The Prospects for Wetland Archaeology in the Champlain Valley

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Introduction

Inundated prehistoric sites likely exist within the Champlain Basin of New York and Vermont (Figure 1). However, these sites will be small targets to find in the great expanse of the recently submerged lands of the Champlain Basin. Visibility is often poor in Lake Champlain and the typical sediment cover may prevent immediate recognition of archaeological sites or paleoterrestrial geological features. Purely random testing of the lake bottom stands little chance of success in locating drowned prehistoric sites. In order to meet the needs of wetland archaeological research, a model similar to that developed for sites along the North American outer continental shelf needs to be constructed for Lake Champlain. This model must address the Champlain Basin's unique setting and be able to locate inundated prehistoric sites. This paper summarizes the current models used worldwide to locate inundated prehistoric sites and outlines the steps necessary to develop such a model for the Champlain Basin.

The World's Inundated Prehistoric Record

During the Late Pleistocene and Early Holocene (15,000-8000 BP), large volumes of water from melting continental glaciers caused a general worldwide sea level rise, flooding the once exposed continental shelves. Following this marine transgression, climatic, eustatic, and isostatic changes have also increased the size of many of the world's freshwater and saltwater bodies, submerging countless prehistoric sites and burying others under great quantities of sediment as drainage gradients decreased (Faught and Donoghue 1997:417-418).

Archaeologists have recognized the existence of inundated terrestrial prehistoric sites since the middle of the nineteenth century when inundated settlements were discovered in the upland lakes of Central Europe. The presence of inundated prehistoric sites on the world's continental shelves was later identified during the early 1950s (Glynn 1953; Goggin 1960; Tuthill and Allanson 1954). Until recently, though, archaeologists have left these resources unstudied in favor of those found on dry land. It was not until the 1960s, following the publication of a number of articles about the archaeological potential of these sites that the archaeological community generally began to understand the magnitude and research potential of the world's inundated prehistoric record (Bullen 1969; Emery 1966; Emery and Edwards 1966; Lazarus 1965; Powell 1965; Salwen 1962, 1967; Shepard 1964; Solecki 1961).

Archaeologists have become increasingly aware, on a theoretical level, of the implications of changing sea levels on the world's coastal shorelines, drainage basin gradients, and water tables. More importantly, archaeologists are taking into account the ramifications of these environmental changes on the archaeological record, lifeways of prehistoric groups, and the resulting biases incorporated into the vastly incomplete reconstructions of the past (Bailey and Parkington 1988a; Bernick 1998a; Coles 1984, 1992; Coles and Lawson 1987; Fischer 1995; Johnson and Stright 1992; Masters and Flemming 1983; Purdy 1988b).

Although the archaeological study of submerged prehistoric sites has had a long history of research in many parts of Europe, it has yet to have much impact on American archaeology, which continues to concentrate its efforts on dry land, or terrestrial, sites. The aim of wetland archaeology is to reconstruct the inundated portion of prehistoric settlement patterns, subsistence activities, and culture history before, during, and after the process of submergence. Wetland archaeology is an umbrella term used for sites found in wet to fully underwater settings that were once at least partially exposed to air (Figure 2). These sites often have excellent preservation of otherwise unretrievable organic artifacts, and require special excavation and conservation considerations. This growing field relies heavily upon oceanography, limnology, and other disciplines in its investigation of the marine/lacustrine processes that affect the archaeological record and for reconstructing the paleoshorelines and littoral environments in which inundated prehistoric sites are located (Faught and Donoghue 1997:417; Watters 1981).

Methodology for Discovering Inundated Prehistoric Sites

Until the 1960s, most inundated prehistoric sites were located by chance, primarily in nearshore settings and were not necessarily excavated using careful archaeological techniques. Following a flurry of articles in the 1950s on submerged prehistoric sites found in the wetlands of Florida and off the coasts of California and Connecticut, a scholarly debate began about the potential for preserved sites in the very dynamic coastal environments on the outer continental shelf (Edwards and Emery 1977; Edwards and Merrill 1977; Flemming 1981; Powell 1971; Salwen 1967). Interest in submerged prehistoric sites soon developed, which lead to the outgrowth of a methodology for the discovery of inundated sites that relies on sophisticated predictive models for site location and preserva-

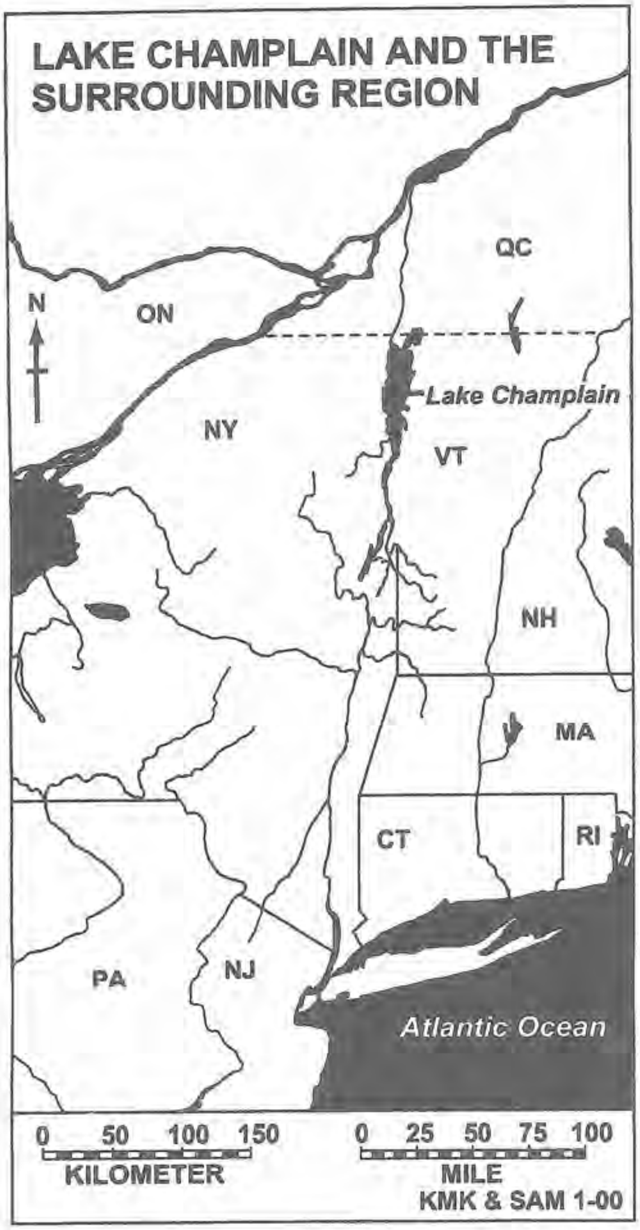

Figure 1. *Lake Champlain and the surrounding region.*

tion (Belknap 1983; Belknap and Kraft 1981; Dixon 1989; Garrison 1975; Grebmeier 1983; Roberts 1979; Stright 1983, 1986, 1990, 1995).

