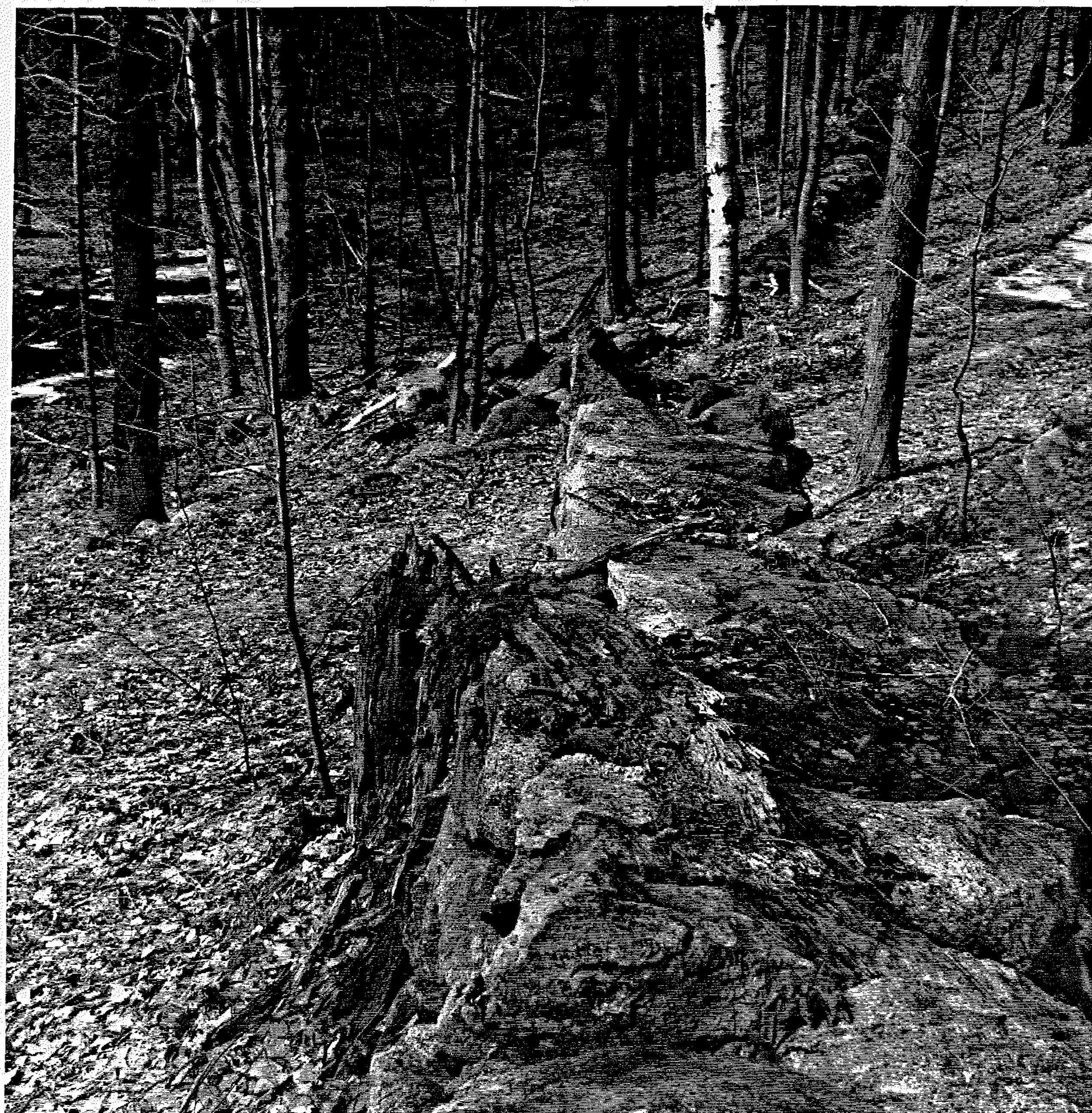
HARVARD FOREST
Summer Student Research Assistants



Abstracts from the 2nd Annual
Harvard Forest Summer Student Symposium
3 August 1994

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Cover Photograph by Marcheterre Fluet
Other Photographs by Paul Wilson

SECOND ANNUAL HARVARD FOREST SUMMER STUDENT SYMPOSIUM

3 AUGUST 1994

HARVARD FOREST - FISHER MUSEUM

9:00 A.M.	Introduction and Welcome	Rich Bowden
	Biogeochemistry	
9:15	The Effects of Soil Warming on the Nitrogen Cycle in a Mixed Deciduous Forest	Nancy Werdin
9:30	Trace Gas Fluxes Following Nitrogen Fertilization: the Influence of Sampling Data	Kaelyn Stiles
9:45	Nitrogen Cycling and Trace Gas Fluxes in a Productive Temperate Forest: Harvard Forest vs Bousson Experimental Reserve	Gwen Stevens
10:00	**Coffee Break**	
	Plant and Animal Ecology	
10:30	Journey to the Overstory: Germination and Survival of Tree Seedlings in a Fern-Dominated World	Lori Biederman
10:45	Following the Fate of Ovules in *Taxus canadensis*	Michelle Buonopane
11:00	3-Dimensional Patterns of Photosynthetic Photon Flux at the Scale of Small Sapling Crowns in a Mixed Deciduous Understory	Jeff Herrick
11:15	The Floral Constancy of Bumble Bees: Handling Efficiency or Cognitive Conditioning?	Melissa Stine
11:30	Butterfly Metapopulations in the New England Landscape	James Chen/Martha Schumann
11:50	Geographical and Habitat-related Variation in Sex Ratios and Population Size of the Inornate Ringlet Butterfly	Jessica Green
12:05 P.M.	**Lunch**	

Forest History: Natural and Human Disturbance

1:30	Reconstruction of an Early 19th Century New England Hurricane	Sherry Baker
1:45	Continued Research into the Long-term Persistence of Trees Following Simulated Hurricane Damage	Amy Miller
2:00	Comparison of the Distribution and Abundance of Coniferous Stands Across the Petershan Landscape: Past and Present	Joel Carlson/Don Strauss
2:20	Land Use History and Vegetation Response in the Towns of Central Massachusetts	Jamie DeNormandie/ George Landman
2:40	The Effects of Land Use on Lacustrine Sediment Characteristics	Meghan Riley
2:55	Forest Regeneration Following Clear-Cutting of Red Pine Overstory	Amy Boyd
3:15	Discussion and Evaluation of Summer Program	
6:00	Picnic	

Reconstruction of an Early 19th Century Hurricane on a Regional and Landscape Level

Sherry Baker

This project is part of a larger study trying to determine the role/impacts of hurricane disturbance on forest ecosystems. One goal of this study is to develop a long-term data set on all of the hurricane disturbances in New England since the 1600's. Reconstruction of the Great September Gale of 1815 is the precedent for modelling historical hurricanes, which lack the amount of meteorological data that generally exist for modern storms.

