these habitats and in future management of pine plains in New England.

In the Petersham and North Quabbin region A. Golodetz has finished compiling historical maps of preserved land owned by private conservation groups and public agencies. Within the 170,000-ha study region

approximately 37% (62,200 ha) is currently protected, with the majority held in state ownership. Working with the Massachusetts Natural Heritage Program, University of Massachusetts, and Mt. Grace Conservation Land Trust, Alisa and D. Foster will analyze the biological and physical characteristics of this protected land in comparison to unprotected lands. Of interest will be the distribution of past land-use activities, and current distribution of rare species and communities. This information will be of great use for assessing the current value of the land and for the identification of additional sites for protection.

With regard to the identification of rare species and communities in the region, G. Motzkin is continuing his work of inventorying plant communities throughout the Connecticut River Valley and adjoining uplands. With funding from the Massachusetts Natural Heritage and Endangered Species Program and the Nature Conservancy, Glenn has surveyed sandbar grasslands, limy seepages, flood plain forest, pitch pine sand plains and trap rock ridge communities.



Donald Hesselton and Alisa Golodetz move the completed map of protected lands of central Massachusetts into Shaler Hall for display in the main hallway.

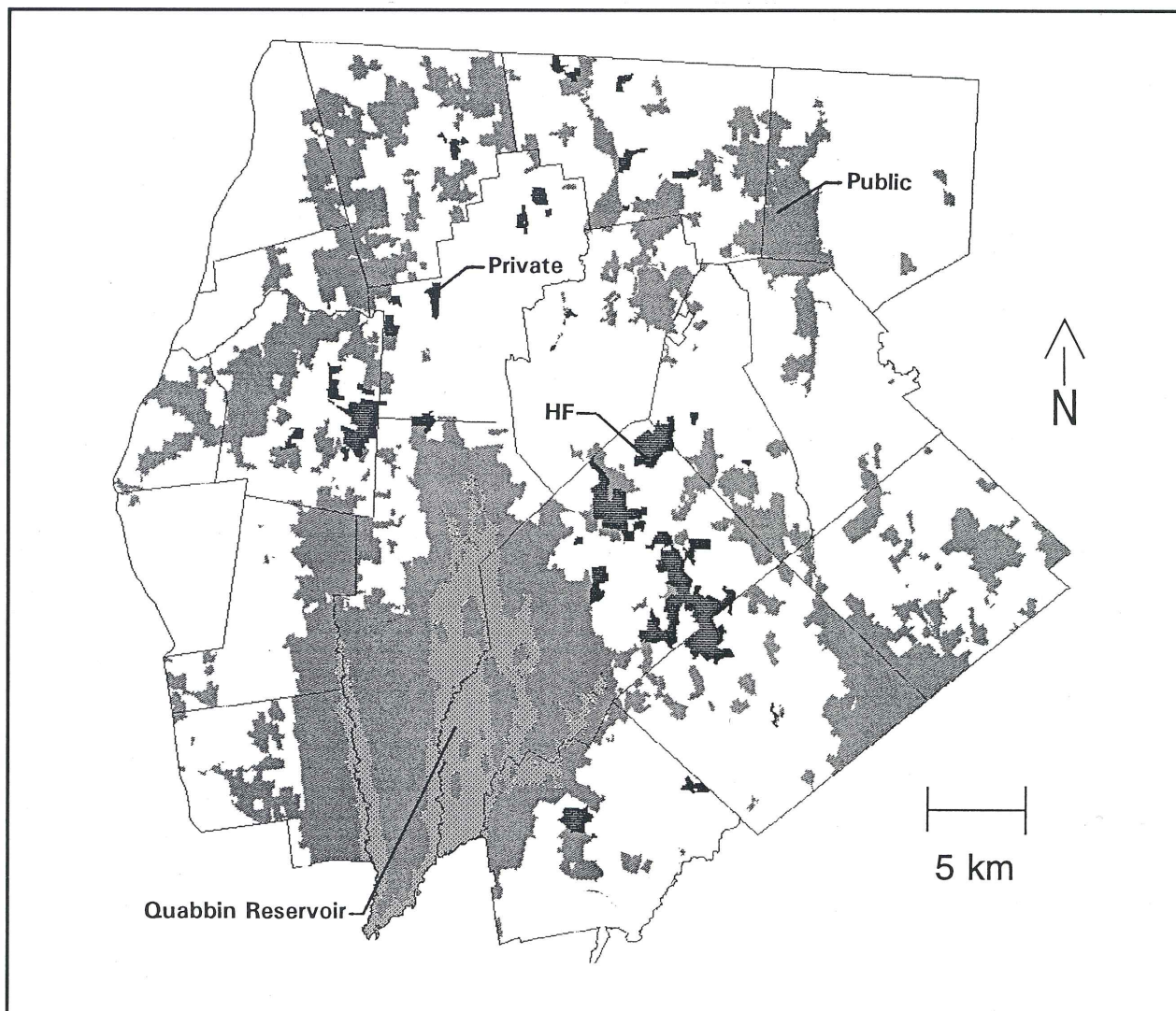


Figure 2. Protected lands in the North Quabbin area of central Massachusetts. Township outlines are indicated as is the shoreline of the Quabbin Reservoir. Protected areas are discriminated as private or public and the location of the Prospect Hill tract of Harvard Forest is marked HF.