Since the 1960s, predictive models for inundated sites have been applied in several areas of the world, most extensively in the Gulf of Mexico along the US continental shelf as part of the legislated mitigation requirements for offshore oil and gas development. One of the primary hypotheses of these models is that inundated sites will be found in similar habitats as those found in the terrestrial archaeological and ethnohistorical records. Studies of maritime cultures have shown that most people preferred to live on estuaries, lagoons, protected bays, and upstream from the mouth's of navigable tributaries. The discoveries of prehistoric settlements, workshops, and boat landings have occurred primarily in sheltered locations. Given the density and types of prehistoric sites known to have existed along the present shoreline and river banks, one would expect that diverse hunting, fishing, collecting, and manufacturing activities took place along the now submerged shorelines (Gagliano 1974, 1977, 1983; Gagliano, et al. 1982; Pearson, et al. 1986, 1989).

The rate of water level rise is an important consideration both in terms of site occurrence and site preservation. Periods of relatively rapid water level rise might have a positive effect on site preservation because of the shorter time a site would be subjected to the effects of shoreface erosion especially where they were somewhat protected from wave action, as in estuaries. However, periods of rapid shoreface transgression also may have resulted in unstable coastal ecosystems that would have been less productive and therefore less likely a focus for prehistoric human subsistence and/or the rapid transgression may have caused substantial erosion where sites were not protected (Odale 1985).

Predicting the location of inundated archaeological sites is more difficult than sites recently formed on land because the underwater landscape is obscured from view, as well as the potentially dramatic changes to this landscape over time. The difficulty in locating submerged prehistoric sites is due to both the simultaneous cataclysmic destructive and depositional elements of marine/lacustrine environments. To define more specially where inundated prehistoric sites are likely to occur, models of the submerged paleogeography must be developed using detailed bathymetry and soil profiles obtained through side scan sonar, sub-bottom profilers, precision depth recorders, and bottom sampling (Figure 3). This knowledge then can be integrated with information concerning the glacio-eustatic, glacio-isostatic, hydro-isostatic, and other paleo-environmental data to develop a hydrological and environmental history of a water body.

With the use of computer software, an enhanced 3-dimensional bathymetric map can be created of a water body with its detailed stratigraphy. These maps will reveal the trend of paleotopography and paleodrainage systems and other topographic irregularities that may reflect the locations of drowned terrestrial sites (Faught and Donoghue 1997:452). These maps are then reviewed for the terrestrial landforms identified as being utilized by prehistoric groups. All of the existing models have been developed in this fashion.

Predictive Models for Site Preservation

Many archaeologists believe that inundated terrestrial sites would have been destroyed by erosion during submergence. Research, however, has demonstrated that this need not be so.

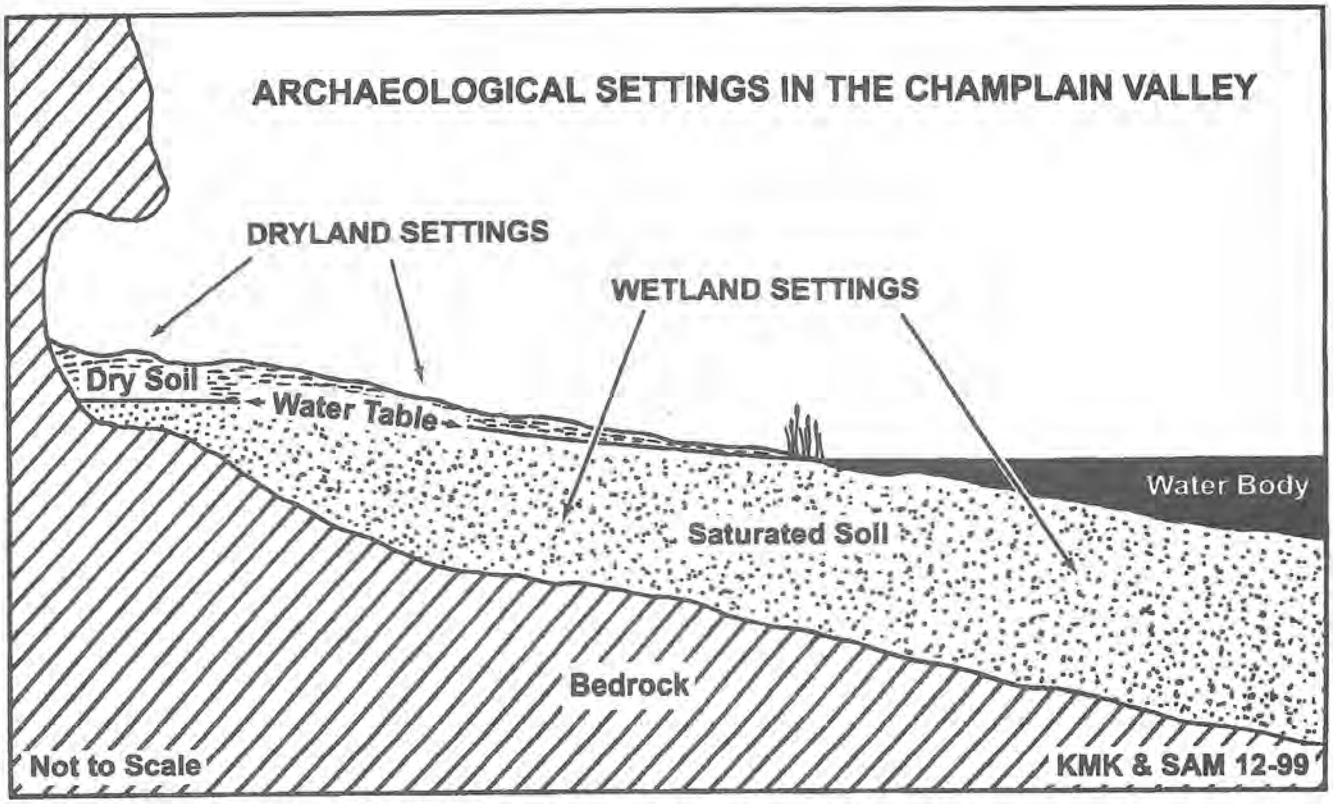

Figure 2. *Archaeological settings in the Champlain Valley.*

There are a number of cultural and noncultural factors that affect site preservation before, during, and after submergence. No single environmental or cultural factor is necessary or sufficient to ensure preservation of archaeological remains underwater. The site formation processes of the prehistoric record on dry land are relatively well understood (Shiffer 1991; Waters 1992) compared to those of drowned archaeological sites (Stewart 1999). However research, conducted since the 1960s, has identified nine attributes that can dramatically affect the preservation of an inundated prehistoric site (Carrell, et al. 1976; Ferrari and Adams 1990; Lenihan, et al. 1981; May, et al. 1978; McCall and Tevesz 1982; Muckelroy 1978:165-182; Will and Clark 1996).

1. Nature of the Site
A short-term occupation site resulting in only a lithic scatter and hearth would be less likely to survive intact through a transgressing shoreline than would a quarry site or one with deeply stratified deposits.