Historical research was conducted in local libraries and historical societies, and historical research libraries. From anecdotal reports in old newspapers and diaries, the approximate track of the storm was determined and used to calibrate the computer model. After running the model, we found that its output meteorological values were consistent with the historical data we had.

The particularly useful feature of this modelling program is that it interpolates the wind velocity and direction for every area of New England throughout the course of the storm. This allows us to take the directions of the highest winds for both the 1815 and 1938 hurricanes and compare their impacts on a landscape level in several towns, which will be the next focus of this project. A topographic exposure model does this by determining which areas in a particular town are protected from or exposed to the winds due to the local topography.

The success of this project thus far suggests that a long-data set can be achieved with this modelling method, as long as the track and strength of each historical hurricane can be estimated.

Journey to the Overstory: Tree Germination and Seedling Survival in a Fern-Dominated World

Lori Biederman

The forest over-story composition is affected by the conditions that young trees germinate and grow in. The purpose of This study was to determine the effect that fern cover might have on the germination and survival of future over-story trees. In other words, does fern cover encourage or discourage certain tree species and thus influence which trees will eventually become part of the over-story?

To address these questions two fern species were chosen: *Osmunda claytonia* (interrupted fern) and *Dennstaedtia punctilobula* (hay-scented fern). Each was subject to three different manipulations: a control plot where the ferns were left intact, a partial removal manipulation where the fern fronds were pulled away from the plot but roots were left intact, and a total removal manipulation where fern roots and shoots were removed from the plot. These six different manipulations were replicated five times within six different sites.

Within each of these plots seedlings were planted and are being monitored for survival and growth. This study concerns the volunteer germination that occurs in these plots. Germinants of red oak, red maple, white pine, white ash, and black and yellow birch were counted and tagged in an initial survey. Their mortality and additional germination was surveyed one month later. In addition distance to the closest parent tree was measured and used as a covariate in the data analysis.

We found that the three different manipulations had an effect on the germination rate of most tree species, however, each species was affected differently. Red maple germination rate was not affected by the presence or absence of fern cover. Birch, red oak, white ash and white pine exhibited the lowest germination in the intact fern sites. White ash was the only tree species that responded to the identity of the fern species. Germination rate across all treatments was higher in the *Osmunda* plots compared to the *Dennstaedtia* plots. Because tree species responded individually to fern cover, ferns can act as an ecological filter which inhibits some tree species while encouraging others, thus influencing future over-story composition.

Forest Regeneration Following Clearcutting of Red Pine Overstory

Amy Boyd

Six acres of a 65-year-old red pine plantation on the Prospect Hill tract of Harvard Forest were clearcut in February 1990. Before harvesting, extensive hardwood regeneration was present in the understory; this was cut along with the pine so that most material left on the site was below 0.5 m. For the past five years since the cutting, regeneration of the forest overstory has been monitored on 50 milacre (1.13 m radius) plots. To evaluate the effects of deer browse on the regeneration, an electric fence exclosure was built surrounding 1/2 of the plots. Species, height, origin, and evidence of browsing have been recorded in late June of each year since the harvest for all woody stems within each plot.

Browse pressure was generally low in 1990, 1991 and 1994 and higher in 1992 and 1993; these fluctuations are probably due to depth of snow cover and amount of other food available. In most years, there was no notable difference in browsing between the plots inside the exclosure and those outside. White ash has been the most heavily browsed in every year. Black cherry was heavily browsed in 1992 but not browsed in other years. Other species that have experienced fairly heavy browsing are red maple and sugar maple.

Overall stem density of tree species peaked in 1991 at 25,577 stems/ha; since then, except for a slight rise in 1993, stem density has been declining (present density: 21,140 stems/ha). The tree species with the most stems are red maple and white ash; in 1994, red maple accounted for 31.6% and white ash 31.1%. These species are followed by sugar maple (16.3%) and black cherry (13.4%). Red oak has risen steadily, and in 1994 accounted for 3.5% of the stems. The percentage of stems (of tree species) that come from seedlings rather than sprouts was highest in 1992 (17.3%) but has since declined; in 1994, only 11.1% of stems appear to be from seed. Mean stem height of tree species has risen steadily, with the most rapid rate of growth in the first few years and then tapering off. After five years' growth, the mean stem height in 1994 was 1.53 m. The stems from sprouts consistently have had a mean height greater than the stems from seedlings.

Following the Fate of Ovules in *Taxus canadensis*

Michelle Buonopane

We studied the reproductive biology of *Taxus canadensis* in five populations in central Massachusetts. Reproductive effort was measured as the number of male and female cones produced by a plant. There was a weak but persistent positive correlation between reproductive effort and the amount of new growth, and this correlation held up even when plant size was taken into account. Plants that produce many cones can also grow long branches. Even though this shrub is monoecious, plants varied greatly in phenotypic gender. In one population, gender was actually bimodal with individuals tending to be either mostly male or mostly female. This may be an evolutionary holdover from a dioecious ancestry. Pollination success varied significantly among the five populations. Some sites exhibited close to 100% pollination success, while other sites seemed distinctly pollinator limited. Within a site, there was a positive correlation between pollination success and the number of male cones. Thus, cosexuality may be of crucial importance in ensuring sexual reproduction in this clonally spreading shrub. We are proceeding to closely monitor seed development. So far, 12% of the female cones have aborted and there are more that are aborting every week. There was a wave of female cone maturation in mid July, but maturation has since slowed down. Once a cone starts to mature and forms a red aril, it is generally removed quickly, possibly by chipmunk predation, which may sometimes occur even prior to seed maturity. There is only one way for an ovule to succeed, but there are many ways for it to fail.

Comparison of the Distribution and Abundance of Conifer Stands Across the Petersham Landscape: Past and Present

Joel Carlson and Don Strauss

Forest distribution and composition across the central Massachusetts landscape reflects individual plant responses to varied site conditions as well as to a range of natural and anthropogenic disturbances. As a result of historical disturbances - including extensive land-clearing for agriculture, reforestation upon agricultural abandonment, and the 1938 hurricane - modern forest composition and distribution differ from pre-settlement conditions. In this study we compare the modern distribution of two major conifer species - white pine and hemlock - with their historical distributions throughout the town of Petersham.

Conifer stands in Petersham were delineated using 1991 color infrared aerial photographs (leaves-off, 1:40,000 scale). Delineated stands are visited in order to determine forest cover types and to record observations on vegetation composition and historical disturbances (e.g. 1938 damage, prior land use, etc.). These data will be digitized in a vector format and then analyzed spatially using a geographic information system. The analyses will enable us to evaluate the relative importance of historical vs. environmental factors (e.g. topography and soils) in controlling modern forest composition and it will enhance our understanding of the influence of land use and other disturbances on the distribution of tree species at a landscape level.

