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Shell Mounds and Mounded Landscapes in the San Francisco Bay Area: An Integrated Approach

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ABSTRACT

Current understanding of the shell mounds of the San Francisco Bay Area, now almost completely destroyed due to urban expansion, is summarized. After interpretations of how and why coastal hunter-gatherers created these sites are discussed, salient characteristics of shell mounds from the area are outlined. Because core questions concerning the meaning and function of these sites remain unresolved, a new project that integrates the results of re-analyses of older museum collections with archival records and CRM work is discussed, an approach that may have applicability in other developed coastal areas. Results of a regional analysis that relies on an assessment of site type *drawn from many site records are then presented. First-time discovery of site type throughout the past 100 years is then analyzed across 20 topographic quadrangles; we conclude that the region's earliest archaeologists captured a surprising range of site type diversity, especially with respect to shell-bearing sites. A north-south pattern of shell-bearing sites is identified, micro-regional differences are characterized, and a subset of the sample is analyzed through GIS to investigate the nature of site clustering. Finally, in light of the site clustering, we present*

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models that may help to explain shell mound occupancy and function.

INTRODUCTION

The shell mounds of the greater San Francisco Bay area in northern California have long fascinated coastal archaeologists. Beginning with Max Uhle's and Nels Nelson's pioneering research in the early 1900s, archaeologists recorded hundreds of impressive shell mounds composed of many cubic meters of sediments, marine shell, rock, and ash. Excavations of these large mounds revealed human burials, extensive faunal assemblages, a diverse range of artifacts, and some architectural features. The mounded landscapes were built up over thousands of years across the largest estuarine system in California—a complex maze of freshwater marshes, salt marshes, mud flats, and open waters that comprise Suisun Bay, the Carquinez Strait, San Pablo Bay and San Francisco Bay (see Figure 1). These waterways thread their way past gentle bay shore plains, low relief knolls, and cliff faces, and the rugged terrain of the East Bay hills and the Coast Ranges mountains, to the Golden Gate and the Pacific Ocean. The mosaic of wetland and terrestrial habitats support a tremendous spectrum of floral resources, as well as shellfish, fish, bird, sea mammal, and terrestrial game populations within a day's walk or canoe trip from any place within the region.

Created over many centuries by coastal hunter-gatherers, the San Francisco Bay area shell mounds should be considered as part of a broader expression of North American mound construction by prehistoric native groups in the American Southeast, Midwest, Southwest and Pacific Coast (Ames and Maschner 1999; Anderson 1994; Buikstra and Charles 1999; Dye and Cox 1990; Goldstein 1997, 2000; Knight and Steponaitis 1998; Lindauer and Blitz 1997; Pauketat 1994; Pauketat and Emerson 1997; Sassaman 2004; Scarry 1996). Of particular relevance are the shell structures built by hunter-gatherers along the interior drainages of Kentucky, Tennessee, and northern Alabama (i.e., Shell Mound Archaic) and the spectacular shell rings and mounds along the southern Atlantic Coast and Gulf Coast. First showing up in the Late Archaic period (ca. 4,500–3,000 years ago) or even earlier, a salient characteristic of these southeastern sites is the burial of the dead in shell mounds built up over many centuries. The interpretation of these mounded structures has generated considerable debate among archaeologists about their functions, degree of planning, intentionality, and symbolism (Aten 1999; Claassen 1991, 1996; Milner and Jefferies 1998; Russo 1996; Russo and Heide 2001; Trinkley 1985). A similar kind of debate, but with surprisingly little reference to the work in the Southeast, has shaped the study of the San Francisco shell mounds.

The purposes of this paper are twofold. One is to summarize briefly the state of our current knowledge about the shell mounds of the San Francisco Bay area (SFBA) and to outline current interpretations about how and why coastal hunter-gatherers created these mounded landscapes. The other is to highlight a significant challenge that many coastal archaeologists face today when working in rapidly developing environments—the significant destruction of archaeological remains, especially mounded sites, which may have only been fully recorded and studied