2. Environmental Setting
Certain geomorphological settings contribute to the preservation of sites by reducing the detrimental effects of inundation, waves, currents, and ice formation. Locations that have alluvial slopes with extremely low angles of less than ten percent are less likely to be considerably affected by transgression as increasing water levels quickly cover the site and promote sedimentary deposits. Protected shorelines, bays, estuary margins, leeward sides of islands, river terraces, point bars, and flood plains all have qualities that help to preserve prehistoric sites.

3. Wave Energy
Waves are in large part produced by winds; so the total straight-line fetch, frequency and strength of winds, and the geographical setting affect the speed, duration intensity, refraction, and diffraction of waves entering the site of a particular setting. The long-term preservation of an inundated site often greatly depends on the effects of waves.

4. Ice Formation
The past duration and thickness of ice covering a site is a possible mechanism in the destruction of archaeological deposits, especially when water levels drop, allowing ice to rest on the shoreline or when large icebergs form and gouge the bottom sediments. During thaws, ice sheets also pile up along windward shores.

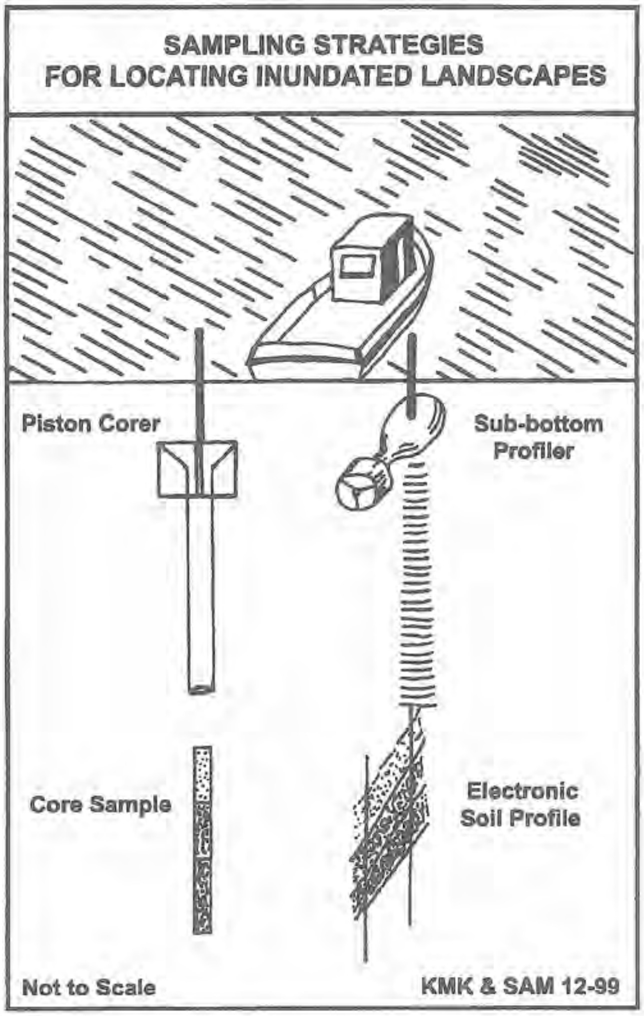

Figure 3. *Sampling strategies for locating inundated landscapes* (after Dean, et al. 1992:Figure 62).

5. Process of Transgression

The process of transgression may be the most important influence on the preservation of prehistoric sites. Archaeological sites caught in the surf zone of a slowly transgressing shoreline would be destroyed unless an adequate sediment cover was deposited prior to submergence and it could be replenished during the erosional cycle. Erosion is most pronounced during relative stillstands or pauses in the transgressive/regressive cycles. The signature for the water level's presence at a relative stillstand is usually in the form of a wave cut terrace on gently sloping terrain, backed by steep terrain. During stillstands, shoreline bays, and ecological zones are established, and become stabilized, supplying resources of interest to humans. The intensity or length of time people exploited these resources would be reflected in the depth and extent of the cultural deposits.

6. Current Energy

Currents differ from waves in that they have a continuous and progressive forward movement of water. They may be created in several ways, such as steep basin gradients, differential water temperatures, and long sustained winds. Bottom currents greatly affect the preservation of inundated sites after they have reached below the effects of surface waves.

7. Sediment Coverage

Climate is an important factor in determining the amount or yield and size of sediment brought to the shoreline by rivers and streams. Vegetation, temperature, rainfall characteristics, and the topography and size of the drainage basin influence the sediment yield. Sites that have been covered by at least 1 m of compact, homogeneous mud, which has a high organic content, generally are the best preserved. In general though, finer and smaller materials are more easily entrained by waves and current and removed from or reworked within the shoreline zone. Coarser and larger materials, especially stones and boulders, act somewhat to stabilize shorelines toward equilibrium, but provide poor environments for organic preservation.

8. Benthic Bioturbation

Biological processes before and after inundation modifies the soils of submerged sites. The burrowing activity of various fauna are extremely destructive as they alter the spatial relationship of artifacts and features as well as causing mechanical and chemical damage. Burrows also create temporarily aerobic pockets that compromise the stability of organic material by exposing them to oxidation and biological degradation. Flora generally has a positive effect on the preservation of inundated sites by bonding bottom sediments and preventing erosion.

9. Cultural Disturbance

Some sites have experienced site disturbance by cultural activities after their submergence. Examples of such activities would include dredging, shipping activity, instillation of offshore structures, and trawling.

Analysis of Disturbed Inundated Prehistoric Sites

Accidental discoveries have predominately recovered isolated surface finds as opposed to inundated sites, generally presumed to lack archaeological context. However, spatial distribution of such finds within a defined area can be analyzed with methods similar to those applied to terrestrial surface finds (Easton 1997:324). Surface finds may also represent eroded and transported remains, signifying additional prehistoric deposits within the sediments they lie upon or nearby. Even if a submerged prehistoric site has been disturbed, the artifacts, ecofacts, and remnants of associated features can tell a great deal about what activities took place and with environmental reconstruction, the type of paleo-setting of the site can also be identified. Although less can be stated about the relationship of single artifacts to each other and possibly to features in this disturbed context, there may be still valuable clues for site reconstruction and the people who created it, depending upon the scale of the spatial analysis. The clustering of artifacts through wave action is not unlike plowzone assemblages in terrestrial settings and has similar archaeological value (Faught and Donoghue 1997:441).

Since the 1960s, the effect of natural processes on archaeological sites has been studied in both saltwater and freshwater environments. These studies of site formation processes have revealed a series of complex mechanisms that affect the preservation of inundated prehistoric sites. Results have shown that sites even in the worst of conditions can and have survived to some degree. Furthermore, if an archaeological deposit is relatively thick, the basal portions of the site may survive marine transgression, even if the uppermost portions are destroyed (Stright 1995:144).

The most common disturbance to inundated archaeological sites is caused by waves. Waves are the primary natural cause for erosion and recession of basin shorelines. The following conclusions about the effects of waves on artifact movement are just examples of what can be reconstructed from the archaeological record.

