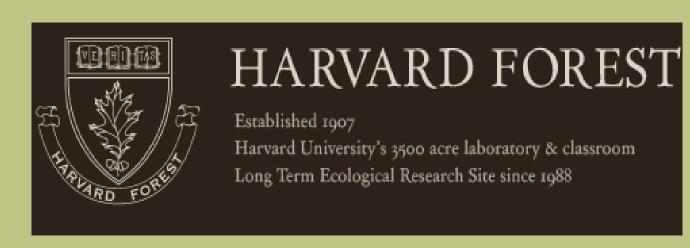




Evaluating the Drivers and Triggers of Ecosystem Dynamics:Disturbance, Climate, and People







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INTRODUCTION

The interpretation that pre-contact Native American land-use played an increasing role in landscape dynamics through the Holocene is prevalent in historical, scientific and popular literature, and yet there has never been a robust analysis of relevant archaeological and paleoecological data on the subject. This poster presents the research design, goals, and progress to date for the archaeological component of a larger National Science Foundation (NSF)-funded collaborative research project entitled: Interacting Influences of Climate, Land Use, and Other Disturbances on Regime Shifts in Forest Ecosystems: Holocene Dynamics in the Northeastern United States (NSF DEB-1146286) intended to test the hypothesis put forth in a recent paper by Munoz et al. (2010)* supporting prior assertions that the major changes in human activity follow rather than drive ecological dynamics, which are linked to climate. Can changes in land use and settlement patterns be attributed to climate, change, human cultural evolution, or human agency? Or is it a combination of these factors? To resolve the relationships this project integrates multiple scales of understanding of both ecological and cultural dynamics, with benefits to biophysical and social science.

This research project has just begun, but aims to advance the understanding of how climate change interacts with human and natural disturbances to generate abrupt ecological changes by developing and analyzing a rich array of paleoecological, paleoclimatic, and archaeological data over the past 13,000 years. The study will focus on periods characterized by sharp declines in oak and hemlock due to rapid climate change, major droughts, insect outbreaks, changing human-population and land-use regimes (e.g., deforestation, fire) at ca. 6000, 5500, and 4000 yr BP and the time of European settlement.

This research is informed by perspectives emerging from our coastal and broader studies:

- Native Americans in New England were hunter-gatherer-collectors throughout the Holocene; maize horticulture provided a minor but increasing supplement before contact.
- Broad continuity and similarity in site use, activity and subsistence patterns exist across coastal New England–New York and perhaps much of New England.
- On the coast, variations in site density (and by proxy, human population) parallel climate and vegetation changes, with peaks in the Late Archaic and Late Woodland and a trough in the Early and Middle Woodland.
- Major questions persist concerning the role of human land use and fire in structuring the vegetation.

METHODOLOGY

The archaeological component of this research will be derived from intensive state-wide site file research and spatial analysis of recorded pre-contact sites across Massachusetts and more specifically from three subregions in Massachusetts: the Taunton River Drainage Basin (TRDB), Martha's Vineyard, and the Deerfield River Valley, which represent three contrasting cultural landscapes: a near-coastal lowland, a habitat-rich island, and an inland river valley (Figure 1).

The paleoenvironmental component of this NSF research will include the analysis of sediment records by coring small lakes (<10 ha) in the three focus areas, thus embracing the archaeological landscapes, and will be carried out by researchers at Harvard University's Harvard Forest, Emerson College, and University of Wyoming (see Figure 1).