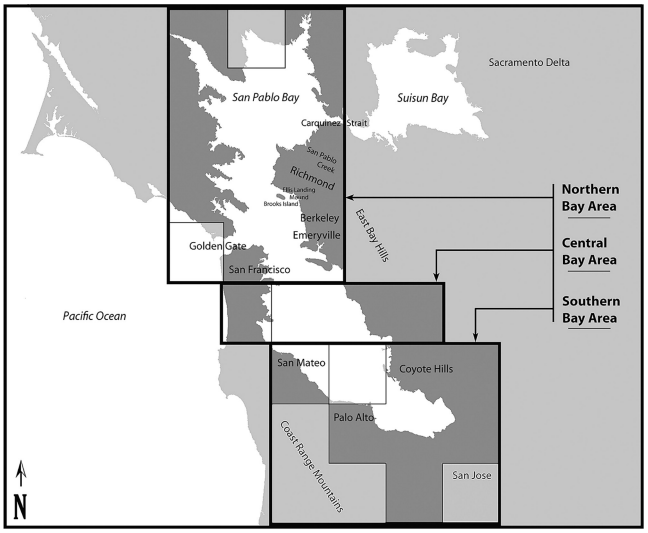

Figure 1. *San Francisco Bay area with Northern, Central and Southern bay study areas. Study areas were divided internally by 7.5' topographic quadrangles; quadrangles in lighter shade were not analyzed.*

by previous generations of archaeologists. The shell mounds here, similar to other ancient mounded landscapes found across North America, have been severely affected by agriculture, the commercial mining of deposits for soil and fill, and the rampant development of roads, houses, shopping malls, and golf courses. Coastal archaeologists working under these conditions clearly must make better use of "old" archaeological records and materials, which may have been collected more than a century ago.

We present the results of the first phase of an integrated approach to the study of shell mounds that involves the analysis of old museum collections and the synthesis of more recent cultural resource management (CRM) projects. The major questions that we address in this paper are:

1. How representative is the earlier information collected by pioneering archaeologists?
2. Can we generate and evaluate sophisticated models about the coastal hunter-gatherers who constructed the mounded landscapes of SFBA using old data, in combination with current field work on remnant basal deposits of sites?
3. Will this integrated approach produce the necessary knowledge to permit us to undertake detailed comparisons of the cultural practices and social organizations of SFBA people with those of mound builders from other regions of North America?

SALIENT CHARACTERISTICS OF THE SHELL MOUNDS

Archaeological field studies of the shell mounds have taken place in three distinct phases over the last century. The first phase, spanning from 1901 to 1925, witnessed the first scientific studies of the mounds, much of it undertaken by Nels Nelson, Max Uhle, W. E. Schenck,

L. L. Loud, and other archaeologists from the University Museum and Anthropology Department at the University of California, Berkeley. This pioneering research is notable for the recording and excavation of some of the largest known mounds, including Emeryville (CA-ALA-309), Ellis Landing (CA-CCO-295), West Berkeley (CA-ALA-307), and the Stege Mound Complex (CA-CCO-298 and 300). Survey work was also undertaken across the entire estuarine system, where more than 425 mounds were detected and recorded, primarily by Nels Nelson. Although agrarian activities, urban expansion, and removal of mound deposits had already taken their toll, the first phase of survey and excavation provides the most comprehensive perspective of what the mounded landscapes looked like before intensive development began during and after World War II.

The second phase ranges from 1940 to 1960 with the creation of the University of California Archaeological Survey (UCAS) directed by Robert Heizer, which ushered in a period of extensive field work across the state, including the SFBA. Archaeologists at Stanford University, San Jose State University, San Francisco State University, and other local universities also developed field programs that included the study of mounded sites. A diverse range of sites were investigated, including the Fernandez Site (CA-CCO-259), Ryan Mound (CA-ALA-329), Patterson Mound (CA-ALA-328), and University Village (CA-SMA-77). The third phase ranges from about 1961 to 2006, with the closing of the UCAS and the shift towards field schools from other local universities, followed by the development of CRM in the 1970s and afterwards.

The three phases of research have each contributed to our current understanding of the shell mounds and the mounded landscapes of the SFBA, which are summarized below.