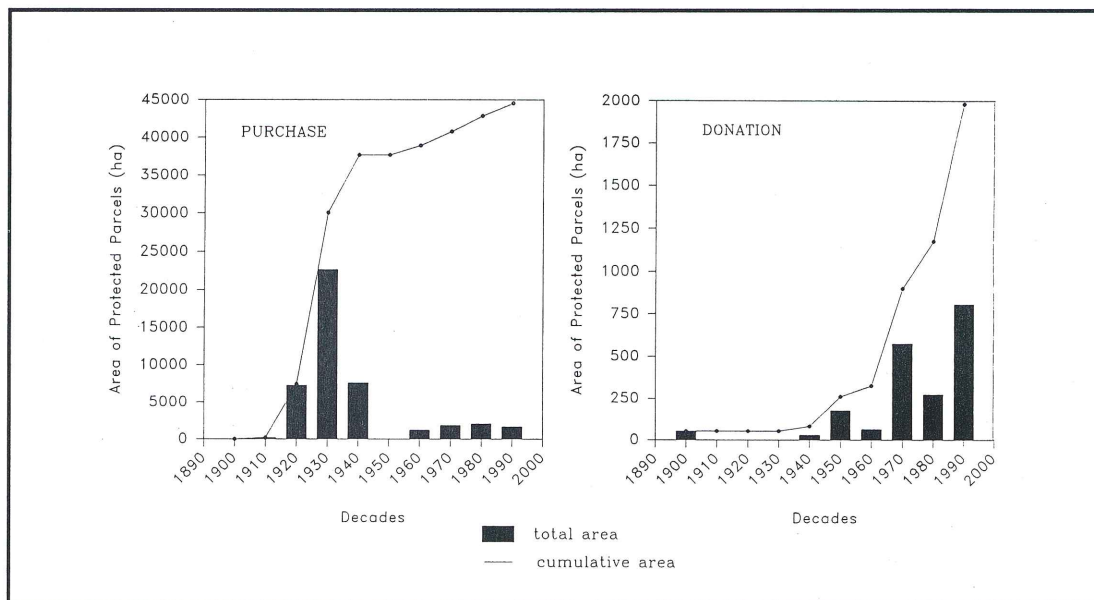


Figure 3. Acquisition history of the protected land in the North Quabbin area (note different scales). Although purchase was the primary mode of acquisition, donations of land or conservation easements have increased in the last few decades.

Soils and Ecosystem Studies

Rich Boone and Knute Nadelhoffer (MBL - Ecosystems Center) completed the assessment of topography and trees on the DIRT (Detrital Inputs, Removal, and Trenching) study area, continued field measurements of soil CO₂ efflux, began sampling soil water with tension lysimeters, and continued a long-term (> 12 months) laboratory incubation study to determine initial conditions for potentially mineralizable carbon and nitrogen. By the fall 1992 the entire study area (1.86 ha) was surveyed, a 10 m x 10 m grid was installed, and all live plus dead trees (> 10 cm dbh) were surveyed and mapped. The digitized tree map will be used to evaluate long-term changes in forest resources over the study area. Other activities during the 1993 summer include installation of time domain reflectometry (TDR) units and soil probes on the plots to monitor soil moisture and temperature. Also, Rich and Knute will evaluate the use of an IRGA system to monitor soil respiration with both static and flow-through chambers. In order to assess regional and ecosystem differences in the controls on soil organic matter storage, they continue to explore the replication of this study across other LTER sites.

In early summer 1993 Kim McCracken, a Master's student working with Bill McDowell at the University of New Hampshire, began field work on the DIRT plots to determine the sources of dissolved organic carbon (DOC) and dissolved organic nitrogen (DON). With help from

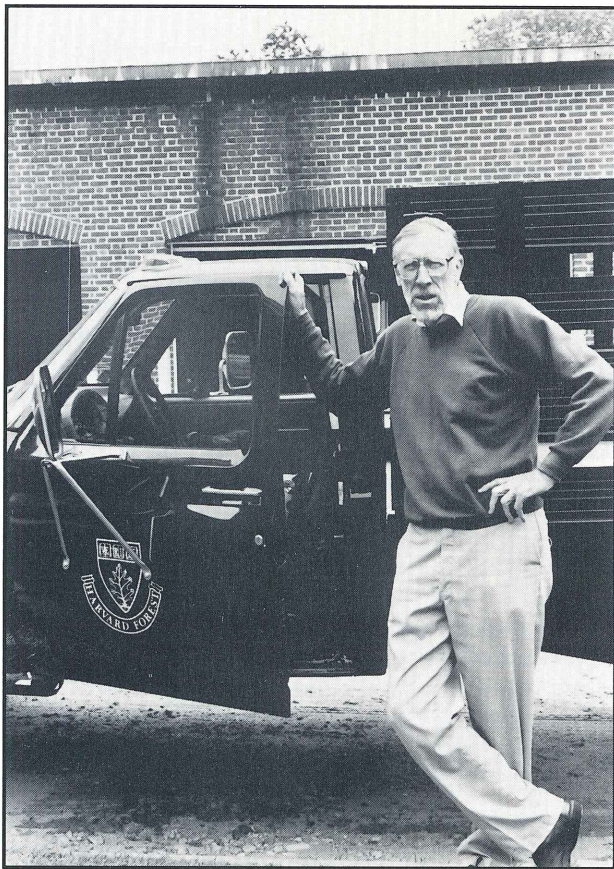
Phoebe Goodwin (NIGEC summer research assistant) Kim installed zero tension lysimeters (ZTL) beneath the forest floor on all plots. The ZTL's will allow Kim to attribute DOC and DON production to young (1-3 year old) leaf litter, older leaf-derived organic matter, and root detritus plus root exudates.

Animal Ecology

Richard Lent initiated several studies shortly after assuming the position of animal ecologist at the Harvard Forest. During the summer 1993 a breeding bird survey and habitat analysis of Prospect Hill was designed with Dan Cooper, a Harvard undergraduate. Martha Schumann, a student at Amherst College, worked on an intensive study of the butterfly ecology and vegetation of two field habitats on the Prospect Hill and Tom Swamp tracts. A second butterfly project, with the assistance of Jennifer Thaler, focussed on butterfly species diversity and its relationship to vegetation and landscape variables on ten grassland sites in the Petersham area. These projects will be tied to statewide analyses of bird and butterfly data collected by the Massachusetts Audubon Society. Rich and John Edwards hired a surveyor to establish a 100-meter grid system across the entire Prospect Hill tract to provide a highly accurate spatial reference system for biological sampling.



Rich Lent, Dan Cooper, Jennifer Thaler and Martha Schumann



Barry Tomlinson

Developmental and Reproductive Biology

Barry Tomlinson was on sabbatical leave in 1992-93. For the period August 1992 - March 1993 he conducted field research on the reproductive biology of the southern coniferous family Podocarpaceae (podocarps) centered in New Zealand, but with visits to Tasmania, Queensland, New South Wales and Fiji. This research was supported by a grant from the National Geographic Society. In August, en route to New Zealand, he presented a paper at the annual meeting of the American Institute of Biological Sciences, held in Honolulu, Hawaii. Complementing the research on conifers in the southern hemisphere was an extension of basic ideas to northern conifers during their period of pollination (March-June), with especial attention to the living collections of the Arnold Arboretum. The Podocarpaceae and Pinaceae share the common feature of bisaccate ("winged") pollen. By direct observation of the behavior of pollen when retained by the pollination drop on the ovule the functional morphology of this type of pollen has been elucidated.