1. Amount of Movement

Artifacts exposed to wave energy in the shoreline fluctuation zones can move, and the scale of movement from their original location may be in meters. Furthermore an artifact will continue to move throughout time until it is either stranded beyond the impacts of waves and ice, or until its movement is somehow impeded (e.g., rocks, vegetation, burial by sediments). The lighter the objects are the greater the distance they will travel. Differential movement will also sort artifacts both vertically and horizontally in an active shoreface. Artifacts whose specific gravity is greater than the surrounding sediments will often migrate downward through the sediments (Murphy 1990:53).

2. Direction of Movement

The direction of artifact movement is generally inversely related to the direction of the major water movement, which is related to the bottom morphology and predominate wave directions. Specifically, artifacts will tend to move up the shoreface or down the shoreline in a direction away from the origin of predominant waves (Will and Clark 1996:516).

3. Damage

Damage occurs to all artifacts subjected to wave action and the amount of damage seems to correlate with the time spent in the active shoreface. Even after a small amount of movement, artifacts show a remarkable amount of damage in the form of abrasion and edge breakage (Will and Clark 1996:511).

Excavation of Inundated Prehistoric Sites

If inundated prehistoric sites are found, they present challenges in excavation, recovery of data and artifacts, and in analysis. In prehistoric sites the environmental and relational contexts of cultural remains are critical to an interpretation of their use; thus, clearly recording the horizontal and vertical relationships between sedimentary levels, artifacts, ecofacts, and their relative ages is essential. An inundated prehistoric site looks very similar to a terrestrial site and if stratified, it can be excavated in precise levels, just as on dry land. The application of standard underwater archaeological excavation procedures to accomplish this is possible in still water to moderate current conditions (Dean, et al. 1992; Green 1990). Underwater archaeological techniques, having been largely developed for the excavation of shipwrecks, sometime need to be modified to accommodate the unique characteristics of inundated prehistoric sites. A number of specialized techniques also have been developed for tasks such as obtaining paleoenvironmental samples not generally taken on shipwreck projects (Oxley 1991). Various underwater archaeology projects have demonstrated that precise excavation controls can be established and safely employed rivaling any land excavation (Andersen 1987; Cockrell and Murphy 1978; Easton and Moore 1991; Malm 1995; Murphy 1978, 1990; Purdy 1992).

Model for Lake Champlain's Inundated Sites

Environmental and Geological Data

If submerged prehistoric sites are to be found and excavated in Lake Champlain and perhaps elsewhere in the region, archaeologists must be able to predict the approximate location of sites so as to minimize the search. They must also be able to predict the potentially relevant destructive elements in order to determine the preservation potential of a site and its associated features and artifacts. This requires a reconstruction of the paleoenvironment, paleogeography, and paleohydrology to develop an accurate predictive model. To date, however, very little work has been directed towards the integration of such data for the Champlain Valley, except at a gross level (Shanley and Denver 1999).

During the last 12,000 years, the Champlain Valley has undergone tremendous transformations (Figures 4 and 5). The change from a saltwater to freshwater body was accompanied by a shift in climate, wildlife, aquatic life, and vegetation. These transitions have been identified through pollen samples recovered from regional wetlands and the plants' assumed associations with fauna (Parren 1988; Thomas 1994:38-44).

The existing general model of the hydrological history of the Champlain Basin is the product of research carried out at

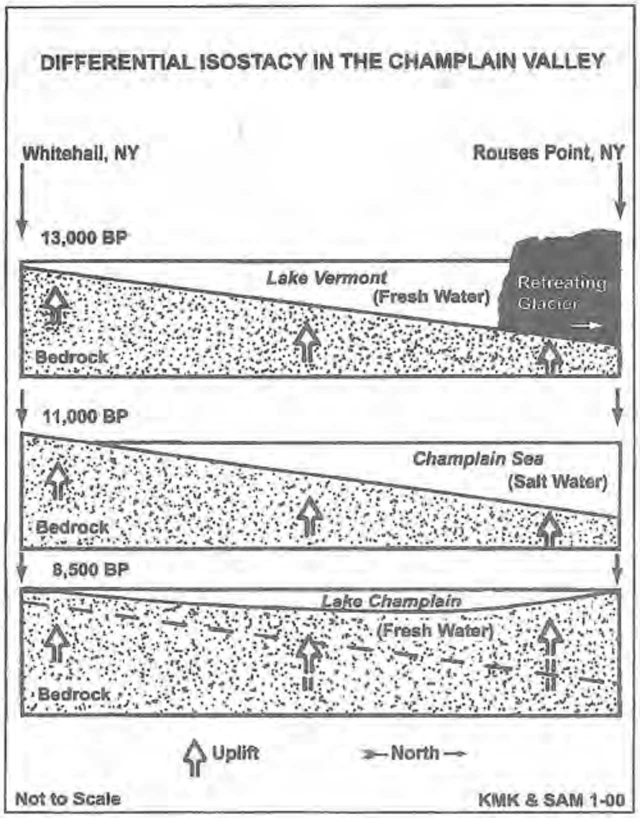

Figure 4. *Effects of differential isostacy in the Champlain Valley* (after Crisman 1981:12).

the beginning of the twentieth century (Chapman 1937; Fairchild 1918, 1919; Woodworth 1905). Although active research has continued, few revisions have been made to its basic theoretical framework since 1937. Therefore, most scholars agree that the altitudes of outlets, the changing positions of ice fronts, and post-glacial isostatic uplift and eustatic sea levels of the North Atlantic are the major controls for the late and post-glacial water level changes in the Champlain Basin.

Along with much of the northern portion of North America, a continental glacier covered the Champlain Valley repeatedly during the late Cenozoic Era (1.6 million BP to the present). The weight of the last Wisconsin continental glacier depressed the landmass of northern North America, including the Champlain Valley, hundreds of meters below the present sea level. As the climate warmed, the glacier began to melt and retreat northward from the Champlain Valley, forming a large melt water lake called Lake Vermont by approximately 13,000 BP. After the glacial retreat reached the St. Lawrence Valley, Lake Vermont was lower in elevation than sea level, allowing the influx of marine waters through the Richelieu Valley into Lake Vermont. This now saltwater body in the Champlain Valley then became a southern extension of the St. Lawrence estuary called the Champlain Sea about 11,800 BP (Chase and Hunt 1972:325; Parren 1988:1).

During the Champlain Sea phase, the Champlain Valley began rapidly rebounding to establish a state of equilibrium, passing the eustatic sea level rise. Initially, the glacio-isostatic rebound was uniform throughout the valley. However, by 10,200 BP, the Champlain Valley's rebound had surpassed the elevation of the Richelieu Threshold, the fulcrum between the Champlain Valley and the St. Lawrence Valley. This event caused the Champlain Basin to return to a freshwater lake, Lake Champlain. The desalination of the basin is believed to have taken as little as ten years (Haviland and Power 1994:36-37). Approximately 10,000 BP, the northern end of the Champlain Valley, having been depressed the greatest and over a longer period of time, began rebounding at a greater rate than the rest of the valley. The basin threshold between the Champlain and St. Lawrence Valley also began moving northward, causing the water level to increase throughout the Champlain Basin (Chapman 1937:116-117). The northern end of the Champlain Valley is still rebounding today, but at a much slower rate (i.e., approximately 1-2 cm a century), causing the entire lake level to rise, especially at its southern end.