1. *Expansion of the Bay System.* The construction of the earliest dated mounds commenced about 5,000 to 4,000 years ago when the expansion of the greater San Francisco Bay system began to reach its current spatial configuration. The product of a post-Pleistocene rise in sea level, the estuarine system spread rapidly from about 10,000 to 6,000 years ago, first drowning the Golden Gate and then filling the connecting river valley through which the waters of the Sacramento and San Joaquin Rivers flowed to the Pacific (see Atwater et al. 1977, 1979). With marine transgression declining after 6,000 years ago, rich tidal marshes and extensive mudflats began to take shape across the estuarine system which soon attracted local hunter-gatherers who began creating shell mound deposits.

2. *Mounded Space.* The shell mounds vary greatly in size. Before recent development, they ranged in size from 9 to 183 m in diameter and rose 1 to 9 m above the land surface (see Moratto 1984; Nelson 1909:325). A few of the large mounds were documented to have sub-surface deposits that extended several meters below sea level. The composition of the sites also varied greatly. Some contained large concentrations of bay mussels, clams, and oysters, along with sand and clay lenses, whereas others were deposits containing some shell, but considerable quantities of ash, rocks, and sand. Along the Carquinez Strait, Suisun Bay, and the Sacramento River delta, the ratio of shellfish declined to a point where the sites became earthen mounds composed primarily of sand and clay.

3. *Human Burials.* Excavations in many of the shell mounds have unearthed burials, typically flexed inhumations with some later cremations. In the

largest mounds, such as Ellis Landing and Emeryville, it is estimated that several thousand people may be buried (Nelson 1910:381; Wilson 1993:2). Apparently, some mounds were constructed over basal cemetery complexes and later burials were added to the mound structures as they expanded over time. Later burials placed outside the basal deposits consist of small groups (often 6–9 people), which Schenk (1926:195) and other early archaeologists interpreted as family burial plots, or individuals or pairs arranged throughout the mound deposits. Although many of the graves that have been reported were associated with few or no mortuary offerings, a few burials contained substantial numbers of *Olivella* and *Haliotis* beads and ornaments (see Holson et al. 2000:535–551). Excavations have also unearthed burials of raptors, such as the California condor, and clusters of exotic artifacts that have been interpreted as ceremonial offerings.

4. *Diverse Assemblages.* Major excavations have revealed a diverse range of bone, lithic, and shell artifacts, although the density of materials per cubic meter of site matrix tends to be low (Lightfoot 1997:133). Formal artifacts from well-provenienced contexts tend to be found in mortuary contexts. A remarkable quantity of mammal, bird, fish, and mollusk remains were processed and discarded into the matrix of the mounds. These remains included large terrestrial game (tule elk, black-tailed deer), smaller terrestrial animals, harbor seals, sea otters, an avifaunal assemblage dominated by geese, ducks, and shore birds, and a diverse range of fish including sturgeon, Chinook salmon, and bat rays (Bickel 1981:27; Broughton 1994, 1997, 1999; Holson et al. 2000; Simmons 1979, 1981, 1985). Depending on the nearby benthic environment and season of the year in which they were collected, different mound strata contained large numbers of bay mussels, bent-nose clams, oysters, barnacles, crabs, whelks, and other various burrowing clams. Analyses of the faunal assemblages indicate significant changes in the size and quantity of some foods, with large terrestrial game and sturgeon decreasing over time and sea otter and smaller fishes increasing. This change has been interpreted as evidence of resource intensification brought about by over-harvesting and hunting pressure as the density of people living along the bay shore swelled in late prehistoric times (Broughton 1997, 1999).

5. *Chronology.* Although the earliest components of the mounds date between 5000 to 4000 BP, the greatest number of well-dated deposits span from ca. 500 BC to AD 900 (Banks and Orlins 1985:34; Lightfoot and Luby 2002). The post-AD 900 period is not well documented; sites may have been abandoned or reused in new ways that may have left few datable materials. Alternatively, the upper levels of the mounds may have been largely destroyed before the common use of radiocarbon dating in California in the 1950s. This question may be resolved by searching for appropriate radiocarbon specimens from different strata represented in the old museum collections excavated by Nelson, Uhle, and others (e.g., see Broughton 1997; Ingram 1998). Sites from which a suite of radiocarbon samples have been analyzed indicate long-term occupations, with current date ranges spanning from five to 1,900 years (Lightfoot 1997:135). There is some evidence based on shellfish growth lines and other faunal data that at least some mounds were used throughout much of the year (Simmons 1979, Chapter 15:15; Veldhuizen 1981, Chapter 15:22). However, the nature of the occupation cycle is not well understood—we do not know whether

sites were used sporadically over extended periods, represented more permanent occupations that lasted for unknown stretches of time, or both.