Butterfly Metapopulations in the New England Landscape

James Chen and Martha Schumann

The New England landscape today is mostly composed of forested land, with open grasslands scattered throughout the area. Animal populations that specialize in these grassland habitats are divided into distinct groups, each of which is a part of the greater metapopulation. The metapopulation is a population structure where the overall population is divided into separate, recognizable entities. The Inornate Ringlet (*Ceonympha tullia inornata*) and Wood Nymph (*Cercyonis pegala pegala*) butterflies, both grassland specialists, are ideal model species with which to study metapopulations. Butterflies were collected from 25 sites along a transect paralleling I-91 from Amherst, MA to Newbury, VT. Phenotypes were scored and recorded, both from the collected butterflies and from offspring raised in a controlled environment. Other data taken included vegetation surveys and field size. Once collected, the data will be analyzed for possible relationships between butterfly phenotypes and habitat variables such as field size, vegetation, and landscape context. Future work will both focus in more detail on local - scale phenomena and expand the geographic scope of the study.

Geographical and habitat-related variation in sex-ratio and population size of the Inornate Ringlet Butterfly *Coenonympha tullia inornata*

Jessica Green

In the reforesting New England landscape, the population structure of many animals species is changing. Butterflies are an easily studied example of one of the populations which are affected by landscape change. The Inornate Ringlet butterfly, *Coenonympha tullia inornata*, is a weak flyer and selective in its habitat choice, choosing only certain open grasslands. For these reasons, ringlets will remain as residents in a particular isolated field for generations, making the local population the evolutionary unit, and a small component of the larger metapopulation. Ringlets in eighteen grassland sites were collected along Interstate 91, which runs parallel to the Connecticut River in Vermont and New Hampshire, to determine the relationship between environmental factors, sex ratio and butterfly abundance, and to demonstrate how changes in microhabitats affect butterfly populations. Two levels of analysis were used -- geographic and site specific.

The sex ratio of collected ringlets varied non-linearly, with fewer females encountered in mid latitude sites. Sex ratio on a broad scale does not vary strongly because there are local environmental factors that affect behavior and catchability, such as vegetation height, nectar resources, and weather. Sex ratio was more significantly associated with population size; larger populations had a lower percentage of females. Variation in local habitat and predation are hypothesized to account for these two results. A strong correlation between population size and latitude was found, with more abundant populations occurring in the northernmost sites. The recent southward range expansion of the ringlet probably accounts for this trend, for northern sites are older and more established. This and future studies will illustrate the effects of landscape change and habitat variation on the population of many habitat specialists, such as butterflies, as those animals move toward a metapopulation structure, allowing evolution to work on the local scale.

3-Dimensional Patterns of Photosynthetic Photon Flux at the Scale of Small Sapling Crowns in a Mixed Deciduous Understory

Jeffrey Herrick

We measured light variation at the 1m sapling level by constructed a 3-dimensional matrix of paper light sensors using fishing line and PVC pipe. The matrix was a cubic meter with 125 sensors arranged 25cm apart in a Dimensional 5x5x5 array. Paper exposure levels were converted to PPF values through a calibration equation. The study ran for a 72 hours in late July at the Harvard Forest, Petersham, MA. These "light cubes" were placed under 5 different canopies: mixed hardwood, white ash, hemlock influenced, red oak, and old gap/mixed hardwood. All sites, except the 2 hardwood sites, differed significantly from each other in mean daily PPF levels. A statistically significant, though modest, vertical gradient was found within each cube when all 25 sensors at each vertical level were averaged. Vertical gradients within in the cubes did not differ significantly from either horizontal gradient(E-W, N-S) except at the white ash site. Eighty-nine percent of the variation in the data occurred between the sites while 11% occurred within the sites. These results suggest that both between-site and within-site variation in light may influence the architecture of tree saplings, species composition and ultimately regeneration success.

Land Use History and Vegetation Response in the Towns of Central Massachusetts

George Landman and Jamie DeNormandie

The extent to which humans alter ecosystems and the surrounding landscape is a major concern in ecological research. In the towns of Central Massachusetts, European Settlers have altered the land dramatically since their arrival. How the land was altered and the consequences of human disturbance can be addressed with the following questions: 1) How did settlers develop and use the land? 2) Does the type and amount of land use vary from town to town? Is it possible to characterize towns from analysis of their unique land use histories? 3) How did the local vegetation respond to human disturbance?

State Tax Valuations, Federal and State Censuses, and other historical data were compiled into a historical database spanning from 1771 to the present. The information in the data base falls generally into the following categories: Agricultural, Industrial, Land Use, and Vital Statistics. Supplemental information for each town was obtained through local town histories and the creation of settlement maps.

The database contains information concerning the land use history of Mass. towns. From the beginning of settlement in the 18th C Europeans proceeded to clear woodland to create pastures, land for crops,and hay fields. Generally, this deforestation, which peaked in the mid nineteenth century, was followed by a gradual reforestation of the same agricultural land. The amount of land used for activities connected to industry and residential settlement can be inferred only from the numbers collected in the categories.

Although most towns hold to the general deforestation/reforestation model, comparison of the industrial, agricultural, and vital statistics of towns, make it possible to find unique features of towns that distinguish them from each other. The town of Harvard, for instance, has been categorized as an agriculturally focussed town because it consistently shows higher output in agricultural categories and remains agriculturally strong further into the nineteenth century. Its low population curves and industrial statistics also agree with this agricultural classification.

The database by itself does not allow for the classification of the vegetation response to human disturbance. However, using paleoecological data in connection with the database demonstrates that deforestation and reforestation due to human disturbance altered the species assemblages in Mass. towns since the settlement period. At this point in time, only general trends between the database and the pollen diagrams can be inferred due to the lack of sediment dating.

The strength of the database lies in its ability to characterize towns with respect to agriculture, industry, and land use. In the future, the ability to determine the amount and type of human disturbance will hopefully be directly connected with the magnitude and type of vegetation response that is found in the pollen diagrams.