With Barry Tomlinson, Taber Allison has initiated a study of the ecological implications of the indeterminate seed-bearing axis in the genus *Taxus*. They hypothesize that this morphology enables species in the genus to respond to varying levels of pollen availability and stress through the production of ovules. Taber is also continuing his work on *Taxus* reproductive ecology and is interested in determining the influence of plant spacing and dispersion on the ability of wind-pollinated plants to donate and receive pollen and ultimately, the gender of the plant. He is con-

is continuing his field work on the long-term impact of deer-browsing on Canada yew reproductive ecology at the Apostle Islands National Lakeshore in Lake Superior. With the assistance of summer researchers Taber has initiated studies on the distribution and genetics of Canada yew populations. Taber is also continuing work on the reproductive ecology of two species of prairie grass, big bluestem and Indian grass, started when on the faculty of Ohio State University.

Tropical Land-use History and Forest Dynamics

In collaboration with the Luquillo LTER site in Puerto Rico and in parallel with studies in New England, Harvard Forest researchers are conducting studies on land-use impacts to tropical forest ecosystems. M. Fluet completed the air photo interpretation of vegetation maps for 1936 and 1989 for the 11,000-ha Luquillo Experimental Forest. Using a Geographic Information System, Marcheterre, E. Boose and D. Foster will assess the changes in vegetation over this period and interpret the relative importance of land-use and hurricane impacts. In May, K. Keith and R. Boone visited Diana Garcia and Dan Binkley (Colorado State University) and X. Zou (University of Puerto Rico) for three days in Puerto Rico to discuss Diana's work on land-use legacies and soils. In essentially a tropical analog for the soils and vegetation studies on Prospect Hill, Diana will examine whether prior land-use influences soil nutrient stocks and nutrient cycling.

Harvard Forest LTER Program

The Harvard Forest is one of eighteen sites forming the Long Term Ecological Research (LTER) program sponsored by the National Science Foundation. Each site addresses ecological questions of a long-term nature; collectively the sites undertake comparative studies across ecosystems. Representatives from the LTER sites, U.S. funding agencies and international research groups meet twice annually to develop collaborative studies.

The central theme of the Harvard Forest LTER is a comparison of historically-important physical disturbances and modern chemical disturbance in terms of their effect on forest ecosystem structure and function. One fundamental question is whether chronic, low-level additions of pollutants can result in more long-lasting alterations of ecosystem functions than does the historical regime of disturbance.

The research project involves soil scientists, atmospheric chemists, and ecologists studying physiological, population, community and ecosystem processes. Principal investigators represent the Departments of Biology (F. Bazzaz), Earth and Planetary Sciences (S. Wofsy), and Harvard Forest (D. Foster, T. Allison, R. Boone, E. Boose, R. Lent, B. Tomlinson) at Harvard University as well as The Ecosystems Center - MBL (J. Melillo, K. Nadelhoffer, P. Steudler), the Complex Systems Research Center at the University of New Hampshire (J. Aber) and the University of Massachusetts (W. Patterson III). The research is organized to maximize the interactions and exchanges among scientists from different disciplines. Four core experiments include: (1) recreation of physical disturbances, including catastrophic hurricane blowdown and smaller windthrows;

(2) simulation of chronic chemical disturbance by altering inputs of important pollutants; (3) interactions between physical and chemical disturbances; and (4) repetition of treatments to assess the range of variation in response.

The LTER science group meets approximately monthly. The annual Harvard Forest Ecology Symposium is held to present current research. Abstracts from this meeting are published annually. The program for the 1993 Symposium is shown on the following page.

National Institute of Global Environmental Change (NIGEC)

Harvard University serves as the Northeastern Regional Center for the NIGEC program sponsored by the Department of Energy. The purpose of NIGEC research is to improve the understanding of mechanisms of global environmental change, to develop innovative experimental and observational programs that enhance the understanding of ecosystem and regional scale processes contributing to global change and to provide educational opportunities in global environmental change research. The Center is administered by the Division of Applied Sciences and a large proportion of the field studies are conducted at the Harvard Forest. Researchers include many of the LTER scientists (Aber, Bazzaz, Boone, Melillo, Wofsy) in addition to faculty from the University of New Hampshire (P. Crill, R. Harris, R. Talbot), State University of New York (D. Fitzjarrald, K. Moore) and Oregon State University (R. Waring and R. McCreight).



Jerry Melillo and Kathy Newkirk from MBL - Ecosystem Center discuss results from the soil warming experiment on the Prospect Hill tract.