6. *Regional Settlement Pattern.* Large and small mounds dotted the bay shore in arrays of single sites, site pairs, and discrete clusters of four to six mounded sites, especially where freshwater wetlands and streams fed into bay waters. In the mound clusters that have been dated, the largest and oldest sites were found closest to the bay shore and ringed by other medium and smaller sized mounds (Banks and Orlins 1985:113). Other kinds of sites have been recorded in the hinterland of mound sites, primarily bedrock milling stations and petroglyphs (see Parkman 1994).

INTERPRETATIONS OF THE SHELL MOUNDS

The first archaeologists to excavate the San Francisco Bay area mounds interpreted them as extensive accretional "midden" deposits produced by hunter-gatherers repeatedly conducting shellfish gathering, fishing, and hunting activities from nearby productive habitats (Gifford 1916; Nelson 1910:380; Schenck 1926:205, 275; Uhle 1907:21). In this scenario, these middens or "trash dumps" were probably located near residential camps or villages. Burial placement in the shell mounds was viewed largely as an afterthought, given that the loose midden soil provided an easy place to dig graves. Another early interpretation, generated primarily from the discovery of many net sinkers from the Stege Mound Complex, is that some shell mounds represented specialized places for harvesting and/or processing specific resources, such as fish (see Moratto 1984:236). For example, recent analyses of faunal remains from two sites in the lower San Pablo Creek indicate they may have been sturgeon processing sites where white and green sturgeon, some weighing over 20 kg, were butchered (Holson et al. 2000:394–397).

In contrast to the traditional view that assumes passive, incidental accretion of shell mound material, more recent interpretations suggest that shell mounds were built as a planned program of monumental construction on the bay shore landscape. This perspective parallels recent interpretations of mounded structures in the American Midwest and Southeast. In one scenario, native people intentionally constructed shell mounds as specialized cemeteries where burial rites and mortuary feasting took place (Leventhal 1993; Meighan 1987). In another scenario, shell mounds served not only as burial areas, but as ceremonial places where people from surrounding places would periodically aggregate for feasts, dances, political functions, and mortuary practices (Luby 2004; Luby and Gruber 1999). That some of these mounds may have served as vacant ceremonial centers, used primarily during the ceremonial calendar by a broader community and abandoned or used by only a small residential population the rest of the year, is also an idea that is gaining momentum for some mound complexes in the Southeast (see Sassaman 2004).

Another interpretation supporting the planned construction of mounded landscapes in the greater San Francisco Bay is that of mounded villages. That some mound tops may have supported full-service villages is an idea that appears to be unique in the literature of North American archaeology. We have traced this interpretation to Nels Nelson's (1910) investigation of the Ellis Landing (CA-CCO-295) shell mound. In 1906 he recorded around 12 surface

depressions, measuring about 3.6 m in diameter and 0.6 m in depth, which he interpreted as the remains of house structures built on the mound top. Nelson noted that Ellis Landing was somewhat unique among the shell mounds he recorded, given its isolated location in extensive wetlands that is now part of the modern city of Richmond. Unlike most other shell mounds, the upper levels of which had been significantly affected by agriculture and bay shore industrial and residential developments, Ellis Landing was largely protected, except for a barrow pit that disturbed one section of the site before 1908.

Nelson further elaborated on the idea of mounded villages in 1943–1944, when he curated an exhibit on the San Francisco Bay area shell mounds in the American Museum of Natural History in New York City. Here he created a scale model of a shell mound village complete with tule-thatched houses, people, tule balsa canoes, and dogs. The working model of the shell mound was that of a miniature "tell" structure, a location built up over many generations by coastal hunter-gatherers repeatedly modifying and building houses, processing, cooking, and depositing foods, and burying their dead. The idea that native people lived on top of mounds that encapsulated the remains of earlier domestic and ceremonial structures, activity areas, food remains, and ancestors continues to be popular among some California archaeologists (Lightfoot 1997).