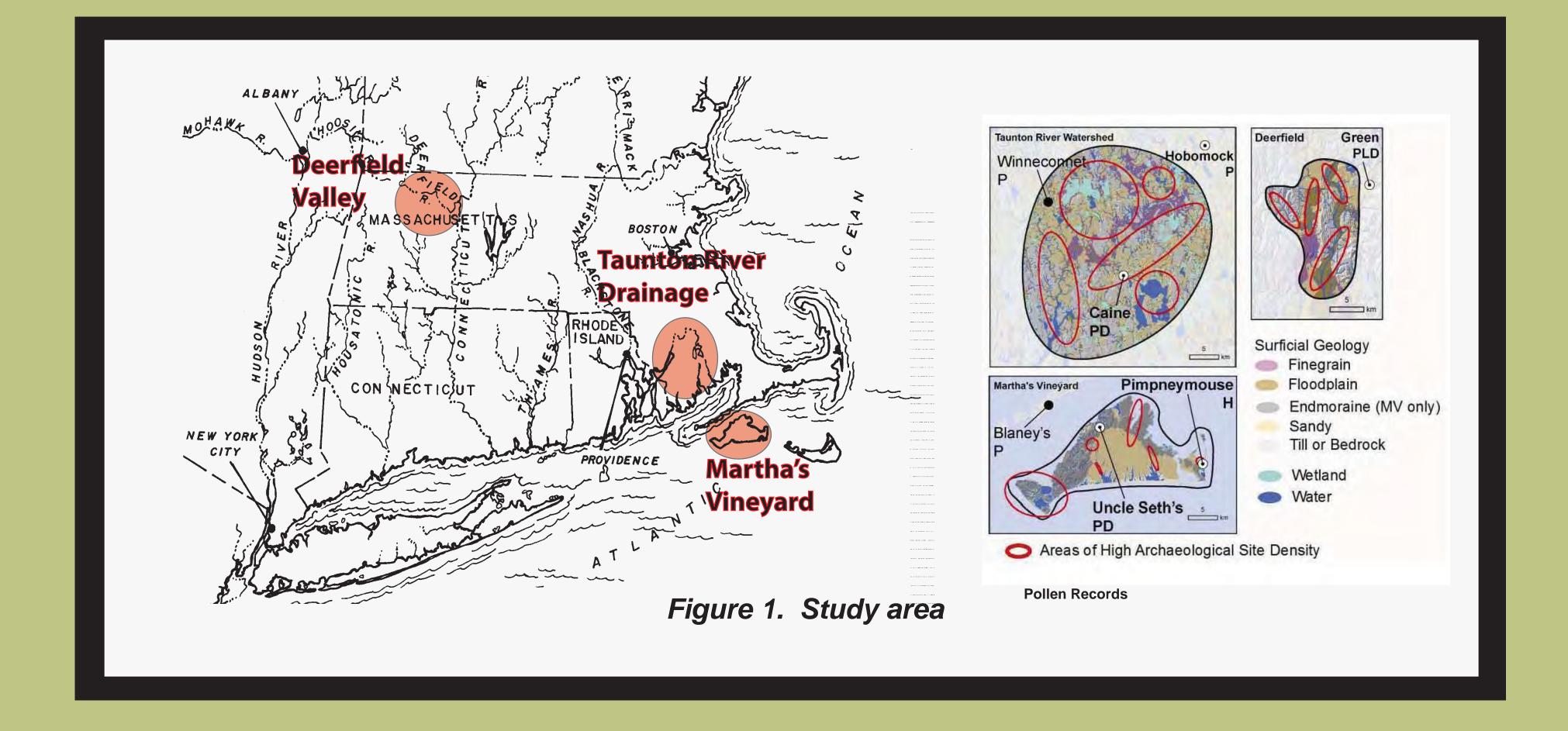
The statewide analysis will involve collecting data on sites across Massachusetts from state site forms to:

- (i) enable cross-discipline analyses of geographical and temporal variation in site density and ecosystem patterns across biophysical and cultural gradients; and
- (ii) provide a focused test of the Munoz et al. (2010) hypothesis concerning the link between environmental change and cultural development in northeastern North America.

The trivariant landscape analyses will involve synthesizing rich site information to:

- (i) provide interpretations informed by the regional analysis and high resolution paleoecological records; and
- (ii) support novel intraregional comparisons of cultural landscapes that contrast in climate, geomorphology, aquatic environments, vegetation, distance from the coast and resources.

This two-tiered approach will answer major questions concerning relationships between land use and ecological dynamics.



HYPOTHESES AND CORROBORATING DATA

HYPOTHESIS	EXPECTED EVIDENCE		
	ARCHAEOLOGICAL SITES	POLLEN	CHARCOAL
H ₀ Progressive Cultural Development Parallels Improving Technology and Influence over the Environment.	Progressive increase in numbers; shift in geographic location and activity patterns ultimately leading to horticulture; increasing sedentary versus seasonal use.	Progressive shift from climatic to cultural control of vegetation with increasing fire, wood consumption, forest clearance and horticulture.	Progressive increase in charcoal abundance, frequency and peaks reaching a maximum during the Late Woodland period of forest clearance and increasing horticulture.
H _A Cultural Continuity and Response to Environmental Change Occurs with Minimal Ecological Impact	Continuity of site use and patterns; variation in population/site density with climate and vegetation changes (e.g., increasing in warm period, ca. 5000-3000 yr BP with greater mast and declining in cool, moist periods ca. 3000-1000 yr BP); regional variation in site density related to resources, but modest variation in subsistence patterns; no evidence for intensive horticulture or villages.	Dominance by mature forest taxa until European settlement; no evidence for deforestation, openlands, horticulture, increased nitrogen, or erosion before contact.	Variation with climate and vegetation; landscape and regional variation associated with vegetation and the environment not humans; no progressive increase before contact.
H _B Cultural Adaptation is Context- Specific in Reaction to Environmental and Cultural Conditions	Variation in size and site use across different ecological and cultural settings; punctuated changes in site density not necessarily related to climate or vegetation; temporally and spatially variable environmental impacts.	Regional vegetation controlled by climate and soils but modified in some landscapes by human activity; localized evidence for changes in aquatic conditions and sediments with human activity.	Charcoal abundance, frequency and peaks variable temporally and regionally with contrasting vegetation and environment and periodic human management of the landscape.