HARVARD FOREST ECOLOGY SYMPOSIUM 1993

Titles of Abstracts and Presentations

- J. Aber. Modelling Carbon Flux over the Harvard Forest.
- T. Allison and J. Stachowicz. The Ecological Status of Canada Yew (*Taxus canadensis*) in Central New England.
- J. Amthor. A Mechanistic Model of Carbon Exchange by Harvard Forest.
- S. Bassow and F. Bazzaz. Scaling Leaf-level Photosynthetic Rates to Ecosystem-level Carbon Uptake.
- G. Berntson, E. Farnsworth and F. Bazzaz. Below-Ground Space Utilization and Morphological Allocation in Two Birch Species.
- M. Binford, T. Allison, D. Foster and N. Drake. Post-settlement Changes in Vegetation and Land-water Interactions.
- R. Boone, K. Nadelhoffer, and R. Bowden. Long-term Litter Manipulation (DIRT) Plots at the Harvard Forest.
- E. Boose, D. Foster and M. Fluet. Hurricane Impacts to Tropical and Temperate Forest Landscapes.
- R. Bowden, M. Castro, J. Melillo, P. Steudler and J. Aber. Fluxes of Greenhouse Gases Following a Simulated Hurricane.
- R. Bowden, K. Nadelhoffer, R. Boone and J. Garrison. Contributions of Litter and Root Respiration to Total Soil Respiration.
- F. Bowles, K. Newkirk and J. Melillo. Optimizing TDR Systems for Routine, Long-term Measurements of Soil Moisture.
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- M. Castro, P. Steudler, J. Melillo and C. Kerfoot. Effect of Soil Moisture on Trace Gas Fluxes in Temperate Forest Soils.
- W. Currie, J. Aber, R. Boone and W. McDowell. The Roles of DOC and DON in Ecosystem Responses to Chronic N Additions.
- P. Del Tredici. Early Stages of Burl Development in *Kalmia latifolia*.
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- L. George. Genetic Patch Structure of *Lycopodium clavatum*.
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- A. Golodetz. Historical Patterns of Land Protection in North-Central Massachusetts: the Emergence of a Greenway.
- M. Goulden et al. Forest and Soil Carbon Dioxide Exchange at Harvard Forest.
- R. Harriss and P. Crill. Sources of Atmospheric Methane in the Eastern United States.
- J. Hendricks, J. Aber and K. Nadelhoffer. Assessing the Effect of Nitrogen Availability on Fine Root Turnover Using ^{15}N .
- A. Lewis. Vessel Refilling After Drought Water-stress in Small, Upper Branches of Tall Trees.
- A. Lezberg. Behind the Forest Cottage: a Quarter Century of Change in a Mapped Forest.
- A. Lezberg and D. Foster. Tree Response to Simulated Hurricane Damage: Initial Patterns of Sprouting and Leafout.
- C. Mabry, G. Motzkin and D. Foster. Composition of Forests Related to History and Site Factors II. Life History Analysis.
- A. Magill and J. Aber. Changes in Nitrogen Mineralization, Nitrification and Nitrogen Leaching in the Chronic N Plots.
- M. Martin and J. Aber. The Use of Near Infrared Reflectance to Measure Canopy Chemistry.
- G. Matlack. Persistence of Forest Herbs in Fragmented Landscapes.
- G. Matlack. Wind Dispersal Within and Above a Tree Canopy.
- C. McClaugherty. Initial Decay of Pine and Maple Wood.
- R. McCreight and R. Waring. Seasonal Estimates of Photosynthetic Capacity from Airborne-reflectance Measurements.
- S. Miao and F. Bazzaz. Tree Seedling Growth Enhancements in a High CO_2 Environment Decline Over Three Years.
- P. Micks. Soil Respiration Response to Chronic Nitrogen Application in Two Forest Stands at the Harvard Forest.
- G. Motzkin et al. Land-use History and the Conservation Biology of Pitch Pine-Scrub Oak Communities in the CT River Valley.
- G. Motzkin, C. Mabry and D. Foster. Composition of Forests Related to History and Site Factors I. Community and Floristic Analysis.
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- K. Nadelhoffer and M. Downs. Using ^{15}N Labels to Trace the Fates of Ammonium and Nitrate Additions to Ecosystems.
- K. Newkirk, W. Peterjohn, J. Melillo, F. Bowles and P. Steudler. The Harvard Forest Soil Warming Experiment: 1992.
- J. O'Keefe, and M. Wallace. Regeneration and the Effects of Animal Browsing Following Clearcutting of Red Pine Overstory.
- J. O'Keefe and M. Wallace. Woody Species Phenology, Prospect Hill Tract.
- J. O'Keefe, M. Wallace and B. Wilson. Woody Understory Distribution on the Harvard Forest.
- S. Ollinger and J. Aber. Progress Toward a Regional Model of Physical and Chemical Climate for the Northeastern U.S.
- R. Primack. Dispersal and Disturbance as Factors Limiting the Distribution of Rare Plants.
- R. Talbot and B. Lefer. The Atmosphere-Biosphere Exchange of Nitric Acid (HNO_3) in Mid-latitude Forests.
- V. Teplyakov. Using GIS in the Research of Spatial and Temporal Changes in Plantations.
- S. Thomas and F. Bazzaz. Habitat-Related Differences in Understory CO_2 Concentrations in a Tropical and a Temperate Forest.
- M. Traw and F. Bazzaz. The Development of Gypsy Moth Larvae Raised on Gray and Yellow Birch Foliage Grown in Elevated CO_2 .
- P. Voss and F. Bazzaz. Measurements of CO_2 Heterogeneity in the Forest Using Rapid Simultaneous Sampling.
- M. Wallace and D. Foster. Presettlement Forest Vegetation in Central New England.
- P. Wayne, S. Morse, S. Miao and F. Bazzaz. Interactive Effects of Carbon Dioxide and Soil Moisture Availability on Tree Seedling's Tissue Water Relations, Growth and Niche Characteristics.
- P. Yao, A. Lewis and J. Cermak. The Relationship Between Measured and Theoretical Sap Flow Rates in Canopy Trees.



Glenn Matlack and Ann Lezberg sort the "catch" from a seed rain trap deployed in the canopy of a hardwood stand on Prospect Hill.

BULLARD FELLOWS

The Bullard Fellowship Program in Forest Studies supported four visiting faculty this year: Dr. Lloyd Demetrius; Dr. Glenn Matlack; Mr. Enos Esikuri from Moi University, Eldoret, Kenya; and Dr. Victor Teplyakov from the Moscow Forest Engineering Institute, Russia.

Lloyd Demetrius' work focussed on the stability of ecological communities, the evolutionary dynamics of plant populations and the relation between physiological variables and demographic parameters in plants. In particular, Lloyd has been concerned with developing models in which size rather than age is considered the index of the reproductive state of an individual, and photosynthetic rate rather than basal metabolic rate, an index of its physiological activity.

Enos Esikuri's research at the Kennedy School of Government and at MIT concentrated on the comparative analysis of environmental policies in the United States and in Kenya. In particular, he examined differences in the structure of linkages between macroeconomics and environmental policy in the two countries and methods for developing national accounting systems that include the costs of environmental degradation.

Glenn Matlack developed a computer model simulating the dynamics of herb populations in disturbed forests. He also prepared manuscripts on the demography of forest

herbs, the history of land use in southeastern Pennsylvania, and landscape-scale determinants of forest community structure. He lectured at the Graduate School of Design and the Department of Organismic and Evolutionary Biology at Harvard, the University of Massachusetts at Amherst and the University of Arkansas, and attended meetings in Indiana and Maine. Glenn was also a motivating factor in the renovation of the Harvard Forest Library.

Victor Teplyakov undertook studies of ecosystem management based on geographic information systems, including the development of a data base on Russian forest resources and elaboration of a management plan for conifer plantations on the Prospect Hill tract. Victor prepared four manuscripts for publication and gave seminars at the University of Massachusetts, Virginia Tech, University of Illinois, Duke University, and at Southeastern and Northeastern Forest Experiment Stations of the U. S. Forest Service.

Bullard Fellows for 1993-94 include Evan DeLucia of the University of Illinois; Gong Wooi Khoo of the Universiti Sains Malaysia; Julian Hadley of Johnsonville, New York; Juan Silva of the Universidad de Los Andes, Venezuela; Tim Sipe of Gustavus Adolphus College; Tom Spies of the Forestry Sciences Laboratory, Corvallis, Oregon; and Carlos R. Vazquez-Yanes of Ciudad Universitaria Mexico.

EDUCATIONAL ACTIVITIES

Two students working with D. R. Foster, Russell Stafford and Fritz Gerhardt, were awarded the degree of Masters in Forest Science. Russell's thesis documented temporal variation in growth rates among hemlock trees in the Pisgah Forest preceding and following the 1938 hurricane. Fritz analyzed the role of land-use history and environmental factors as determinants of the composition of the forests of the town of Petersham.