The above scenarios have significant implications for understanding how and why hunter-gatherers created mounded landscapes along the greatest expanse of tidal wetlands on the Pacific Coast of North America. They raise several important questions. First, were these mounds the end results of haphazard dumping episodes over hundreds of years or the product of intentional, planned construction? Second, were they places used primarily for mortuary practices, feasting, and the burial of the dead or were they village sites where a full spectrum of residential and ceremonial activities took place? Third, were mound clusters consisting of one large mound surrounded by four to five smaller or medium sized sites the consequences of multi-site village communities? Finally, did the largest and oldest mounds serve as community centers where tribal leaders and high status families differentially participated in ceremonial and political activities (see Lightfoot 1997)? Clearly, the study of the shell mounds of the greater San Francisco Bay may provide critical insights into the cultural practices of so-called complex hunter-gatherer peoples on the Pacific Coast who initiated intensive harvesting systems, food storage, varying degrees of sedentism, high population densities, elaborate ritual systems, and possible hierarchical political organizations.

CHALLENGES IN THE STUDY OF COASTAL SHELL MOUNDS

After more than a century of archaeological research, we might assume that the basic questions concerning the meaning and function of the San Francisco shell mounds would be resolved. But this is not the case. There are two significant challenges that researchers face in studying the mounded landscapes of this region.

The first challenge is faced by many archaeologists working in coastal urban environments across the world. The rapid development of the Bay Area beginning in the late 1800s and early 1900s has had a severe impact on much of the archaeology of the region. Agricultural activities initially degraded many of the mounds, followed by the commercial

mining of deposits for garden soil and fertilizer, and ultimately the construction of housing developments, roads, and shopping malls. Large and small mounds have been largely destroyed (with only a few exceptions) and only remnants or pockets of their basal deposits remain intact. We are fortunate that Nels Nelson completed his survey of the greater San Francisco Bay region in 1908 before many were completely leveled by later plowing, mining, and housing developments. However, even Nelson (1909:327) observed that "not a single mound of any size is left in its absolutely pristine condition." Thus, any comprehensive study of the shell mounds must involve research on "old" museum assemblages collected before the mounds were heavily impacted.

The second challenge involves fieldwork in coastal environments that are subject to urban sprawl. Current field work in the San Francisco Bay area, most of it funded by CRM contracts, tends to be piecemeal, relegated to parcels that are part of redevelopment plans or the redesign of existing structures, parking lots, or roads. The upper levels of most mounds have long since disappeared. What archaeologists tend to work with are the remnants of intact basal deposits or secondary deposits of the upper levels of the mounds that have been pushed or moved to outlying places, often as fill in grading parking lots and house foundations. This raises a number of critical questions. How do the contemporary excavations of the basal and secondary deposits of former mound sites correlate to earlier excavations with respect to recovery biases? Are there other kinds of sites or deposits detected by contemporary archaeologists that may have been missed by earlier archaeologists? For example, it is possible that the first phase of archaeological research may have overemphasized the conspicuous shell mounds over other less visible sites such as non-mounded sites that may have been buried by alluvial deposition (see Meyer and Rosenthal 1997). Thus, a significant question that must be addressed in working with museum assemblages and archival field notes and photos is how representative of the broader settlement pattern are the survey and excavation materials collected by first phase archaeologists?

THE SAN FRANCISCO BAY AREA ARCHAEOLOGICAL PROJECT

The archaeological study of urban coastal environments requires a coordinated research program that involves the investigation of "old" museum collections in collaboration with the synthesis of recent CRM projects. We began such a project in 2004 with funding from the National Science Foundation. The project has two aspects: the synthesis of existing information on recorded archaeological remains across the larger SFBA region and the analysis of old museum assemblages curated at local universities. The goal of the regional synthesis is to define the spatial structure of the shell mound sites, to identify other non-mounded sites, and to place them into a broader regional context.

Concurrent with the regional synthesis, we have started analyzing the archaeological assemblage from the Ellis Landing site (CA-CCO-295), the large shell mound originally excavated by Nels Nelson in 1906–1908. The Ellis Landing collection, housed in the Phoebe Hearst Museum of Anthropology at the University of California, Berkeley, presents a test case for studying a nearly 100-year-old collection. The project is also analyzing other shell mound sites (Brooks Island, CA-CCO-290) and non-mounded cemetery sites (e.g., CA-ALA-

343). By integrating analyses of recent CRM studies with those of historic museum collections, we hope to develop a methodological approach that has broad applicability to other coastal areas facing the onslaught of development.