Continued research into the long-term persistence in trees following simulated hurricane damage

Amy Miller

In the fall of 1990 hurricane damage was simulated on a 0.8 ha *Quercus borealis* - *Acer rubrum* stand to study the effects of wind disturbance on long-term forest development. All damaged and residual trees were surveyed for extent of sprouting and degree of crown foliage to explore the importance of vegetative growth and survival in forest recovery, and the influence of species, size, and damage type on tree response. After four growing seasons, specific trends in growth and mortality are beginning to emerge. Of previously live, damaged trees, *Carya* sp. and *Betula* sp. continue to have the greatest incidence of crown foliage, while *Pinus strobus* and *Quercus borealis* display the lowest frequency. Among all damaged trees, those that had snapped exhibit the steepest decline in crown foliage. Over time, the percentage of damaged trees which continue to leaf out has been declining and mortality rates continue to rise. In 1994 only 28% of damaged trees still produce leaves. In some species, mortality rates were off-set by the production of basal and trunk sprouts. *Fraxinus americana* and *Carya* sp. show the greatest incidence of trunk sprouts while *Betula* sp. and *Quercus borealis* show the lowest. Bent trees had the highest frequency of basal and trunk sprouts; uprooted trees showed the lowest frequency of sprouting. As predicted, rapid growth and prolific sprouting in both standing and damaged trees seems to be holding steady: ~51% of all trees show some sort of sprouting. However, sprouting frequency among damaged trees has been declining, from a peak of 65% in 1992, which also reflects the increase in mortality among those trees that have sustained damage. Newly caused damage in the form of uprooted and snapped trees as a result of severe winter storms may account for some of the year to year fluctuations in species survival and the natural dynamics of the forest ecosystem. Propensity for sprouting and leafing out was explained in part by differences in damage type and species characteristics, however, tree response to wind damage is the result of complex interactions with the forest regime.

Land Use and Its Effects on Lacustrine Sediment Characteristics

Meghan Riley

Land use has the potential to increase erosion, salinization, sedimentation and nutrient flux. Changes in these physical factors may adversely affect ecological processes and communities. A long term study is being conducted to determine the effects of watershed land use on limnological and sediment characteristics. Sediment cores, approximately 1 m in length and 10 cm in diameter, were sampled at the mud water interface of several lakes in Massachusetts. These lakes are in watersheds that have a range of land use histories which are being separately documented. Gravimetric analysis was performed to determine water content, loss on ignition and bulk density. Analyses of nitrogen and phosphorus concentrations were also done. Satellite images were digitized and stored as part of a geographic information system to classify present land use. Bulk density increases as organic matter decreases due to the increase of heavy inorganic matter from the surrounding watershed. A relationship between nitrogen and carbon was found while phosphorus and carbon were not related, implying that nitrogen is found in the organic layer while phosphorus is in the inorganic layer. ^{210}Pb radionuclide measurement will be conducted in order to obtain dates of disturbance horizons, as well as to provide information about sediment accumulation rates. Future studies include pollen grain analysis ascertaining vegetation changes over time. The long term goal of this project is to generate predictive models for how human activities affect limnological characteristics of a lake system.

Nitrogen Cycling and Trace Gas Fluxes in a Productive Temporate Forest: Harvard Forest vs. Bousson Experimental Reserve

Gwen Stevens

The purpose of this study was to observe the effects of N-fertilization on rates of N cycling and trace gas fluxes at the Bousson Experimental Reserve, an area of naturally rapid N cycling. Rates of trace gas fluxes were taken monthly in the field, and these data were supplemented with measurements of net mineralization rates from three-week laboratory incubations of soil cores. From the first three months of this long-term study, it is evident that both N_2O fluxes and CH_4 effluxes increased after the first month of fertilization, yet decreased after the second. Analysis of incubated soils revealed an increase in net mineralization rate in the fertilized plots, indicating a slight rise in the N cycling rate. From these initial results it seems evident that fertilization does indeed impact this high N cycling site, yet several more months of data are needed in order to solidify trends and validate initial findings.

Trace Gas Fluctuations Following Nitrogen Fertilization: The Influence of Sampling Date

Kaelyn Stiles

The Nitrogen Saturation Hypothesis provides a link between global warming and acid rain. At Chronic N, an artificial high nitrogen deposition site in Massachusetts, this link is explored. The high nitrogen deposition plots have shown increased rates of nitrogen cycling, a confirmation of the nitrogen Saturation Hypothesis. These plots simulate nitrogen deposition due to acid rain and have allowed us to look into the future and study the effects that increased rates of nitrogen cycling have on various ecosystem processes. Three important greenhouse gases, CO_2, N_2O and CH_4, all affected by increased nitrogen cycling, are sampled monthly from Chronic N, and so far we have seen significant trends in the gas fluctuations. Scientists are looking for new ways, using the Nitrogen Saturation Hypothesis, to account for the increasing concentrations of these greenhouse gases in the atmosphere. In collecting this data, critics have suggested that there may be an N_2O pulse immediately after fertilization that has been overlooked in the monthly sampling. Therefore, daily gas samples were taken before and after fertilization to catch any possible nitrogen pulse. There was no evidence of such a pulse. N_2O and CH_4 moisture residuals were analyzed, and the resulting graphs suggest that the published trends due to fertilization may not be as clear as they were once thought to be. Perhaps moisture is a more important variable than fertilization in describing the decrease in CH_4 uptake.

Bumblebee Constancy: Handling Efficiency or Cognitive Conditioning?

Melissa Stine

We studied the foraging patterns and floral preferences of Bombus vagans workers visiting four plant species that varied in color, flower morphology, and inflorescence architecture. Naturally foraging bees were presented with pairs of flower options that they could choose between. This allowed us to quantify floral constancy, the tendency for individual bees to specialize on a particular flower species.

We predicted that if bees are constant in order to maximize handling efficiency, then constancy should be stronger where flowers grow intermixed. If bees are constant because they form a cognitive search image, constancy should be equally strong or stronger where only one species is flowering. For bees on red clover, we found that their preference for red clover over white clover was stronger in a pure field of red clover than in a mixed field. For bees that were on white clover, there was equal preference for white clover in a pure field and a mixed field.

We further predicted that if handling efficiency is the cause of constancy, bees should be less constant when given the choice of two closely related flowers that are handled nearly identically than when given the choice between two dissimilar flowers that are handled differently. We found that bees were more constant when foraging on red and white clovers than on red clover and the mint selfheal. In addition, we found that bees on red clover preferred vetch over the more similar white clover.

These results are not consistent with the classical view that bees are constant to minimize handling time. Rather they suggest a more ethological explanation involving some form of cognitive conditioning.

The Effects of Soil Warming on the Nitrogen Cycle in a Mixed Deciduous Forest

Nancy R. Werdin

The soil warming pulse-chase experiment was designed to explore the effects of soil warming on the partitioning and allocation of nitrogen into various pools within the nitrogen cycle. Heavy isotope ^{15}N in the form of $^{15}NH_4^+$ and $^{15}NO_3^-$ was injected into the soil in a 1x1 m square in 3 heated plots (heating cable buried 10 cm in ground and kept at 5°C above ambient) and 3 disturbance control plots (heating cable installed, but no current). Samples of the forest floor (Oe and Oa) and mineral soil were collected on five sampling dates: 0, 1 day, 2 wks, 4 wks, and 14 months after initial injection. For determination of microbial biomass N, a portion of these samples were fumigated with chloroform. Fumigated and non-fumigated soil samples were extracted with K_2SO_4. Portions of the extracts were digested using the Kjeldahl method, and the ammonium concentrations of the extracts and digests were determined by a LACHAT auto ion analyzer. Preliminary results of the K_2SO_4 extracts and Kjeldahl digests of the 0 and 14 month sampling dates indicate that the N concentration (mean mg NH_4-N/kg soil) is allocated into the following pools in descending order: microbial N pool, dissolved organic N pool, and inorganic N pool. Heating did not increase the N concentrations within any pool. This result is of particular interest in evaluation of the microbial biomass N. While seemingly contrary to previously published net N mineralization results, a decrease in microbial biomass N may explain the NH_4 build up in heated soils. In addition, these findings lead to speculations of more efficient microbial metabolic processes and utilization of a more resistant C energy source.