Three undergraduate students completed senior theses on research at the Harvard Forest. Alisa Golodetz from Hampshire College documented the ownership pattern and historical development of conservation and protected lands in the North Quabbin area of central Massachusetts. Also at Hampshire College, April Mills modelled the development of hemlock-hardwood forests using the stand development model JABOWA, and compared her results to those obtained by Earl Stephens utilizing stand reconstruction techniques on an old growth forest in the Tom Swamp tract. Jay Stachowicz completed his thesis at Dartmouth College on the distribution and ecology of the Canada Yew, *Taxus canadensis*.

D. Foster taught Biology 160 "Forest Ecology." Together with B. Tomlinson he led the Harvard Forest Freshman Seminar program, which meets in Petersham over four weekends during the spring term. Both were involved in a new course Biology 205 "Field Biology," which features laboratory sections in Cambridge and field experiments at the Harvard Forest and Concord Field Station. During this past year R. Boone and D. Foster were appointed as Adjunct Faculty in the Department of Forestry and Wildlife Management at the University of Massachusetts. R. Lent received an adjunct faculty appointment at Amherst College in the Department of Biology.

Summer Research Program

A total of 34 undergraduate students and recent graduates were involved in our summer program designed

to provide first-hand experience in ecological investigations. Many students conducted independent research and all participated in a weekly seminar program and excursions to other research sites.

Ned Ajanovic	Allegheny College
Arthur Allen	University of Massachusetts
Rachel Byard	Cornell University
Joel Carlson	University of Massachusetts
Wendy Cass	Oberlin College
Kris Chamberlin	Antioch New England
Meghan Clancy-Hepburn	Swarthmore College
Carol Collier	Williams College
Daniel Cooper	Harvard University
Saara J. Dewalt	Brown University
Robert Ditzion	Harvard University
Germaine Garcia	Connecticut College
Alisa Golodetz	Hampshire College
Phoebe Goodwin	Connecticut College
Jonathan Harrod	Harvard University
Douglas Holland	Harvard Forest
Jason Kaye	University of Virginia
Wenda Luff	University of Massachusetts
John Magnino	Quabbin Regional High School
Melinda McCall	University of Massachusetts
Jennifer Reed	Oberlin College
Gina Rullo	Allegheny College
Elizabeth Ryan	Yale University
Rebecca Sauser	University of Vermont
Martha Schumann	Amherst College
Shannon Scott	Harvard University
Roopal Shanghvi	Harvard University
Kira Sherwood	Yale University
Wendy Smith	Wesleyan College
Laura Suomi	University of New Hampshire
Rebecca Tatum	Amherst College
Jennifer Thaler	Wellesley College
Christine Vanderlan	Cornell University
Martha Varnot	Quabbin Regional High School



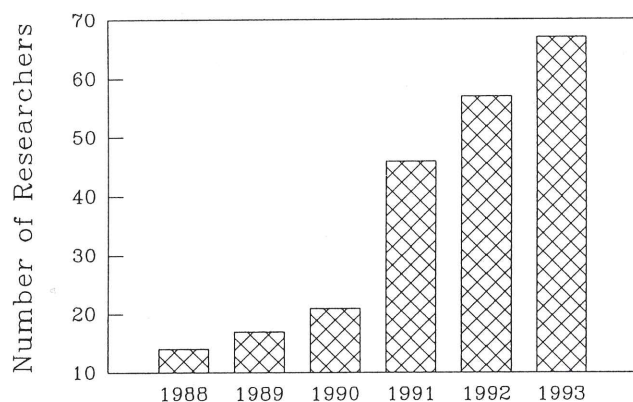
As part of the Freshman Seminar students watched a horse logging operation on the Prospect Hill tract.

Summer Research Program 1993



Rich Bowden leads an evening research discussion group

Senior Researchers & Graduate Students



Summer Undergraduate Research Program

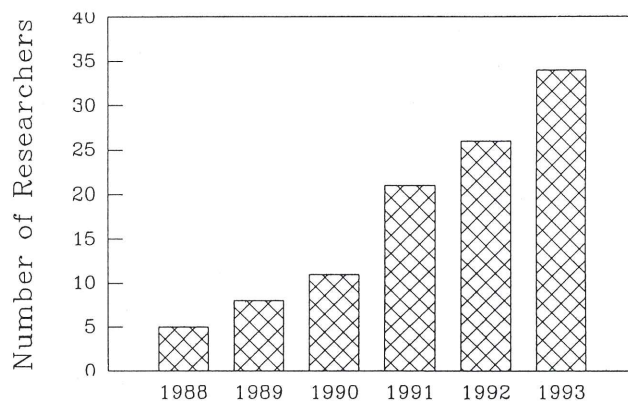
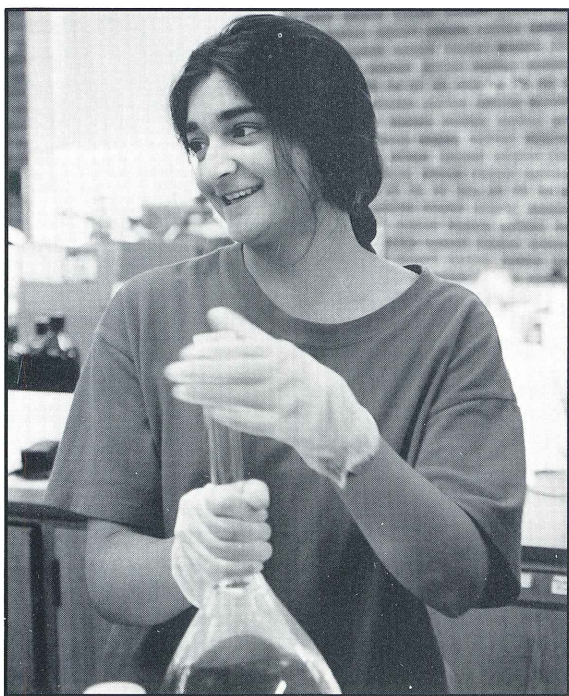


Figure 4. The undergraduate, graduate student and visiting scientist population at the Harvard Forest has increased tremendously through the LTER, NIGEC and summer research programs.