Our proposed plan of study is to evaluate the above scenarios on the development and function of shell mounds at multiple scales of analysis. On the regional scale, we will undertake a GIS analysis of the location of mounded sites and other kinds of archaeological remains by chronological periods. Our goal is to assess the degree to which a broader spatial structure underlies the placement of archaeological sites. We expect a planned program of mound construction may produce regularities in the spacing and size of mounds and their concordance with outlying archaeological remains. We plan to examine the broader spatial relationship of shell mounds to one another and to other kinds of archaeological sites in the hinterland. We are specifically interested in identifying mound clusters and considering their regional spatial structure in order to determine if there is a regular or predictable pattern to their spatial distribution along the bay shore. Similar kinds of analyses of earthen mounds and shell mounds in the American Midwest and Southeast have detected regularities indicating some level of regional planning in the construction of mounded sites (Russo 1996; Sassaman 2004; Sassaman and Ledbetter 1996).

At the local scale of analysis, we will select three or more mound clusters from across the greater San Francisco Bay area for detailed study. The Ellis Landing and Brooks Island sites comprise one part of a prominent mound cluster from the northern San Francisco Bay that we are currently studying; we will also choose other mound clusters from the central and southern areas. Our analysis considers the spatial layout of the individual mounds to one another and their relationship to other kinds of nearby archaeological remains. We are particularly interested in considering the spatial relationship of the mounded sites to non-mounded sites such as rock art sites and processing sites.

For each of the three shell mound clusters we select, we will undertake analyses of archaeological remains from those sites, including Ellis Landing and Brooks Island, that have been scientifically excavated. Here we hope to integrate the results of earlier fieldwork undertaken during the first two phases (from 1901 to 1960) with more current fieldwork funded by CRM. Currently, we are concentrating on the Ellis Landing site and developing a method for addressing questions concerning mound origin and function. The analysis is focusing on the diversity and spatial organization of features, artifacts, and food remains across the mound. If Ellis Landing served as a specialized cemetery built up, in part, by feasting and other mortuary observances, then we might expect discrete building episodes and burial placement that were timed with specific mortuary events. Archaeological studies of feasting suggest that we might see evidence for periodic, tightly timed depositional events that are characterized by high densities of food remains, artifacts associated with processing and serving food, and ritual offerings (i.e., Pauketat et al. 2002). Furthermore, if Ellis Landing served as a specialized cemetery, we might also expect to see specific age or gender groupings in analyses of the mortuary population, as well as extensive evidence for secondary burial, perhaps indicative of death away from the mound, or of elaborate, on-site mortuary ritual.

If Ellis Landing functioned as a multipurpose mounded village, then we expect to see evidence of observances and feasting in addition to archaeological signatures of domestic life and daily practices. There may be more accretional pattern to the growth of the mound, with cycles of mortuary feasting sandwiched between deposits produced from daily domestic routines. The seasonal use of the mound may be more variable through the annual cycle and not fixed to a ritual calendrical cycle. In non-mortuary contexts, we expect to see evidence of stone tool production (debitage, cores, etc.), production of shell artifacts (such as beads), and a greater range of food remains with diverse meat cuts and plant species represented. We also expect the ash, rock, and clay features to be associated with diverse uses, ranging from mortuary ceremonies to residential activities associated with households. In addition, we might expect to see different kinds of sites within specific mound clusters. Distinguishing a mounded village from a refuse dump, which people did not live on, is admittedly difficult, but we expect the former to be characterized by an interpretable spatial structure that indicates discrete zones of residential, food processing, and mortuary activities across the mound, as well as the intentional construction of features, such as houses, hearths, and earth ovens.

Given the diverse kinds of information that we need to evaluate the shell mound models, we must first address whether it is prudent for us to spend considerable time and funding working with old museum collections and documents. Below, we evaluate the utility of undertaking a regional synthesis that can address the above questions, and present our preliminary results. We describe our methods for recording site data and some of the challenges of using this information. We conclude by considering the question of how representative the earlier information collected by first phase archaeologists is.