The lowest paleowater level of the Champlain Basin is unknown; however, it was likely less than 30 m and took place between 10,200-9,500 BP (Turner 1977:58-59). The Port Henry stage is believed to represent this lowest level. This transitional stage from the Champlain Sea to Lake Champlain (10,200 BP) has been identified by submerged features. The primary Port Henry feature was described originally as a delta, but now is believed to be a beach, suggesting a much lower water level for the Champlain Basin. Regardless of which interpretation is correct, vast expanses of the lake bottom were once dry land (Figure 6).

Geologists currently know very little about the depths and shape of the Champlain Basin over the past 12,000 years. Most of the limnological research conducted in the region has been in an effort to collect data on the basin's sediments and microfauna. As a result, various studies have presented fragmentary and often conflicting data about the locations and depths for the inundated paleoshorelines (Freeman-Lynde, et al. 1979).

The hydrological history of the Champlain Basin is very similar to the record once believed to be characteristic of parts of the Great Lakes region. However, geoarchaeological studies have shown this history to be too simplified for the Great Lakes as the water levels were severely affected by Holocene climatic changes causing the water levels to fluctuate radically, although in general, increasing over the past 5,000 years (Larsen 1985). The discovery of deeply buried Archaic and Woodland sites associated with riverine settings in the Champlain Valley is also supportive of a revised water level model for the Champlain Basin. It is quite clear that the current hydrological model for the Champlain Basin is too simple and imprecise to develop accurate water level curves or predictions of where the water level was at a particular time.

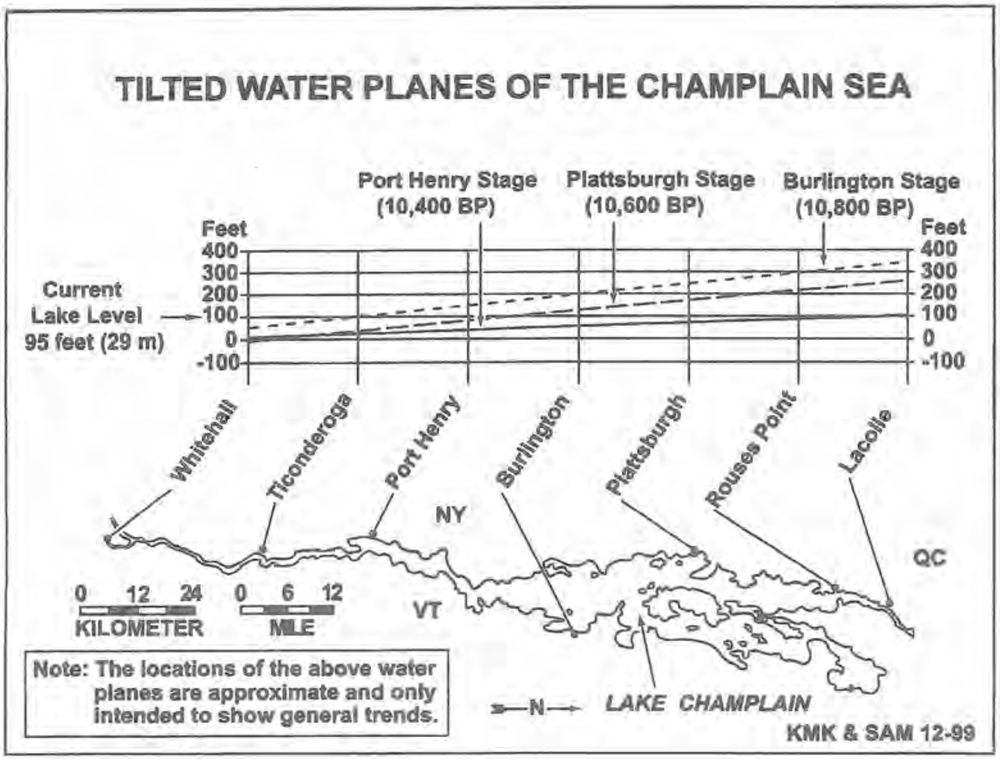

Figure 5. *Tilted water planes of the Champlain Sea* (after Chapman 1937:Figures 15 and 16).

Although more detailed bathymetric mapping has been completed for selected areas throughout Lake Champlain; the most complete bathymetric map has 3.1-m contour intervals and a scale of 1:80,000. These maps are largely inadequate for the detailed mapping necessary to identify paleoterrestrial landforms. The more detailed bathymetric maps show that the near shore profile for much of Lake Champlain is quite gentle, although there are some stretches of lakeshore that are extremely steep. Typically, the land topography and the basin bathymetry are closely related (Myer and Gruendling 1979:30).

Sedimentation rates within the Champlain Basin have dramatically reduced through time from the post-glacial Lake Vermont to the Contact period and then increased as a result of deforestation. The bottom sediments of the Champlain Basin are quite variable in thickness, ranging from 0 to 24 m. Soil cores taken throughout Lake Champlain over the past forty years have determined the depth of the younger Lake Champlain sediments as 0 to 6.5 m. The absence of Lake Champlain sediments in some areas is believed to indicate that no soil deposition is taking place, or, erosion is equal to or exceeding the deposition in particular areas of the basin (Freeman-Lynde, et al. 1979:238; Chase and Hunt 1972).

Lithologically, Lake Champlain soils contain four sediment types: gravel, sand, iron-manganese nodules, and organic mud. Gravel makes up less than four percent by area of the surface lake bottom sediments. Sands cover twenty-two percent of the lake bottom. Both gravel and sand occur primarily in shallow nearshore environments surrounding islands and at the mouths of rivers. Iron-manganese concretions have been identified in several areas of the lake; however organic mud makes up the dominant sediment type in Lake Champlain sediments (Hunt 1980:12, 14).

A few studies have been conducted on the types and effects of waves in Lake Champlain. These studies have proven that the dynamics of the lake vary significantly depending upon the local characteristics (Becker 1978). At present there is no single area within Lake Champlain where all the necessary data has been collected to begin to reconstruct its hydrological and environmental history. Obviously, additional environmental and geological data need to be gathered in order to create a predictive model for the entire Champlain Basin; however, an in-depth review of the available data could provide enough information to identify potential areas for a pilot study.

Inundated Site Types and Their Potential Discovery

Knowing how the various types of submerged prehistoric sites are formed makes it possible to predict in general terms, their ability to provide important archaeological data and to foresee their preservation and discovery potential. The archaeological literature suggests that five types of submerged prehistoric sites may exist in Lake Champlain: drowned sites, sites constructed in the water, refuse sites, ceremonial sites, and redeposited sites (Gluckman 1982; Goggin 1960).

A drowned site is any terrestrial archaeological site that has been submerged due to water level fluctuations as a result of natural causes. The currently identified and presumed site types in the Champlain Valley are extractive camps, small residential camps, base camps, small horticultural hamlets, fortified villages, bedrock quarries, quarry workshops, kill sites, individual burial sites, cemeteries, caches, and sweat lodges (Thomas 1991:1–8).