1994 Harvard Forest Summer Student Activities

Seminars

June 8 Dr. Jan Weger, Research Institute of Horticulture, Czech Republic

Forest decline in the northern Czech Republic

June 8 Dr. Timothy Sipe, Harvard Forest Bullard Fellow

Forest dynamics in a natural area: lessons from a non-equilibrium landscape

June 15 Dr. Tom Spies, Harvard Forest Bullard Fellow

Science, policy, and politics in the Pacific Northwest

June 22 Dr. Ann Lewis, University of Massachusetts

Why do basic research?

June 29 Evan DeLucia, Harvard Forest Bullard Fellow

Influence of climate change on western forests

July 6 Becky Field, U. S. Fish and Wildlife Service

Birds and biologists on the Arctic Tundra

July 13 Paul Wilson, Harvard Forest

Floral evolution: when is selection for pollination success strongest?

July 20 Larry Buell, Earthlands, Petersham, MA

The Petersham environment in the 1800s as told by Lucius Spooner

August 3 Student Symposium

2nd Annual Harvard Forest Summer Student Symposium

August 10 Emery Boose, Harvard Forest

New England hurricanes

Dinner Discussion Schedule

June 13 Elaine Baskan, free-lance science writer

Communicating science to the public

June 23 David Zimmermann, science writer

Probing the anti-science movement

June 27 Lisa George, Harvard University, PhD student; Dr. Ann Lewis, University of Massachusetts; Cathy Mabry, Harvard Forest, Research Assistant; Kathy Newkirk, Ecosystems Center, Research Assistant.

Women and minorities in science: personal observations

July 11 Evan DeLucia, University of Illinois; David Foster, Harvard Forest; Tim Sipe, Gustavus Adolphus

Selecting the graduate school for you

July 18 J. Thomas Callahan and Ann Takai, National Science Foundation

The role of the National Science Foundation in Ecological Research

July 25 Rich Lent and Emery Boose, Harvard Forest

Research presentations

Field Trips

June 9 7-8:00 AM - Ann Lezberg, Harvard Forest

Shrubs and herbaceous vegetation at Harvard Forest

June 14 4-5:00 PM - Glenn Motzkin, Harvard Forest

The major trees of Harvard Forest

June 20 7-8 AM - Richard Lent, Harvard Forest

Birds of the Harvard Forest

July 7 4-5 PM - Art Allen, Harvard Forest

Field description of soils

July 12 All Day - Institute of Ecosystem Studies, Millbrook, NY

Careers workshop

July 25 4-5 PM - Paul Wilson, Harvard Forest

Flowers and pollination

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PERSONNEL AT THE HARVARD FOREST
SUMMER 1993-94

Arthur Allen	Research Assistant
Taber D. Allison	Paleoecologist
Richard D. Boone	Soil Ecologist
Emery R. Boose	Computer Scientist
Jeannette M. Bowlen	Accountant
Jana D. Canary	Research Assistant
Gary C. Carlton	PhD Candidate, OEB
Evan H. DeLucia	Charles Bullard Fellow
Sean M. Divoll	Woods Crew (part-time)
Elaine D. Doughty	Laboratory Assistant (part-time)
John A. Edwards	Forest Manager
Marcheterre Fluet	Research Assistant
Barbara J. Flye	Librarian/Secretary
David R. Foster	Director of the Harvard Forest
Lisa George	PhD Candidate, OEB
Julian L. Hadley	Charles Bullard Fellow
Donald E. Hesselton	Woods Crew
Jason P. Kaye	Research Assistant
Gong Wooi Khoon	Charles Bullard Fellow
Oscar P. Lacwasan	Custodian
Richard A. Lent	Data Manager/Ecologist
Ann L. Lezberg	Research Assistant
Anita Locke	Summer Cook, 1994
Catherine M. Mabry	Research Assistant
Glenn R. Matlack	Charles Bullard Fellow
Patricia Micks	Research Assistant
Ellen G. Moriarty	Graphic Artist (part-time)
Glenn H. Motzkin	Research Assistant
John F. O'Keefe	Museum Coordinator
Gloria Rapalee	GIS Assistant
Juan F. Silva	Charles Bullard Fellow
Timothy W. Sipe	Charles Bullard Fellow
Dorothy R. Smith	Secretary
Thomas A. Spies	Charles Bullard Fellow
Charles C. Spooner	Woods Crew
Mark Thibault	Woods Crew (part-time)
P. Barry Tomlinson	E. C. Jeffrey Professor of Biology
Carlos Vazquez-Yanes	Charles Bullard Fellow
Paul S. Wilson	Research Associate
John S. Wisnewski	Woods Crew
Steven C. Wofsy	Associate of the Harvard Forest

The Institute of Ecosystem Studies presents

A FORUM ON OPPORTUNITIES IN ECOLOGY

Tuesday, July 12, 1994
9:30 a.m. - 4:30 p.m.
at the IES Plant Science Building

This forum provides undergraduate and graduate students the opportunity to hear firsthand about a wide range of career paths in ecology, including:

• Academia • Science Writing • Education • Consulting
• Applied Ecology • Industry • Conservation
• Government • Environmental Protection • Legislation
• Environmental Law

In the morning session (9:30 a.m. - 12:00 noon), speakers representing each field will discuss the rewards and motivations involved in their work.

In the afternoon session (1:00 p.m. - 4:30 p.m.), speakers will join small groups for informal discussions about issues of concern to the student participants.

The forum is open to all students at no charge. Interested individuals should register for the program by calling Stephanie Shoemaker or Susan Eberth at the IES Education Office at (914)-677-5359. Since space in the afternoon session is limited, you are encouraged to register soon.

There will be a break at noon: please bring your own lunch and beverage.

The Institute of Ecosystem Studies presents:

FORUM ON OPPORTUNITIES IN ECOLOGY

July 12, 1994

Morning Sessions: Rewards and Motivations in Ecology Careers

Session One: 9:30-10:45 A.M.