What was the extent of human agency on the environment?



LANDSCAPES

The three contrasting landscapes shown in Figure 1 to be analyzed include:

Taunton River Drainage Basin. The TRDB has been a focus for archaeological research for the past 70 years. The lower TRDB has been rich in wetland resources continuously for 10,000 years and experienced relatively stable land-use through this period. The landscape was a significant core settlement area based on diverse resources including large runs of anadromous fish and served as a major corridor for travel and communication between coastal and inland areas. Hundreds of archaeological sites date to the PaleoIndian through Contact periods including some of the largest Archaic sites in New England: Peace Haven, Titicut, Seaver Farm, Annasnappet Pond, and Wapanucket.

Martha's Vineyard. Comprised of two moraines, intervening outwash plain and large coastal ponds, the island supports diverse habitats that differ in striking ways from TRBD. Through progressive sea level rise the island's extent and configuration, as well as groundwater table and wetland abundance have changed significantly since its separation from the mainland ca. 6000 years ago. The pre-contact Native American history is well known due a century of study. Recent projects have advanced a close collaboration between archaeologists and the resident Wampanoag population, whose ancestors lived on the land over the entire period of human occupation.

Deerfield River Valley. This confluence of the Connecticut River Valley and Deerfield-Miller's River Valleys served as a major transportation route for Native Americans throughout the pre-contact period, supported by the presence of Paleo-Indian to Late Woodland and 17th century archaeological sites. The Deerfield River floodplain offers rich bottomland, a more productive and warmer environment than the surrounding uplands and protection from the more flood-prone Connecticut River. The Deerfield River Valley has been the locus of study by archaeologists at UMass Amherst for the past 30 years. The rich archaeological and historical record affords a detailed synthesis of the geomorphological, botanical, and cultural histories within the state-wide record and in comparison with other landscapes.

PROGRESS TO DATE AND NEXT STEPS

To date, out of approximately 8,000 pre-contact sites on record at the Massachusetts Historical Commission (MHC), we have chosen 2,200 sites to include in our research. Find spots and sites for which little data on provenience, cultural material evidence, and literature is not available were omitted.

Categories of collected data for each site include: Site Provenience (Town, UTM coordinates, MHC designation), Age (PaleoIndian to Contact), Radiocarbon Data, Length of Occupation (short term, seasonal, sedentary), Activities (lithic workshop, hunting, fishing, shellfish gathering, plant gathering, food processing, cooking, storage, disposal, horticulture, burial, ceremonial, long distance trade), and Literature References.

We are in the process of amassing the collected data to complete the regional background research, which will be analyzed temporally and spatially.

The comprehensive data from sites in the TRDB, Martha's Vineyard, and the Deerfield Valley (approximately 200 sites in each area) will be augmented by further researching cultural resource management (CRM) reports, professional literature, and collections at CRM firms, local historical societies, and museums. When possible, additional charcoal and sediment analyses will be conducted on archived samples. This will allow us to:

- (i) examine site and landscape attributes in terms of physical and cultural aspects;
- (ii) determine site function, human response and impacts through site density, seasonality and faunal and archaebotanical analysis; and to
- (iii) identify regional similarities and cultural continuities, as well as differences among groups in these contrasting environments.

Our collaborative ecological and social research positions us to produce a novel regional synthesis as one critical element of the proposed study on ecological dynamics and regime shifts. This synthesis will enable our archaeological group to test the Munoz et al. (2010) hypothesis and better understand the relationships among climate, environment, and humans.

*Munoz, S. E., K. Gajewski, and M. C. Peros. 2010. Synchronous environmental cultural change in the prehistory of the northeastern United States. In: *Proceedings of the National Academy of Sciences*.