Evaluating the Drivers and Triggers of Ecosystem Dynamics in Pre-Contact New England

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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 exerts a strong influence on modern conservation practices especially the use of prescribed fire (Cronon 1984, Abrams 2002, Pyne 1984, Mann 2002) and yet there has never been a robust analysis of relevant archaeological and paleoecological data on the subject. This paper presents a progress report for the archaeological component of a larger National Science Foundation (NSF)-funded research project with colleagues from Harvard University and University of Wyoming, and is intended to analyze the triggers and drivers of ecosystem dynamics. More specifically, the research aims to determine the role of human activity (fire, land clearance, horticulture) in shaping vegetation dynamics. Some of the questions examined in the archaeological analysis include: (1) do we see progressively intensive cultural development and land use throughout the pre-Contact period? (2) do we see cultural continuity with fairly passive responses to environmental change and minimal ecological impact of people?; or (3) is cultural adaptation environmental and/or cultural specific, with clear influence of human agency?

This research will allow us to consider basic ecological questions concerning interactions among climate, disturbance, and human activity in ecosystem dynamics;
provide a landscape and regional test of a hypothesis put forth by Munoz et al. (2010) concerning the link between environmental change and cultural development in northeastern North America; and position our archaeological community to apply new ecological perspectives to their research.

The archaeological component of this research, which is the subject of this paper, is 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: Martha’s Vineyard, the Taunton River Basin, and the Deerfield River Valley, which represent three contrasting cultural landscapes: a near-coastal lowland, a habitat-rich island, and an inland river valley (see Figure 1).

The paleoenvironmental component of this NSF research will include the analysis of sediment records from small lakes in the three focus areas – Cape Cod and islands, coastal lowlands, and interior uplands – embracing the three archaeological landscapes (again see Figure 1).

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 (Chilton 1999, 2001, 2009; Duranleau 2009; cf. McBride 1990, Little and Schoenberger 2005, Mulholland et al. 1998);

• 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 periods (Duranleau 2009; Chilton 2010). These results support the Munoz hypothesis.

• Major questions persist concerning the role of human land use and fire in structuring the vegetation (Parshall and Foster 2002, Parshall et al. 2003, Foster and Motzkin 2003, Oswald et al. 2010).

Hypotheses

H₀ Progressive Cultural Development and Influence over the Environment. This widely held perspective holds that cultural development paralleled improving technology (e.g., for hunting, fishing, food processing, cooking), diversification of the resource base and emergence of horticulture and exotic cultigens (maize, squash, beans) and was accompanied by: increases in people, sites, sedentism and village development; regional differentiation in cultural patterns (e.g., coastal, interior wetland, riverine and upland; northern versus southern); and increasing impacts of humans on ecosystem patterns. Expected support (evidence) for this hypothesis includes:

Archaeological Sites (proxy for population size): progressive increase in numbers; shift in geographic location and activity patterns ultimately leading to horticulture; increasing sedentary versus seasonal use.

Pollen (proxy for ecosystem patterns): Progressive shift from climatic to cultural control of vegetation with increasing fire, wood consumption, forest clearance and horticulture. Long-term decline in fire-sensitive and mature forest trees (e.g., beech, hemlock, red maple); increasing early/mid-successional (oak, pine, birch), openland (graminoids,
shrubs, ragweed, weeds) and cultivated taxa (e.g., maize, *Chenopodium*); increase in sedimentary nitrogen and erosional material.

*Charcoal (proxy for fire):* Progressive increase in charcoal abundance, frequency and peaks reaching a maximum during the Late Woodland period of forest clearance and increasing horticulture.

**Hₐ  Cultural Continuity, Response to Environmental Change with Minimal Ecological Impact.** Recent studies assert that despite meaningful cultural and material change relatively minor shifts occur in hunter-gatherer-collector subsistence patterns, land use or human impacts through the Holocene. Human populations were responsive to climate and vegetation changes, but exerted little impact on the environment and exhibited minor regional differences in settlement and subsistence patterns.

Expected evidence includes:

*Archaeological Sites:* continuity of site use and patterns; variation in population/site density with climate and vegetation changes (e.g., increasing in warm periods (5000-3000 yr BP) with greater mast, and declining in cool, moist periods (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.

*Pollen:* changing with climate trends including rapid dynamics with natural perturbations with regional patterns controlled by climate and soils; dominance by mature forest taxa until European settlement; no evidence for deforestation, openlands, horticulture, and increasing N or erosion before contact.

*Charcoal:* 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.* This is a Darwinian perspective allowing for human agency and impact in models of ecological relationships and suggesting that humans adapt to conditions by choosing from possible alternatives, some of which leave a stronger archaeological and ecological signal than others.

Expected evidence includes:

*Archaeological Sites*: 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.

*Pollen*: 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*: charcoal abundance, frequency and peaks variable temporally and regionally with contrasting vegetation and environment and periodic human management of the landscape.