9:35	Dr. Judy Preston	Director of Science and Stewardship (*Applied Ecology*) The Nature Conservancy, Middletown, CT
9:45	Allisa Perreault	Science Teacher (*Education*) Wappingers Junior High School, Wappingers Falls, NY
9:55	Shabazz Jackson	Municipal Recylcing Specialist (*City Government*) City of Beacon, Beacon, NY
10:05	Jon Polishook	Staff Microbiologist (*Industry*) Merck Research Laboratories, Rahway, NJ
10:15	~~Mark Gallagher~~ CANCELLED	Senior Scientist (*Consulting*) Coastal Environmental Services, Princeton, NJ
10:25	Drayton Grant	Environmental Lawyer (*Law*) Rhinebeck, NY
10:35	David Stern	Supervisor of the Pathogen Program (*Environmental Research*) Department of Environmental Protection, Valhalla, NY.

Break: 10:45-11:00 A.M.

Session Two: 11:00 A.M.- 11:50 A.M.

11:00	Dr. Ann Lewis	Assistant Professor of Forestry (*Academia*) The University of Massachusetts, Amherst, MA
11:10	Barbara "Charlie" Murphy	Assistant to the Executive Director (*Environmental Activism*) Scenic Hudson, Poughkeepsie, NY
11:20	Dr. Andrea Worthington	Associate Professor of Biology (*Research Abroad*) Siena College, Loudonville, NY
11:30	Louis Sorkin	Senior Scientist, Entomology & Arachnology (*Museums*) American Museum of Natural History, New York, NY
11:40	Bruce Stutz	Features and Contributing Editor (*Science Writing*) Audubon Magazine, New York, NY

Novice Ecosystems Scientists Learn By Doing in Harvard's Forest — P. 6

PROBE

David Zimmerman's newsletter on science, media, policy and health

Vol. III, No. 8 July 1, 1994, New York, NY $5

Eager Novices Are Having Fun Doing Science

Petersham, Mass.

"We have a *great* time talking about science, and laughing about it. It's *wonderful*!"

The speaker is Oberlin College sophomore, Kaelyn Stiles. She is spending the summer at the Harvard Forest research facility here collecting and processing soil samples from normal and heated (+5° C) forest plots. This long-term experiment is designed to show how global warming may change the influx and output of nitrogenous compounds from various soils.

Stiles' friend and co-worker, Gwen Stevens, a senior in environmental sciences at Allegheny College in Meadville, Penn., says:

"I'm just one small part of this study . . . . But they are teaching me what is really done at a place like this . . . . I want to immerse myself in *all* of the *stuff* they're doing here!"

Careers Foreseen

Stiles has her eyes set on a research career. Stevens favors scientific management or government work.

Their youthful enthusiasm, and that of a dozen other undergraduates who are sharing a research summer here, may be a major human resource for environmental science. They are subsidized by grants from the National Science Foundation (NSF), the Department of Energy and other federal and state agencies.

Harvard Forest is 3,000 acres of abandoned 19th century farmland that has grown back as trees. It was started early in this century, and thrived, briefly, until Harvard abandoned its forestry school, which was the forest's *raison d'etre*. A half dozen years ago, current administrators say, the research facility was moribund.

New Questions Asked

Then forests became important in a new context: as major, but largely unprobed, sources and sinks in the global flux of nutrients — carbon, nitrogen, oxygen and sulfur — that are being altered by human disturbance. Forests hold answers to key questions on how hazardous these changes may be.

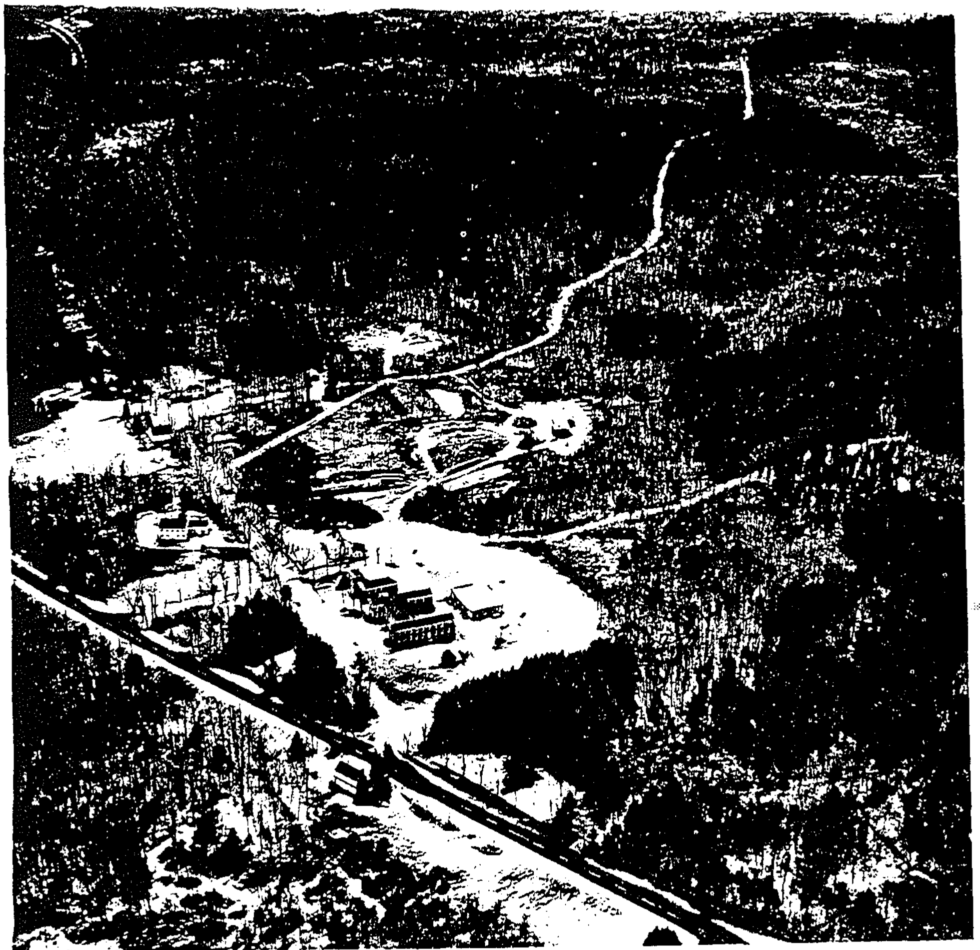
This new scientific mission reanimated Harvard Forest as a research station. Dozens of senior scientists, post-docs, and students now work there full or part time; labs are being refurbished.

This renaissance created the opportunity to bring in novice researchers like Stevens and Stiles — whose tasks we were privileged to share for a few days last month. They and others like them are an important resource for the environment and for the American people, as well as for science in the same way.

Many more such labs that will train and attract young people to the practice of science are badly needed.

# # #

ATHOL DAILY NEWS Saturday, July 30, 1994



FOREST VIEW — Harvard Forest, located on Route 32, North Main Street in Petersham has received a $3.7 million, six year grant from the National Science Foundation for the NSF Long Term Ecological Research program that was initiated in Petersham in 1988.