Sites that were constructed in the water may include fish weirs, fish traps, and perhaps fishponds. While portions of these sites would have been above water, most of the structural elements for these sites would have been underwater. Prehistoric fish weirs and traps have been found throughout the Northeast and appear in the ethnohistorical records of the Western Abenaki (Petersen, et al. 1994); however, none have yet been located in the archaeological record in the Champlain Valley.

Refuse sites are the result of deliberate or accidental loss of material into a water body, which could have happened from shore, on the water's winter ice, or from a watercraft. Refuse sites created through intentional means are almost always found down current from habitation or special purpose sites. Those created by accident will likely be found near hazardous navigational areas and landing areas.

Ceremonial sites are shrines or places of offering and interments into the water or along its shoreline. So little is known about the religious and ceremonial aspects of prehistoric groups in the Champlain Valley that prediction of either the presence or location of ceremonial sites is at best difficult. However, the ethnohistorical record of the Western Abenaki and other Native American maritime cultures indicate that such sites must exist in the Champlain Valley. Until about 1940, the Western Abenaki continued to leave tobacco offerings to Odzihòzo, believed to be the creator of the Champlain Valley, on an island in Lake Champlain presently known as Rock Dunder (Haviland and Power 1994:193).

Redeposited sites are secondary deposits of archaeological material that have been transported from their original contexts by currents, waves, and floods. These sites are likely to exist in locations adjacent to areas where site erosion or extensive disturbance from organisms and plants has occurred. It is expected that many of the prehistoric sites surviving in Lake Champlain will be of this type. Several examples of this site type are known to occur in the Winooski River Interval.

Based on the terrestrial archaeological database, prehistoric sites in the Champlain Valley lack substantial stone or wooden architectural structures or earthen mounds, making them difficult to find in submerged settings. Inundated prehistoric sites are likely to be small concentrations of artifacts with perhaps some features such as hearths, storage pits, and evidence of structures. To compound the difficulties

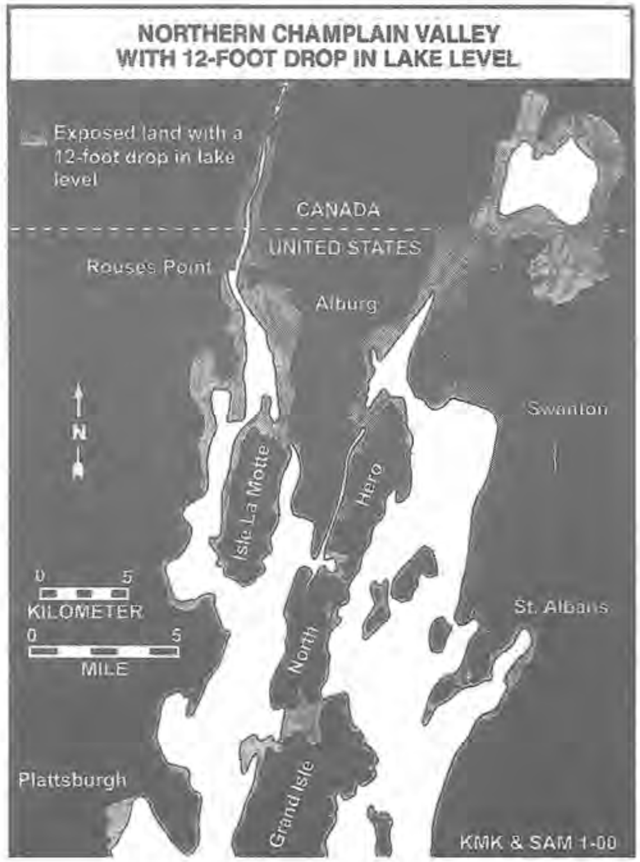

Figure 6. *Demonstration of exposed lake bottom with a 12-foot drop in lake level* (after International Sailing Supply 1993).

of detecting submerged prehistoric sites is the fact that the artifacts occur at low densities per unit area. Discontinuous spatial patterning also occurs at many Champlain Valley terrestrial sites and as much as fifty percent of the total site area may consist of empty space or space void of inorganic artifactual material. Most sites contain a nuclear activity area of 20-50 m^2, although the absolute limits of the site might encompass 200-1000 m^2. These features of local prehistoric sites make them extremely difficult to locate (Thomas 1986: 119). It is possible with the preservation of organic material that inundated prehistoric sites may in fact be easier to locate than terrestrial prehistoric sites, at least in some cases.

Archaeological sites may occur anywhere on the current lake bottom that was once dry land during the past 12,000 years. However, evidence from terrestrial sites suggests that prehistoric peoples concentrated their activities near specific landforms associated with rivers, lakes, bays, and estuaries. These areas provided resources basic to human subsistence, such as freshwater, plants, animals, and some lithics (Haviland and Power 1994; Thomas 1994).

Current Database of Inundated Prehistoric Sites

The potential of submerged prehistoric sites in the Champlain Basin has been recognized since the early 1970s. This conclusion was based on the region's geological history, isolated prehistoric finds in Lake Champlain, and terrestrial archaeological sites located below the current water table (Volgelmann 1972). Over the last century artifacts have been found within the lake's annual shoreline fluctuation zone and in submarine locations across nearshore areas (see collections at Chimney Point State Historic Site, Addison, Vermont; Robert Hull Fleming Museum, Burlington, Vermont). These artifacts date from the Paleoindian to Contact period, the entire span of Native American occupation.

Divers have recovered a number of complete and nearly complete prehistoric ceramic vessels from Lake Champlain. These vessels have been found at water depths ranging from 8.5-15.2 m. Although these finds probably represent isolated losses due to accidental swamping of watercraft or intentional discards, they are proof that relatively fragile objects can survive on the lake bottom with little damage (Dillon 1987; Lewis 1994; McLaughlin 1997; Petersen 1997). It is highly likely that many other prehistoric artifacts have been dragged up from the bottom of Lake Champlain over the years, but have gone unreported.

Artifacts have also been recovered from the lakeshore during low water levels by a number of artifact collectors and lakeshore residents. Some of these artifacts exhibit extensive wear, suggestive that the lake bottom sediments have actively abraded them, and, waves and currents have possibly transported them a considerable distance from their original location of deposition. Other artifacts exhibit little or absolutely no evidence of wear. These artifacts are likely very close to their original location and have been only recently exposed (McLaughlin 1991). The current database of known locations and numbers of Lake Champlain's submerged prehistoric sites in no way represents the spectrum of the lake's potential archaeological deposits. Nonetheless, the small sample of artifacts from underwater contexts is indeed impressive.