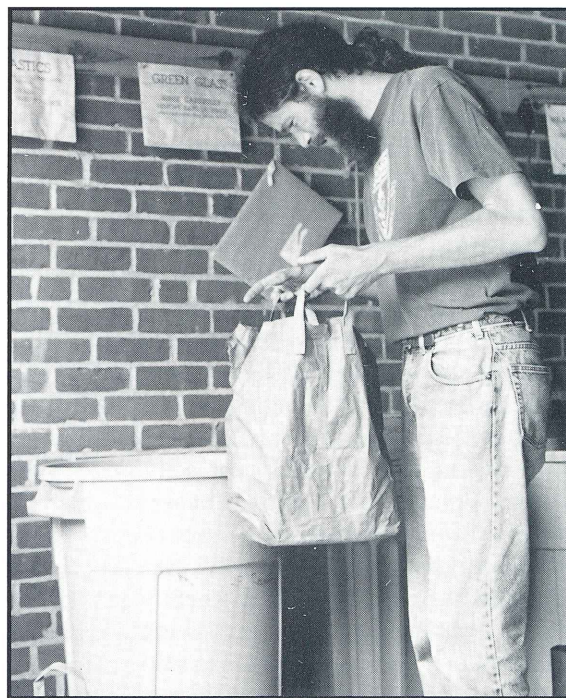
Roopal Shanghvi



Meghan Clancy-Hepburn and Susan Bassow



Rebecca Tatum



Fritz Gerhardt - recycler



Al Cline contemplates the future following the 1938 Hurricane

ACTIVITIES OF THE FISHER MUSEUM

The Fisher Museum plays a very important role in the educational mission of the Harvard Forest by providing a public outlet for information related to research activities in the fields of forest biology and management. In addition, the Museum provides a unique setting for conferences sponsored by the Forest and outside organizations. Dr. John O'Keefe has primary responsibility for the development of activities and coordination of use of the Museum.

The Fisher Museum's summer schedule continues to be very popular with over one thousand people visiting the Museum on summer weekends in 1992, a ten percent increase over 1991. The enthusiasm of our growing number of volunteers make this weekend operation possible and provides support for additional activities. The Second Annual Volunteer Recognition Dinner was held in November to recognize the vital contribution of the volunteers. The now traditional buffet dinner by Newton and Ramsdell Caterers and pies by John O'Keefe were followed by a review and discussion of the past season and future plans for the Museum. Helen Gronich was recognized for her continuing work as volunteer coordinator, as were Lisa Hastings and Mary Ann Walker who shared honors as the most frequent volunteers.

The Museum continued its collaborative programs with the Petersham Craft Center. In July, John O'Keefe and Marlene McDermott led a children's walk through the Forest and in August Elio Schecter, Professor of Botany at Tufts University, led a mushroom collection and identification walk that attracted over thirty delighted participants on a beautiful summer day. In our continuing work with the Rainforest Collaboration group, the Museum hosted 38 inner-city, middle school children, eight teachers and several UMASS faculty and graduate students over two weekends in the fall. The trip to Harvard Forest provided the opportunity to explore and study a temperate forest ecosystem as part of this joint UMASS-Boston/Boston Public Schools program designed to excite these students about careers in the biological sciences. In January, John O'Keefe accompanied 20 of these students, their teachers and organizers to Costa Rica for 10 days to explore and study the rain forest.

In October the Museum was awarded a grant by the National Science Foundation to transfer our second slide show, "Long-Term Ecological Research at Harvard Forest," to video and to distribute the video to each of the LTER sites.

Meetings, Seminars, Conferences

In November the Fisher Museum hosted the annual meeting of the Boston Chapter of the Appalachian Mountain Club, in December the annual meeting of the Massachusetts Forestry Association and in May the spring meeting of the New England Botanical Club. Other meetings at Harvard Forest included the Massachusetts Cooperative Extension Service Coverts Project, Massachusetts Project Learning Tree, Massachusetts Department of Environmental Management Wetlands Workshop, New England Chapter of the Wildlife Society, Northeast Forest Economists, Millers River Watershed Council and the Trustees of Reservations Conference.

In May, Harvard Forest hosted a workshop for loggers and foresters sponsored by the Cooperative Extension Service, DEM, DEP, and Massachusetts Wood Producers' Association. The workshop discussed guidelines for wetlands protection during timber harvesting. John Edwards and John O'Keefe used stream crossings from recent logging on Prospect Hill as demonstration sites.

The Harvard Forest Seminar series consisted of discussions of projects under development as well as formal presentations. Speakers included Bullard Fellows G. Matlack and V. Teplyakov; George Peterken, England; John Ogden, New Zealand; Stan Gemborys, Hampton Sydney College; Charlie Cogbill, Vermont; Rich McCreight, Oregon State University; Bill Peterjohn and Mark Castro, MBL, Woods Hole; Paul Helmund and Kristina Hill, Harvard Graduate School of Design; Tom Spies, U.S. Forest Service; Joe Elkinton, Curt Griffin, Todd Fuller and Bill Patterson, University of Massachusetts; Chris Peterson, Princeton; Jim Vogelmann, University of New Hampshire; David Ford, University of Washington; Margareta Ihse, Stockholm University; Nick Brokaw, Manomet Bird Observatory;

Jeffrey Hughes, University of Vermont; Carmen Cid, Eastern Connecticut College; Mary Leck, Rider College; Pat Hynes, M.I.T.; Francis Hole, University of Wisconsin; Rich Bowden, Allegheny College; and Otto Solbrig, Lisa George and Mike Binford of Harvard University.

Visitors

Dr. Robert Waide, Director of the Luquillo LTER project in Puerto Rico, visited Harvard Forest in March 1993 to discuss collaborative research on hurricanes and vegetation change. Also in March, Diana Garcia from Colorado State University spent several days examining the Puerto Rico aerial photographs and vegetation maps with M. Fluet to choose research sites for her doctoral research involving land-use and soils.

Francis Hole, Professor *Emeritus* of Soil Science and Geography at the University of Wisconsin visited in late May to examine the Harvard Forest long-term litter manipulation (DIRT) plots and to discuss our land-use/soil legacies work. Francis gave a lecture entitled "The Soil Body Revisited," and presented a program on soils ("The lively darkness beneath our feet"), utilizing his violin and puppets, to the students of the Petersham Center School.

Dennis Ojima and Bill Pulliam, from Colorado State University, conducted a two and a half day workshop on use of the CENTURY ecosystem model in March. The workshop included a general overview of model structure and data requirements as well as hands-on experience. Participants from the Harvard Forest and The Ecosystems Center - MBL used the model to simulate several experimental treatments at the Forest including soil warming, chronic N additions, and the hurricane pulldown plus the effects of different forest management schemes on water quality at the Quabbin Reservoir.



John O'Keefe and Robert Waide from the Luquillo LTER site review field experiments.