Harvard Forest Photo

Long-Term Funding For Forest

PETERSHAM — Faculty and staff at the Harvard Forest in Petersham have been studying the biology of forests in central New England since 1906 as part of their research and educational role as a department of Harvard University. The recent announcement of a six-year grant from the National Science Foundation (NSF) guarantees strong support for this tradition through the year 2000.

David Foster, director of the forest, said the $3.7 million award represents six years of continued funding for the NSF Long-Term Ecological Research (LTER) program that was initiated in Petersham in 1988. It is the largest single grant in the history of the Harvard Forest.

The LTER program is a national research effort supported by NSF that is carried out at 18 sites across the continental United States, Alaska, Puerto Rico and Antarctica. These sites range from tropical forest in Puerto Rico to the arctic tundra in northern Alaska and from the deserts in New Mexico to the conifer forests in northwestern Oregon. Two sites are represented in New England, the Harvard Forest and Hubbard Brook, part of the White Mountain National Forest in central New Hampshire. A national network office is maintained at the University of Washington in Seattle. The LTER program is based on the recognition that many processes in nature occur very slowly or exhibit cyclical changes. Understanding these processes requires long-term observation and comparative investigation across many sites. In contrast to the majority of research grants awarded to U.S. scientists, which range from two to three years in duration, LTER awards run for a six-year period and are renewable to provide continuity of study at individual sites and integration of research across sites. Research within the Harvard Forest LTER program involves collaboration among faculty and scientists from three departments at Harvard University (Organismic and Evolutionary Biology, Earth and Planetary Science, Graduate School of Design) in addition to the Harvard Forest, as well as the University of New Hampshire, the Ecosystems Center at Woods Hole, Mount Union College, the University of Pennsylvania and the University of Massachusetts.

Each summer the Harvard Forest sponsors an educational research program for undergraduate and graduate students from institutions throughout the country that provides hands-on experience with the development and coordination of research projects, many of which are supported by the LTER program. Approximately 20-30 students live in Shaler Hall at Harvard Forest and interact with faculty and staff from the forest and the other academic institutions involved in the research program. This summer program is largely supported by a separate NSF grant and is coordinated by Dr. Rich Bowden, a faculty member at Allegheny College in Pennsylvania.

The research in the forest LTER project focuses on the long-term changes in forest ecosystems that result from natural and human disturbance processes. This focus on disturbance processes has been a central theme at the Harvard Forest since its establishment under the directorship of Richard Fisher, and has been a major interest of more recent past researchers including Hugh Raup, Ernest Gould and Walter Lyford. These investigations recognize that periodic disruptions to the forest include natural events such as windstorms, fires and insect outbreaks as well as human impacts including agricultural development and subsequent abandonment, forest management, land clearance and development, and, more recently, atmospheric pollution.

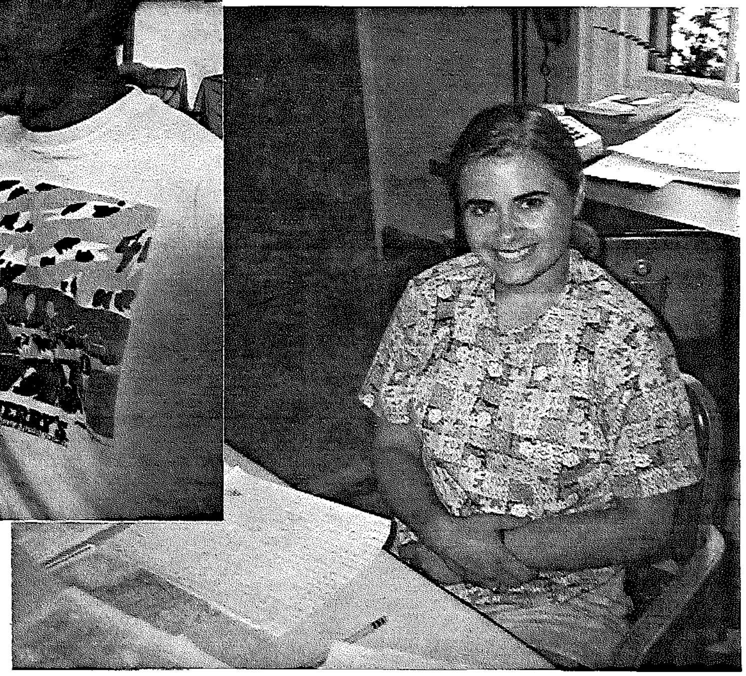
Scientists at the forest are interested in studying and comparing the ways in which forests recover from each of these different disturbances. Major questions include: 1) Are the impacts of human disturbances, especially pollution effects and the introduction of new diseases and pathogens, different from and more long-lasting than the effects of natural disturbances that the organisms have presumable experienced for many millennia? 2) Do different organisms and different parts of the forest ecosystem respond to these impacts at different rates and in different ways? The answers to these questions should reveal much about the basic functioning of forest ecosystems and also directly contribute to our understanding and predicting the ongoing and future changes in natural ecosystems in eastern North America.

During the first six years of LTER funding researchers at the Harvard Forest LTER have published more than 125 papers on these subjects in publications including Scientific American, Science, Nature and numerous ecological journals, and have presented results from these studies at conferences throughout the world. The research has also been described in the general media, ranging from the New York Times to National Public Radio. In addition, the Harvard Forest hosts many conferences and meetings that involve discussions or lectures about the research findings form the LTER program including a day-long symposium each spring to review the past year's results in each of the projects within the forest's LTER program.

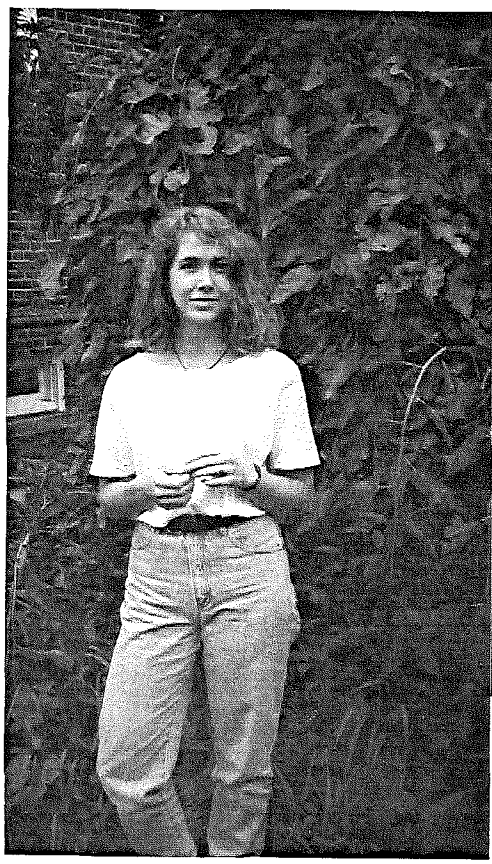
Published articles have dealt with many topics, including the history of agricultural land-use in New England and its effects on the resulting pattern and distribution of forest types within the New England landscape, the impact of nitrogen additions from acid rain to soil fertility, the effect of increased carbon dioxide in the atmosphere on plant growth and insect herbivory, the impact of potential climate change on forest soil processes, the response of forest trees to winds from the 1938 hurricane, and the role of New England forests in the global carbon cycle.