A number of underwater archaeological projects, mandated by legislation, have been conducted in an attempt to determine the existence and location of submerged archaeological sites within Lake Champlain (Cohn and Crisman 1986; Cohn 1984; Frink, et al. 1991; McLaughlin 1998; Thomas and Cohn 1991; Thomas, et al. 1982, 1984, 1989, 1992). These surveys, however, have concentrated their efforts on locating shipwrecks, for which side scan sonar has been employed as the primary survey tool. Occasionally sub-bottom profilers and towed or free swimming divers have also been used during surveys. Only one survey has utilized subsurface testing of the lake's bottom sediments in search of prehistoric cultural material (Frink, et al. 1997). During the excavation of a submerged historic feature, archaeologists unknowingly recovered a small collection of possible prehistoric flakes off the shore of Mount Independence in Orwell, Vermont. Due to the methods used to recovery the flakes, the stratigraphic context of these artifacts is largely unknown (McLaughlin 2000:342-343).

One approach that offers potential for identifying the locations of submerged prehistoric sites is a survey of divers and artifact collectors, as well as reviewing the New York and Vermont archaeological site archives for prehistoric sites that lie immediately along the lakeshore. Presumably, portions of these sites may be partially submerged and be good candidates for underwater investigations. Additional archival and informant research may identify a number of inundated prehistoric sites, which would help to understand the various existing submerged site types and their preservation potential.

Benefits of Researching the Inundated Prehistoric Record

The question of whether or not there are any potential benefits to the research of inundated prehistoric sites has been sporadically debated in the archaeological literature since the early 1980s (Flemming 1981; Patterson 1981; Roberts 1981; Stickel 1981). A number of authors have called for greater attention to the world's wetland sites to supplement the dry land archaeological record and correct some of the shortfalls and biases in the current reconstructions of the past (Coles 1984, 1987; Purdy 1988a).

The primary argument is that dry land sites present a narrow perspective of the past due to their generally poor preservation qualities compared to wetland sites. On dry land sites, eighty to one hundred percent of all materials found are imperishable inorganics, which leaves archaeologists to attribute an importance to these remains that may be far beyond their value to the society which made and used them. In contrast, wet sites provide a broader spectrum of materials, where inorganic artifacts appear to be relatively unimportant, and where richer interpretations are possible due to the greater artifact representation in the archaeological record (Dark 1995:46-47).

Inorganic material comprises only ten to twenty-five percent of a wet site's artifact assemblage (Figure 7). In contrast, organic remains such as wood, plants, skin, leather, textiles, basketry, unburned bones, and other elements, which are very rarely encountered on dry land sites, account for seventy-five to ninety percent of the material record. Many archaeologists believe that greater efforts should be directed towards those sites and regions where this scale of evidence survives to help complete cultural histories and address difficult questions such as ideology among prehistoric groups (Coles 1988:7-8; Purdy 1988a).

Over the last 12,000 years, Native Americans have witnessed shifts in water levels on the continental shelf as well as within inland water bodies. The hydrological record indicates that some of these changes were dramatic enough during certain periods so that their effects must have been clearly noticeable to people living in the area. Changes in the

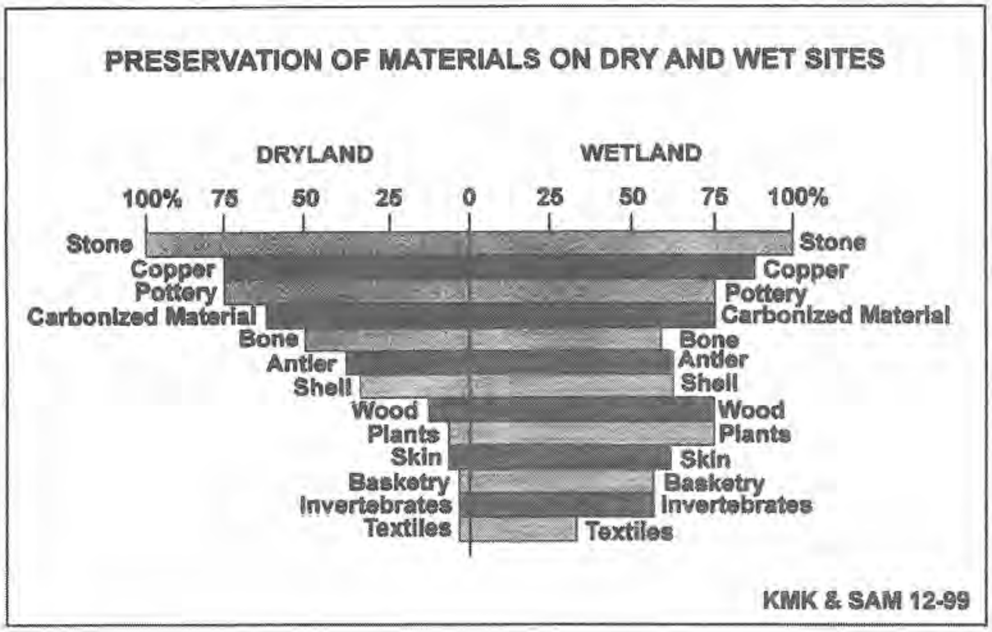

Figure 7. *General differences in the preservation of materials on dry and wet sites* (after Dean, et al. 1992:Figure 11).

landscape from one generation to the next has had unknown consequences on the conceptual orientation and ideology of prehistoric Native Americans. Fishing on a shallow bank, knowing that their ancestors had lived on firm land that had become inundated or knowledge that the water was receding must have significantly affected the people's conceptual world. Such stresses would have been of both a physical and a mental nature (Inman 1983:6).

Vestiges of these stresses appear in the oral history of many coastal Native Americans, who describe their origins in water bodies or at least describe the use of lands now submerged (Stright 1990:439). The Western Abenaki looked to the Champlain Valley and particularly Lake Champlain as the spiritual center of their world. It was the place where their principal cultural heroes and mythic transformers lived and performed their exploits. Many quasi-human beings in Western Abenaki mythology live in or on the waters of Lake Champlain, including the transformer, Odzihòzo, who created the Champlain Valley's mountains and waterways (Haviland and Power 1994:194-196).

Other benefits of the inundated archaeological record lie in its ability to solve a number of related research problems facing archaeologists. These issues include the lack of sites in the 7,500 to 6,000 BP time-range (Middle Archaic period), the antiquity of maritime exploitation, and the topic of cultural continuity. The poor preservation of early prehistoric sites and the limited paleoenvironmental data have led archaeologists to create problematic theories regarding these issues. Consequently, the current understanding of the prehistory of the Northeast is heavily biased by the lack of Middle Archaic period sites in the current archaeological database (Robinson, et al. 1992; Starbuck and Bolian 1980).

The debate regarding the lack of Early and Middle Archaic sites has generated a number of plausible explanations. These arguments include: 1) a low carrying capacity of animal and plant resources in the predominately coniferous forest established throughout the region, 2) the destruction of Archaic sites by the movements of river channels, 3) flooding of sites by fluctuation of water levels, 4) the deposition of thick layers of sediments on archaeological sites in riverine settings, 5) inadequate survey in potential areas and bias produced by areas of current fieldwork, 6) lack of research programs to fill the gaps in the culture history, 7) major shift in subsistence practices, and 8) lack of visibility of some types of projectile points and unrecognized regional types (Chapdelaine and LaSalle 1995:122; Thomas 1992:198-200).

