1979

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SUBSISTENCE, HORTICULTURE, AND ECOSYSTEMS: 
A MODELING APPROACH TO CULTURAL RESOURCE MANAGEMENT

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Abstract

An ecologically oriented model is presented which seeks to explain the introduction of horticulture into a marginal area. The model is grounded in ecosystem succession theory, having as its key the inability of new information to enter a mature ecosystem. Means of testing the model in the Middle and Late Woodland of the Connecticut River Valley are explored. The development of this preliminary model clearly exemplifies the critical role of theoretical propositions for successful Cultural Resource Management.
The original aim of this paper was simply to present a modeling approach to our understanding of prehistoric change. The approach was intended to address the problem of the introduction of horticultural subsistence methods into a rich but marginal area, the Connecticut Valley. By examining ecological factors in such a topographically defined area, by fitting these factors onto a probabilistic description of the hunter/gatherer/fisher way of life in the valley, and by applying an ecological theoretical perspective, I had hoped to derive both a descriptive model of the process of adding horticulture to the economy, and an explanatory model concerned with the subsistence activities connected with such a change.

These goals will be touched on, but another dimension has asserted itself in the derivation of those models. This dimension might be described as the practical aspect of the derivations. Specifically, I wish to describe the part played by the burgeoning field of Environmental Impact Assessment/Historic Preservation in the progress and processes of the research.

First I will give a very brief background of the project which engendered this research, then a brief history of the research, and finally an overview of the present state and direction of the research.

The I-391 project is an extension of the interstate highway system, and consists of about four-and-a-half miles of four-lane limited access roadway, four interchanges, and bridges over the Connecticut and Chicopee Rivers.

The proposed construction will connect the downtown area of the City of Holyoke, Massachusetts, with Interstate 91 (a major north-south artery) at a point near the center of the City of Chicopee. The right-of-way will traverse, besides the downtown areas of Holyoke and Chicopee and the two rivers, a section of Chicopee known as the Willimansett Bluffs. These bluffs are actually a part of the front of the largest of several deltas which were formed in glacial Lake Hitchcock at the close of the Pleistocene. The planned construction contemplates both extensive cuts and considerable amounts of fill along these bluffs, and in the vicinity of the Chicopee River crossing.

Those parts of the project which lie in the business districts of Holyoke and Chicopee have been thoroughly disturbed by urban construction, and probably no longer contain anything of prehistoric interest. Several historic sites, structures, and an historic district may be impinged upon by the proposed I-391 construction, but that is beyond the scope of this paper.

In 1975, amid the confusion of the early implementation of the several new historic preservation laws and regulations, Paynter and Thorbahn carried out what, in retrospect, was a Phase I/IIa survey of the I-391 project area. Although woefully underpaid, undermanned, and under the twofold stress of operating in both a physical space (the Connecticut Valley), and a theoretical area (contract archeology) wherein few
stated in its simplest terms, Paynter and Thorbahn's approach was to evaluate the several environments in the vicinity of the project, to devise a seasonal model of prehistoric hunter/gatherer and hunter/gatherer/horticulturalist settlement patterns in terms of that evaluation, and thus to derive probabilistic statements as to site locations within the project area. These statements were then tested by means of a stratified sampling strategy. This approach predicted and tentatively located a locus of prehistoric activity which was named the Indian Crossing site.

In 1976, a Phase IIb survey of the I-391 project area was carried out, which, among other things, evaluated the Indian Crossing site (Ulrich 1977). The location of the site was sampled by means of numerous test pits and trenches, and chronological and spatial parameters determined. In analyzing the results of the field and lab work, the model of settlement pattern devised by Paynter and Thorbahn was revised and expanded, and used heuristically to develop a descriptive and explanatory line of thought necessary to justify Phase III research on the site. Specifically, the Phase IIIb work indicated the presence of late Middle Woodland and early Late Woodland components, and a strong likelihood of continuous occupation between the two. As it is probable that horticulture was added to the subsistence base during this period, it followed that the dual hunter/gatherer - hunter/gatherer/horticulturalist model of Paynter and Thorbahn could now be used as a basis for examining the process of subsistence change which took place at the site.

The Phase III research, which will begin the summer of 1979, is focused on this process of subsistence change. Using a further refinement of the subsistence/settlement pattern model, a series of propositions or testable statements have been derived, and specific methods of testing them determined.

Some of these propositions are:

1. The site was occupied between 700-1300 A.D.
2. The site became larger through time.
3. The site was occupied in the spring and the fall.
4. Regional and local climate remained the same through time.
5. Site environment at all levels included grasslands.
6. Site economy at all levels included nuts, roots, tubers, berries, fish, fowl, eels and possibly mammals.
7. Site economy at later levels included, in addition, cultigens such as maize, beans, squash, sumpweed, goosefoot, etc.