FOREST AND MAINTENANCE ACTIVITIES

The diverse talents of the Woods Crew were employed on silvicultural activities and building improvements. Two conifer plantations, 3 acres of red pine on Slab City and 4 acres of mixed spruce on Prospect Hill, were harvested to create research sites dominated by hardwood sprouts. This effort was aided by the use of our new 1978 Timberjack 230 skidder and new one ton truck. Hundreds of man hours were expended this spring to clear debris left by two winter blizzards. In August, 1992 Oscar Lacwasan joined the Harvard Forest staff as custodian. Oscar's diverse skills have already made him a valuable member of our community.

The Forest and Fisher Cottages received new vinyl siding and roofs and with the completion of the handicapped ramp, Shaler Hall and The Fisher Museum are now more accessible to everyone. Other improvements include redesigning the dark room and mail areas in Shaler and reconfiguring the J. G. Torrey Laboratory.

Through funding from the National Science Foundation computer facilities at Harvard Forest were doubled with the purchase of twelve 33 or 66 MHz 486 IBM computers, installed by E. Boose and R. Lent. The new computers provide significant improvements in processing speed, storage capacity, and graphics capability. Operating software and most of our application software have been upgraded as well. The computer lab is now well equipped for GIS, remote sensing, and statistical analysis software, while most of the permanent staff now has a computer in his or her office.



Oscar Lacwasan heading out for the mail



The snow returned to New England

Jack Edwards



ACTIVITIES OF THE HARVARD FOREST STAFF

In addition to their research and educational activities Harvard Forest staff members participate in many advisory boards, conferences and committees at the local, regional, national and international level.

Taber Allison presented seminars on the pollination of yew (*Taxus*) at the University of Wisconsin and at the International Yew Conference at the University of California, Berkeley. He served as a panel member at a symposium at Amherst College "Global Climate Change: Past, Present, and Future"; as a guest speaker at the 25th Anniversary Celebration, Center for Environmental Studies at Williams College; and attended the LTER Coordinating Committee Meeting, Las Cruces, New Mexico.

Rich Boone presented a paper at the Ecological Society of America meeting, Honolulu, Hawaii. He served as a graduate committee member for the following graduate students: P. Micks, B. Currie, S. Ollinger, N. Lambert, S. Benjamin, University of New Hampshire and F. Gerhardt at Harvard University. In January, Phoebe Goodwin, an environmental chemistry major from Connecticut College, worked as a student intern in the soils lab gaining experience on the LACHAT autoanalyzer by helping Mike Binford with nitrogen and phosphorus analyses of lake sediments.

In July Pat Micks was hired as a research assistant on the recently funded USDA study of nitrogen immobilization at the chronic N plots. Pat is completing her Master's degree in Natural Resources at the University of New Hampshire, holds a BS in soils from Stephen F. Austin State University and has broad research experience in forest soils.

Emery Boose serves on the GIS Working Group and Climate Committee of the Long Term Ecological Research program. Emery represented the Forest at the LTER Coordinating Committee Meeting in Fairbanks, the LTER Data Managers and ESA Meetings in Honolulu. Emery and Marcheterre Fluet served as judges at the Petersham Center School Science Fair.

David Foster attended the following conferences: ESA meeting in Honolulu, Annual Meeting of the Luquillo LTER program in Puerto Rico, LTER Coordinating Committee Meeting in Fairbanks, Northeastern MesoAmerican Conference at Williams College, and the 10-year Review of the LTER program at Miami University. David was appointed an Associate Editor for the journals *Ecology* and *Ecological Monographs* and gave lectures at the University of Maine, University of Connecticut, The Ecosystems Center, Highstead Arboretum and to the New England Botanical Club.

Richard Lent represented the Forest at the LTER Data Manager's meeting in Honolulu, at an NFS symposium "Environmental Information Management and Analysis: Ecosystem to Global Scales," University of New Mexico, and at the annual meeting of the Population Biologists of New England, Mt. Holyoke College. Richard presented an invited paper ("Avian Habitat Management in an Urban National park") at a meeting of the George Wright Society in Jacksonville, and a seminar on avian ecology at the University of Massachusetts. Richard serves on the Council of the Association of Field Ornithologists as a representative to the International Council for Bird Preservation. He is also involved with the Massachusetts Division of Fisheries and Wildlife's Partners-in-Flight Working Group, concerned with long-term monitoring and management of neotropical migrant bird populations. John O'Keefe served as a panelist at the Harvard-Radcliffe Science Alliance program for incoming freshmen in September. In October, John visited the U.S. Forest Service Historical site at Gray Towers in

Milford, Pennsylvania, the family home of Gifford Pinchot, and discussed the slide shows he has produced with the interpretive staff there. In January, John was appointed Chair of the Yankee Division of the Society of American Foresters.

Ann Lezberg attended the CENTURY workshop held at the Harvard Forest on modelling temperate forest response to disturbance and completed a Radcliffe Seminar course in Restoration Ecology. Cathy Mabry presented a poster paper at the ESA meeting. Glenn Motzkin attended the Natural Areas Conference at the University of Maine, Orono. In December Fritz Gerhardt visited George Peterken, and explored the effects of land-use history on the New Forest in southern Great Britain. He presented a paper on his research at the annual meeting of the British Ecological Society. Jeannette Bowlen continued in the MBA program at Clark University completing three courses during the academic year.



In April, John O'Keefe, Barbara Flye, Jeannette Bowlen and Dottie Smith brought President Neil Rudenstine up-to-date on Harvard Forest activities at a meeting organized for staff members to meet with the President and Dean.

GIFTS AND NEW FUNDING

Generous gifts and new grants have enabled us to expand many activities this year. An anonymous Friend of the Harvard Forest established a new endowment fund "The Living Diorama Fund" with a gift of \$150,000 in order to support educational activities in ecological sciences. With support from another Friend the R. T. Fisher Fund also reached the \$150,000 mark. Together these two funds assist undergraduate and graduate student research activities.

The family of R. T. Fisher made a very generous gift of approximately 50 acres of land adjoining the Prospect Hill tract. This land includes mixed hardwood stands and conifer plantations that have been managed in similar fashion to the Harvard Forest. The gift extends our frontage along Route 32 and French Road and adds significant protection to our boundary as well as diversifying our forest holdings.