Recent research has not resolved this problem, but points to the fact that a large number of Early and Middle Archaic age sites have been either inundated or deeply buried in riverine environments due to changes in the region's water levels (Robinson and Petersen 1992). The lower water levels in the Champlain Basin, which occurred during the Early and Middle Archaic periods, exposed large portions of the current lake basin as dry land, only to be flooded afterwards (Thomas 1992:199).

How long Native Americans have exploited the maritime and lacustrine resources in the Champlain Valley is unknown, but some researchers have suggested that its origins may be found during the Paleoindian period. This argument seems justified by the relative lack of great numbers of megafauna in the region and the likely large quantities of marine resources available in the Champlain Basin (Chapdelaine and LaSalle

1995:122-123). The existence of a maritime adaptation for the Paleoindians is made plausible based on the location of most Paleoindian sites being near the shorelines of the Champlain Sea and in coastal drainages. These sites suggest that populations were at or near the coast and may have at least taken advantage of some of the maritime resources (Haviland and Power 1994: 17-37; Loring 1980; Thomas 1994:44-49; Volgelmann 1972). Recently, a greater number of artifacts have been found on the continental shelf in the Northeast, suggesting Paleoindians utilized marine resources to some extent along the North Atlantic (Crock, et al. 1993).

Worldwide, the early intensive exploitation of marine and lacustrine resources is now recognized thanks to new methods and the exploration of the world's submerged prehistoric sites (Bailey and Parkington 1988b; Bernick 1998b; Coles 1988). The faunal record for Paleoindian and Archaic period sites are sparse, however, it appears that people increasing used aquatic environments throughout the Archaic period. Changing water levels, salinity levels, climate, and the quantity, variety, and location of floral and faunal resources complicated the adaptive process to the Champlain Basin's resources. These changes in the terrestrial resources were likely greater than that of the maritime resources. They might explain the broadening of the subsistence base of prehistoric peoples through utilization of local littoral and riverine environments in the Champlain Valley. Recent excavations in the Northeast have shown that this was a trend throughout the region (Robinson, et al. 1992).

Changing water levels in the Champlain Basin have not been incorporated into the local reconstructions of the prehistoric population sizes, settlement patterns, and subsistence strategies. The validity of these reconstructions can thus be questioned. Archaeologists can not adequately assess these theories without considering the inundated prehistoric record and the total exposed landmass for the period under consideration. The salinity and fluctuations in water levels in the Champlain Basin must have played an important role in the human adaptation to the region throughout the prehistoric period. The Champlain Valley's prehistoric populations must have been sensitive to these changes, which would affect the location of their settlements and the extent and nature of the subsistence resources.

Summary

Significant inundated prehistoric sites must occur in portions of Lake Champlain. Although the number of intact inundated prehistoric sites is unknown, the current geological data indicates that the lake potentially holds well preserved prehistoric sites dating from the Paleoindian to Late Archaic period. Underwater archaeologists have proven that preserved inundated prehistoric sites do exist in environments like Lake Champlain, can be easily located through predictive modeling, and carefully excavated with techniques and methods developed over the past forty years.

Changing water levels certainly must have had social, ideological, economic, and demographic importance to the groups living in the Champlain Valley. The existence and importance of submerged sites must no longer be ignored by archaeologists working in the Champlain Valley, as the existence of these sites profoundly affects the archaeological theories regarding cultural adaptations, subsistence strategies, and demography of the prehistoric groups living in the Champlain Valley, especially prior to the Early Woodland period.

Many people wonder whether or not there are any potential benefits from expenditures for research on submerged prehistoric sites. The increasing number of wetland sites excavated throughout the world (e.g., Greece, France, Scotland, Denmark, Sweden, Israel, Poland, Australia) indicates that coastal and riverine environments held a greater importance in the prehistoric past than previously thought (Dortch 1997; Dunbar, et al. 1992; Egloff 1987; Flemming 1983; Galili and Weinstein-Evron 1985; Larsson 1983, 1998; Matsui 1992; McWeeney 1986; Muche 1978; Ruoff 1987; Taylor and Cooley-Reynolds 1982). Wetland settings have provided vast quantities of information about prehistoric people that typically does not survive in terrestrial settings, except in the rarest cases. The artifacts, structures, and features preserved in wetlands present a wealth of information for the development of new theories and more accurate cultural histories. The excellent preservation qualities of an inundated prehistoric site will yield an unprecedented variety of material culture (e.g., leather, wood, skin, textiles, basketry, and structures), allowing for a richer and broader interpretation of the past.

Inundated prehistoric sites, as opposed to terrestrial sites, have received little attention in the Champlain Valley and their protection from development has been minimal. As the threats to the region's wetland sites are growing from draining of wetlands, deforestation of shoreline areas, dredging, construction activities, ship traffic, and lake level increase, archaeologists must take steps to preserve these sites. Although some attempts have been made to identify inundated prehistoric sites in Lake Champlain (Frink, et al. 1997; McLaughlin 1998), previous methods have been inadequate and as the threats to these resources increase, projects need to be better designed, and a standard archaeological methodology needs to be addressed.

Archaeological investigations in the Champlain Valley must be sensitive to relative water level changes in the Champlain Basin and their effect on the physical environment throughout the valley. For a given rise in water level, the gradient base levels of tributaries are raised, causing aggradation along the floodplains near tributary mouths to as far upstream as the first falls. High groundwater tables produced by rising water levels led to the establishment of marshes in low-lying areas where they may have never existed. These processes have been demonstrated locally in the Winooski Interval, for example (Petersen and Power 1983; Thomas 1980). During periods of falling water level, tributaries are expected to down cut their channels and erode the preexisting tributary mouth alluvial fans and deltas. Fringing marshes are desiccated when the groundwater table falls. Each of these processes is repeated with fluctuating water levels. The occupation settings normally associated with archaeological sites are shifted from place to place and are later buried by new nearshore or eolian deposits (Larsen 1985:106).

It is not uncommon for an underwater archaeological project to cost five to ten times that of a comparable land excavation in terms of the same total cubic meters of soil excavated. This appears to be one, if not the greatest, hindrance to this type of research; however, many of the submerged sites yield a tremendous amount of data in the form of organic material unavailable in most open-air settings. Two of the largest expenses for an underwater archaeological project are the conservation of recovered artifacts, and their curation and care for perpetuity. The current cost to conserve small wooden objects involving only one kind of material with few complications is between \$300-500 (US) for each artifact. The cost of long-term curation and care requires the establishment of endowments or other sources of permanent funding (Daugherty 1988; Singley 1998:348).

The field archaeology, conservation, and analytical work all cost far more for research on inundated sites than comparable activities on dry land sites. Yet, the growth of wetland archaeology around the world has dramatically increased in the past twenty years in large part because of the positive benefits of such research. In areas such as Western Europe and Florida, the archaeological value of and growing threats to wetland resources have been increasingly recognized. American archaeologists working in areas that have experienced dramatic changes in water levels, like the Champlain Valley, need to acknowledge their wetland resources and begin to protect, investigate, and incorporate the inundated prehistoric record into their interpretations of the past.

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