8. Indications of a trade network were present, indicating far-flung relationships. Lithic material (chert) came from the Hudson Valley.

9. The site fits into a modeled regional settlement and subsistence pattern.

10. There was little change in the social patterns from the earlier to the later levels of occupation of the site.

Finally, an ecologically oriented model based on the succession theory and information processing themes of Margalef (1968) is useful. A key element in this model is the use of Margalef's concept of maturity (as opposed to climax) within a succession (1968:32). In Margalef's view, climax is a static concept, difficult to apply in a general discussion of succession. In contrast, by using the concept of a mature state of succession, one is able to qualify it. (This is conceptually difficult with an absolute term such as climax.) One may have an ecosystem which is described as mature, but which nevertheless becomes subject to change, and therefore arrives at a more (or less) mature state. The concept thus becomes sufficiently flexible to be useful in a variety of successional situations. In the present context, this flexibility is essential in seeking an explanation of a system which was once static (less mature), became unstable and underwent change, and succeeded then to a static state once again (more mature).

As an aside, it is noteworthy to realize that change in cultural systems, like succession in ecosystems, and unlike biological evolution, does not occur continuously, but sporadically, in fits and spurts as it were. I may be less misleading, especially within an overall ecological context, to use successional theory as a general paradigm for analyses of cultural change, rather than the theory of evolution (cf. Gall and Saxe 1977, in a discussion of the origin of the state).

The ecologically oriented model based on the foregoing is testable within the larger framework of the subsistence/settlement pattern model, and has the following preliminary form.

The hunter/gatherer subsistence system in the Connecticut Valley prior to the introduction of horticulture, was a subsystem of a larger ecosystem which included the environment of the entire valley. Assuming that this larger ecosystem was a mature system (it had not changed substantially for at least several millennia), it follows that the hunter/gatherer subsistence system within it was also a mature system. According to Margalef's view of succession theory, an ecosystem at a mature state of succession does not permit the introduction of new information (1968:30). New information would change the system, and therefore the system would not be mature if it were changing. So, in regards to the human subsistence subsystem, as long as the state of maturity or stability remained, new information, e.g., horticulture, could not be introduced.
In order for the new horticultural information to be acceptable, an element of instability must be introduced into the system, rendering it something less than mature. Sources of such instability might be divided into three classes:

Extra-systemic instability: for example, climatic change.

Inter-systemic instability: such as interference from another ecosystem

Intra-systemic instability: population change, for example.

All three of these classes, especially the last, seem to belie the assumption of maturity. But in order for such an assumption to be viable, primary assumptions, usually unstated, must exist. A primary assumption in this case is that the mature system has existed for some period of time, say several thousand years. The elements of instability, both from within and without, may to some degree be considered to have been brought about, within the larger temporal setting, by the very state of maturity. Population change, for example, might not cross some critical threshold except through the long-term existence of a stable state, i.e., maturity. Neither climatic change nor outside interference would have a profound impact on an already unstable system, an immature system. To return to the concepts of Margalef, a less mature system (the human subsistence subsystem), encountered, or developed, a source of instability which it could not handle except by means of change, thereby becoming a more mature system.

Within the framework of the previously stated propositions, examples of the approaches to testing the three classes of introduced instability might be as follows:

Extra-systemic - climate change. This is contained in Proposition 4, "Regional and local climate remains the same through time."

Inter-systemic - interference from another ecosystem. This is testable within Proposition 8. By analyzing changes in the numbers, distributions, sizes, etc. of the Hudson Valley cherts within the site, indications of changes in intersystemic relationships may be inferred

Intra-systemic - population change. This is testable through examination of Proposition 2. If the site increased in size through time, it is possible that the human population was increasing.

This model is of course by no means in a finished state. It is presented here only as a means of demonstrating that the modeling process can play a vital role in the evolution of Environmental Impact Assessments. It can be seen that, contrary to the pessimistic conclusions recently expressed by Fairfax (1978) (which were directed to the entire field of
of Environmental Impact Assessment, including ecology, zoology and botany, noise pollution, social impacts, etc., conservation in general), it is possible, at least in the field of archeology, to do more than churn out paper, it is possible to address current research problems. By means of the modeling process, the I-391 project has provided a basis for archeologically approaching both a relatively unknown geographic area, the Connecticut Valley, and a timely and important set of theoretical problems, cultural change as manifested by the introduction of horticultural subsistence methods into a marginal area.
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