METHODS

The synthesis involved the compilation and review of site records from the Northwest Information Center (NWIC) at Sonoma State University, the place of record for archaeological resources in the eight counties that comprise the San Francisco Bay area. We have now completed the review of site records associated with twenty 7.5-minute topographic quadrangles, representing all parts of the San Francisco Bay area. Detailed information concerning site locations and site types was transcribed and entered into several interrelated tables using the Access database. These tables were designed so that data could transition smoothly into ArcEditor 9, the Geographic Information Systems (GIS) software that we selected for this project. In the end, records associated with 791 unique trinomials were identified, reviewed, and abstracted into the database, as outlined below.

To begin with, a list of sites and their locations for a given topographic quadrangle was created by examining the set of maps housed at the NWIC that depicted survey study areas and site locations. Site locations had been recorded by hand on NWIC maps and each site location was designated by a trinomial which was also handwritten. Next, the actual site records associated with this list of trinomials were reviewed. These site records usually consisted of a single page or two, and outlined basic information, if available, in several standardized categories, such as site location, site type, site features, researcher, date site recorded, and the

types of artifacts present at the site. There were often multiple observations for a single trinomial in these records because sites have been visited by more than one observer over the years. As a result, there was often no one, definitive "site record" for many sites, but rather a series of such documents that often varied in content and quality.

Information derived from the review of site records was entered into several tables. For example, any locations that had been recorded using the Universal Transverse Mercator (UTM) system were entered into a base table, the "UTM Location" table, which consisted of data fields such as "Trinomial" (an identifier for sites using one of the main NWIC tracking systems); "P#'s" (an identifier for sites using another one of the main NWIC tracking systems); "Easting" (the six-digit Easting coordinate used in the UTM system); "Northing" (the seven-digit Northing coordinate used in the UTM system); and "notes" (verbatim information on the original records we reviewed concerning location). As a result, for each topographic quadrangle examined, a table of all known sites with their UTM locations was created.

Additional information derived from the site records was also entered into a table designated the "Site Records" table. This table was designed to hold information on sites for each trinomial and was created with 26 different fields. These fields closely followed the categories listed on the site records themselves, especially those listed on the site record format developed in the 1950s by the forerunner to the NWIC, the University of California Archaeological Survey. The specific fields included in the "Site Records" table ranged from "researcher" (the person who originally provided information entered into the other fields) and "observation date" (the year the *original* observation was made) to "artifacts" (a verbatim list of the major artifacts, including those made of stone, shell and/or bone) and "features/burial" (a text field noting the specific numbers and types of burials and/or architectural features that were identified).

Most of the site records that were reviewed also reported information on the *type* of site in categories such as "shell mound" or "occupational site without shell." To investigate changes in site types across topographic quadrangles and across time, we developed 14 site categories based on the original site descriptions. These categories will be discussed later in the paper and are listed and described in Table 1. Although some of these categories appeared to be outdated, we decided that using them would allow us to assess how their use might have changed over time and whether or not entire new site types or features emerged during the second and third phases of archaeological work in the area. Based on a careful review of site records, individual sites were then assigned to at least one of these categories in the "Site Records" table. In cases where one site had multiple descriptions, such as "shell mound," "burial" and "occupational site," the site was assigned to all three categories.

METHODOLOGICAL CHALLENGES

In reviewing site records, we encountered two fundamental challenges: information that was incomplete, conflicting, or ambiguous; and the fact that some data might be superseded by more recent descriptions available in other sources, most notably in the so-called grey literature.

In terms of incomplete information, several categories listed on site records were often left blank. Most importantly, some site records did not supply UTM coordinates. In this situation,