Results from the LTER studies are also incorporated into the educational program at the forest. John O'Keefe, coordinator of the Fisher Museum at the forest, has developed two slide presentations for the Gould Audiovisual Center of the museum that review the history of Harvard Forest research and outline the purpose of and activity within the national LTER program. Both shows have been converted to video-tape format and have been widely distributed for showing at other institutions. Visitors to the museum can learn about the LTER program from slide shows and other exhibits describing results from ongoing research.

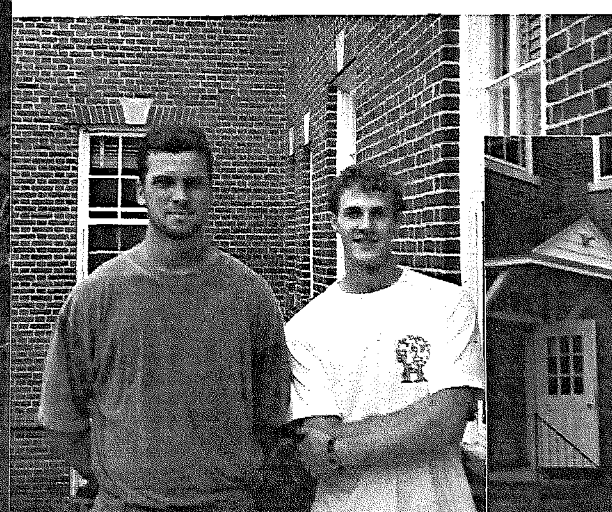
Martha Schumann Jessica Green James Chen



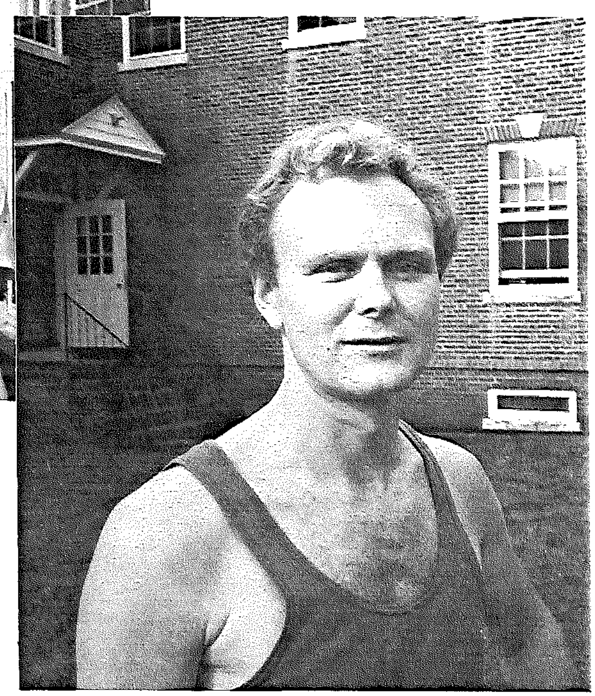
Sherry Baker



Amy Miller

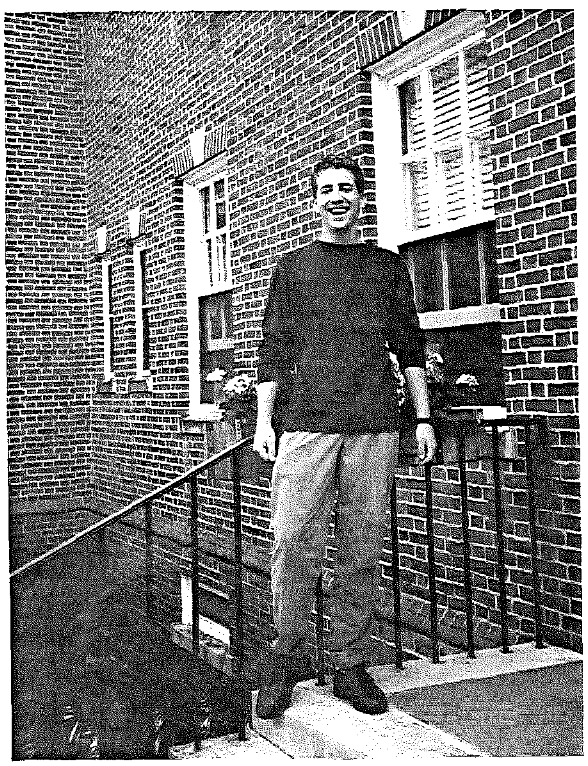


George Landman Jamie Denormandie

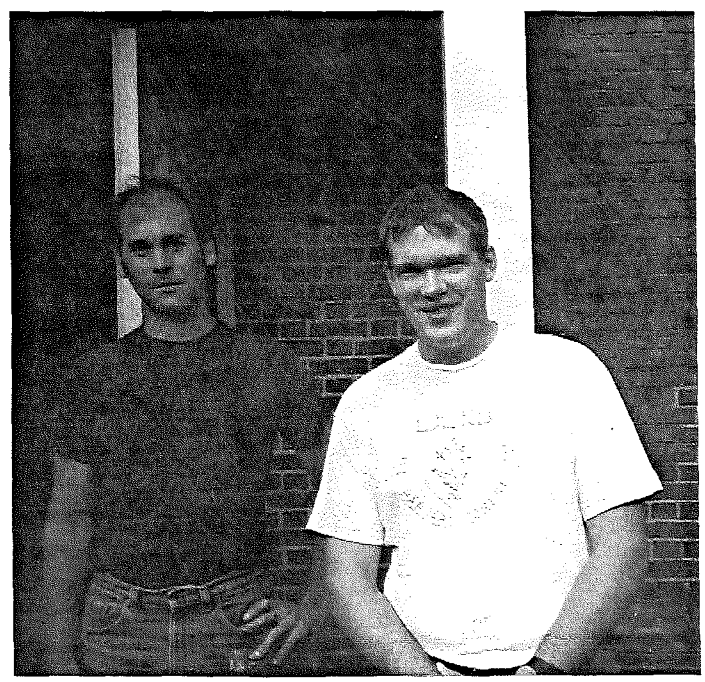


Rich Bowden

Front Row: Kaelyn Stiles, Michelle Buonopane, Nancy Werdin, Lori Biederman, Melissa Stiles, Jeff Herrick, Gwen Stevens
Back Row: Amy Boyd, Lisa George, Hafiz Maherali, Ilse Ackerman, Meghan Riley



Mike Pine



Don Strauss Joel Carlson