In June the A. W. Mellon Foundation made a grant of \$420,000 to Harvard University to initiate the first three years of a ten-year program of research and training in forest ecology at the Harvard Forest. The program is intended to develop stronger ties between the Department of Organismic and Evolutionary Biology (OEB) and the Harvard Forest by supporting doctoral students in OEB and post-doctoral fellows at the Forest. The program will be administered by a committee consisting of D. R. Foster and A. H. Knoll and J. Taft, Chairman and Financial Director of OEB. Harvard Forest scientists (D. Foster, T. Allison, R. Boone, R. Lent and R. Bowden of Allegheny College) received a

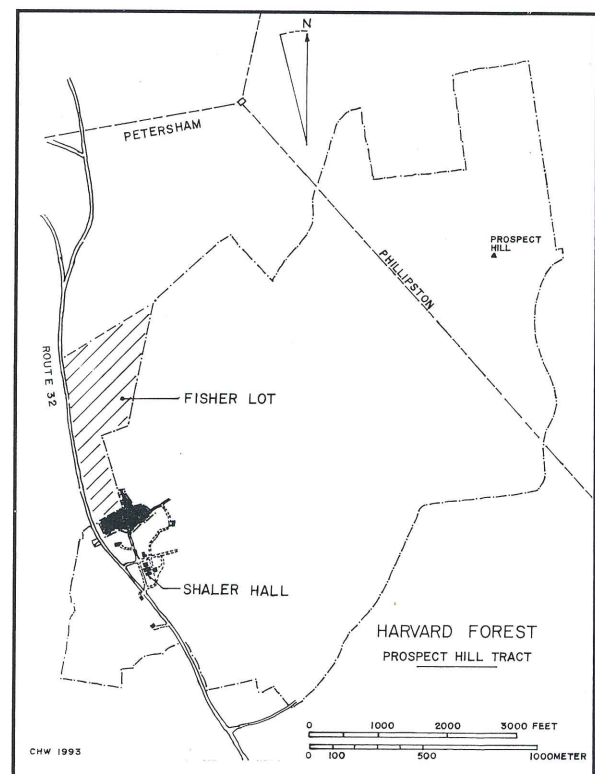
grant of \$150,000 from the National Science Foundation to establish a Research Experience for Undergraduates (REU) program at the Harvard Forest. This three-year program will fund undergraduates to work on independent research projects at the Harvard Forest. D. R. Foster, E. R. Boose, T. D. Allison and R. Lent received \$65,500 from the National Science Foundation to improve computer and systematic facilities at the Forest. As part of this effort the herbarium collections are being upgraded, expanded and computerized and new insect collections are being established.

Rich Boone received two new grants this year. In collaboration with W. McDowell and J. Aber at the University of New Hampshire he was awarded \$105,000 from the USDA Forest Service Competitive Grants program for a 3-year period for a study of carbon controls on nitrogen retention by temperate forest ecosystems. With K. Nadelhoffer at MBL Ecosystems Center he received \$90,000 from the National Institutes of Global Environmental Change (DOE) program for a study of organic matter dynamics in temperate forest soils.

In a continuation of his efforts to identify and describe rare plant communities in central and western Massachusetts, Glenn Motzkin received \$4,000 from the Massachusetts Natural Heritage Program.

As a complement to our efforts to renovate our library facility and holdings, Mr. Robert Metcalf, former Bullard Fellow, made a generous gift of many volumes in the areas of forestry, environmental studies, soils and New England vegetation.

Figure 5. Map of the Prospect Hill tract showing the location of the Fisher lot addition.



Visiting Research Scientists at the Harvard Forest 1992-93

In addition to Harvard Forest researchers a large number of outside scientists made use of Harvard Forest facilities and research sites. Many of these scientists were involved in the HF LTER program or in Harvard University's Northeast Regional Center of NIGEC (National Institute for Global Environmental Change) project.

John Aber	University of New Hampshire	Christina Kilday	Rhode Island School of Design
Peter Bakwin	Harvard University	Otto Klemm	University of New Hampshire
Susan Bassow	Harvard University	Ann Lewis	University of Massachusetts
Fakhri Bazzaz	Harvard University	Alison Magill	University of New Hampshire
Glenn Berntson	Harvard University	Mary Martin	University of New Hampshire
Mike Binford	Harvard University	Charles McClaugherty	Mount Union College
Caroline Bledsoe	University of California, Davis	Richard McCreight	Oregon State University
K. Boering	Harvard University	Ernesto Medina	Centro de Ecologia y Ciencias Venezuela
Rich Bowden	Allegheny College	Jerry Melillo	Ecosystem Center - MBL
Frank Bowles	Ecosystem Center - MBL	Shi-Li Miao	Harvard University
Wally Broecker	Lamont Doherty Observatory	Patricia Micks	University of New Hampshire
Mark Castro	Ecosystem Center - MBL	Kathleen Moore	State University of New York
Chaur-Fong Chen	Oregon State University	J. William Munger	Harvard University
A. Coleman	Harvard University	Knut Nadelhoffer	Ecosystem Center - MBL
Rose Crabtree	Harvard University	Kathy Newkirk	Ecosystem Center - MBL
Patrick Crill	University of New Hampshire	Fred Paillet	U.S. Geological Survey
William Currie	University of New Hampshire	William Patterson	University of Massachusetts
Bruce Daube	Harvard University	Bob Pearcy	University of California, Davis
Peter Del Tredici	Arnold Arboretum	William Peterjohn	Ecosystem Center - MBL
Marty Downs	Ecosystem Center - MBL	Richard Primack	Boston University
Todd Drummey	Ecosystem Center - MBL	Andrea Ricca	Ecosystem Center - MBL
Aaron Ellison	Mount Holyoke College	Michael Rogers	GA Institute of Technology
James Ehleringer	University of Utah	Paul Rygielwicz	Environmental Protection Agency
Elizabeth Farnsworth	Harvard University	Jay Stachowicz	Dartmouth College
Chris Field	Carnegie Institute	Paul Steudler	Ecosystem Center - MBL
David Fitzjarrald	State University of New York	Robert Talbot	University of New Hampshire
Song-Miao Fan	Harvard University	S. Thomas	Harvard University
Jason Garrison	Allegheny College	Brian Traw	Harvard University
Alan Goldstein	Harvard University	Richard Waring	NASA, Oregon State University
Alisa Golodetz	Hampshire College	Peter Wayne	Harvard University
Michael Goulden	Harvard University	Brayton F. Wilson	University of Massachusetts
Robert Harriss	University of New Hampshire	Steven C. Wofsy	Harvard University
Joseph Hendricks	University of New Hampshire		
Shoichi Kawano	Kyoto University		
C. Kerfoot	Ecosystem Center - MBL		
Dave Kicklighter	Ecosystem Center - MBL		

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