**Methodology**

To address our hypotheses regarding ecological and cultural dynamics requires an integrated analysis of cultural datasets at scales and resolution commensurate with the biophysical data. The major archaeological goal for the first year was to “assemble the regional and subregional archaeological data” (Foster et al. 2012:16).

We’ve been compiling and analyzing existing archaeological data at two scales:
regionally for Massachusetts and in the three contrasting cultural landscapes: the Taunton Basin, Martha’s Vineyard, and Deerfield Valley (see Figure 1). The statewide analysis of all recorded pre-contact archaeological sites will apply the protocol from Duranleau’s (2009) highly successful coastal synthesis of 2000 sites (see Figure 2).

We have compiled an inventory of all of the nearly 7,700 archaeological sites in Massachusetts. This inventory was initially developed from archaeological site forms housed at the Massachusetts Historical Commission (MHC) in Boston, MA. The information in these forms was supplemented by site reports and published articles available at the MHC, and at several cultural resource management firms in southern New England, including UMass Archaeological Services in Amherst, MA, John Milner and Associates formerly of Littleton, MA, and the Public Archaeology Laboratory, Inc. in Pawtucket, RI.

Out of these 7,700 sites, we compiled detailed archaeological information on the 2,011 sites that were either excavated by professional archaeologists under permit from the MHC or under the direction of members of the Massachusetts Archaeological Society (the reason for this is that we wanted to exclude sites that were either just find spots or lacked the pertinent information we needed about site type and time period). The information we gathered from these 2011 sites includes, but is not limited to: site provenience (Town, UTM coordinates, MHC designation), site age (PaleoIndian to Contact), $^{14}$C data, length of occupation (short term, seasonal, sedentary), and site activities (such as lithic tool repair, lithic workshop, hunting, fishing, shellfish gathering, plant gathering, food processing, cooking, storage, disposal, horticulture, burial, ceremonial activity, and long distance trade).

The locations of all these sites have since been mapped using ArcGIS. Out of these
2,011 sites, there are 1,126 sites with a known temporal affiliation.

While we literally received the GIS data and maps last week, we wanted to share just a few preliminary observations. Within the three subregions we will investigate further, there are a total of 381 sites from the Taunton River Drainage, 208 of which have a known temporal affiliation; 72 sites from the Deerfield River Valley with 26 of known temporal affiliation; and 63 sites from Martha’s Vineyard with 41 of known temporal affiliation.

From these 516 sites, we have also compiled a list of 75 sites within the three subregions that we’d like to potentially explore further. Archaeologists excavating these sites uncovered features and other evidence suggesting groups occupying these sites were practicing a broad range of activities. Some of these sites have unprocessed radiocarbon samples and/or flotation samples that we plan to process. Charcoal, faunal, and botanical remains recovered from the features at these 75 sites can be identified allowing us to further explore the plant and animal species exploited by these groups. We will also consider the potential for lithic and phytolith analyses.

Challenges

One of the biggest obstacles in gathering data for this project was accessing the site forms—these are hard copy forms on file in Boston at the MHC. Many contained only preliminary data with reference to a full report elsewhere, which then needed to be hunted down in order to get a complete picture of what was recovered at a site. Some site forms were quite cryptic and after hunting down the report, we realized that very little had been recovered at a given site.

Additionally, over 50% of our sites were occupied during more than one time period, so, in many instances we aren’t certain what features were associated with what
occupation. For example, one of the repeatedly occupied sites has evidence of PaleoIndian occupation, so when comparing the percentage of PaleoIndian sites by activity graph, 6% of the sites have evidence of horticulture, thus projecting evidence from later Woodland Period occupations (see Figure 3). Teasing apart multicomponent sites within the three focus areas is a challenge we will be addressing head on next year.

One major hurdle is to determine what is really meant by 'site type' since our data collection has shown that professional and amateur archaeologists alike have a different idea of what constitutes a camp site, workshop, hunting site, village site, etc., and short term vs. long term occupation.

By intensely analyzing all site data available in the three areas, we will hopefully be able to redefine site types by looking at artifact and feature assemblages, and temporal affiliations, together with location/placement on the landscape. When combined with the new paleoenvironmental data, the triggers and drivers of land use and settlement patterns on a local level within each of the three areas will be identified. This data can be compared with what the statewide data is suggesting, and how this either differs or confirms what Munoz has presented for the northeast. Using GIS will be instrumental in interpreting and presenting such a vast amount of data in conjunction with the climate and environmental data, and will lead to a greater understanding of ecosystem dynamics in pre-contact New England.
Bibliography


Foster, D. R., Chilton, E. S., and Shuman B. 2012 *Collaborative Research: Interacting influences of climate, land use and other disturbances on regime shifts in forest ecosystems: Holocene dynamics in northeastern United States.* Proposal submitted to the National Science Foundation.


Figure 1. The three subregions for this study
Figure 2. Duranleau’s (2009) coastal synthesis
Figure 3. PaleoIndian sites by activity type