Table 1. **Site type categories.**

Site Type	Definition
Assumed Shell	Information on records was incomplete, but evidence suggests that site was associated with shell (usually sites from Nelson's survey that do not have a specific type assigned to them).
Shellmound	For sites designated "shellmound" in the document (or mounded shell, mound with shell component, etc).
Shellmidden	For sites designated "shellmidden" in the document (or midden with notable shell component).
Shellheap	For sites designated "shellheap" in the document.
Shellscatter	For sites designated "shellscatter" in the document.
Midden (other)	For sites designated "midden" in the document (usually of earth, ash, or midden with very light shell component).
Occupational Site with Shell	For sites identifiable as occupation sites with notable non-artifactual shell components ("Occ Site w/Shell").
Occupational Site without Shell	For sites identifiable as occupation sites without notable non-artifactual shell components ("Occ Site w/out Shell").
Burial	For sites with a human burial component; may be a component of another site type or the sole identifying type of site.
FCR	For sites containing a notable Fire-Cracked Rock component; may be a component of another site type or the sole identifying type of site.
BRM	For sites containing a notable Bedrock Mortar component; may be a component of another site type or the sole identifying type of site.
Petroglyph	For sites containing a notable petroglyph component; may be a component of another site type or the sole identifying type of site.
Lithics	For sites composed primarily of lithic scatters or stone tool-making debris.
Other	For sites that do not fit neatly into previous categories such as historic transplants of prehistoric materials, largely historic sites with small prehistoric components, very specific-use prehistoric site like a "cooking site," etc.

other relevant information, such as street addresses, or an association with other sites or prominent features was recorded. In many cases, locations could then be determined and plotted manually directly into a GIS environment, with the corresponding UTM coordinates noted. Even so, information concerning location was not available for approximately 24% of the records reviewed, and these were excluded from the current analysis. Many of these sites were recorded in the early 1900s with locations based on newspaper accounts and have been subsequently disturbed or destroyed; locations for sites that do not possess UTM coordinates cannot be established until any associated grey literature or archival material can be analyzed.

It was also necessary to attempt to resolve conflicting accounts of site locations in cases where there was more than one site record for a site (for example, a site observed several times over the years by different observers) or when different locations were supplied

for the same site. For example, sites possessing multiple records with different locales often clustered very close to one another. As a result, we could determine the likely location of the site and which outliers probably resulted from poor mapping. For sites where there were multiple locations and one or more of these locations conflicted, the location specified on the NWIC maps was given priority and used as the basis of geo-referencing.

Information was also ambiguous on some site records for aspects of site type, site size, and site date. For site type, for example, "occupation site" was often listed on records as well as "shell mound" or "earth mound," whereas several categories were used to describe some shell-bearing sites that on first glance appeared to be quite similar. Although some of these categories might prove to be problematic in later analyses, we decided that we would first need to analyze their meaning and use before offering alternatives, especially since many of them continue to be used today. As a result, the range of site type categories reflected on site records was included in the databases developed for the project, as outlined in Table 1. For site size, it was not always clear if the extent of the site described in records was measured in an intact state or if the site had been scattered by disturbance. While repeated observations of an intact site were made over a period of years, for other sites it was unclear if some of the first observations were of already destroyed sites, scattered remnants, or if they represented the true dimensions of the original site. As far as observations of site date, only a very small percentage of records were associated with reliable temporal information. In addition to the use of outmoded temporal systems in earlier records (e.g., "Early Horizon"), a diversity of temporal systems were employed in more recent site records. Older records also did not include radiocarbon dates, and some listed temporal assignments that were based on superficial assessments of artifact assemblages.

This brief review of some of the challenges encountered in reviewing primary data on site records for the San Francisco Bay area indicates that information on site location, site type, or site features might be superseded by the great number of studies completed during the third phase of archaeological activity in the area. Nevertheless, virtually all of the site records reviewed for this study were associated with a *site type* designation, including sites assessed by first phase archaeologists. Moreover, it is clear that some of the site type categories used by first phase archaeologists were used throughout subsequent phases. As a first step in understanding the totality of the archaeological record in the region, if one were to assume the veracity of most site type designations, as indeed most area archaeologists do, then some interesting questions can be raised. For example, across the region, how have site type designations, which highlight a key characteristic of a site, changed over time? Furthermore, if we look at the dates when sites were initially recorded, how do assessments of site type made by first phase archaeologists compare with assessments made during subsequent periods? In other words, do new site types appear in large numbers, or did the work of first phase archaeologists capture the essential diversity of site types in the area?

SITE TYPE DISCOVERY AND DISTRIBUTION

For the preliminary analysis reported in this paper, we divided the 20 topographic quadrangles reviewed here into three geographic groups, designated

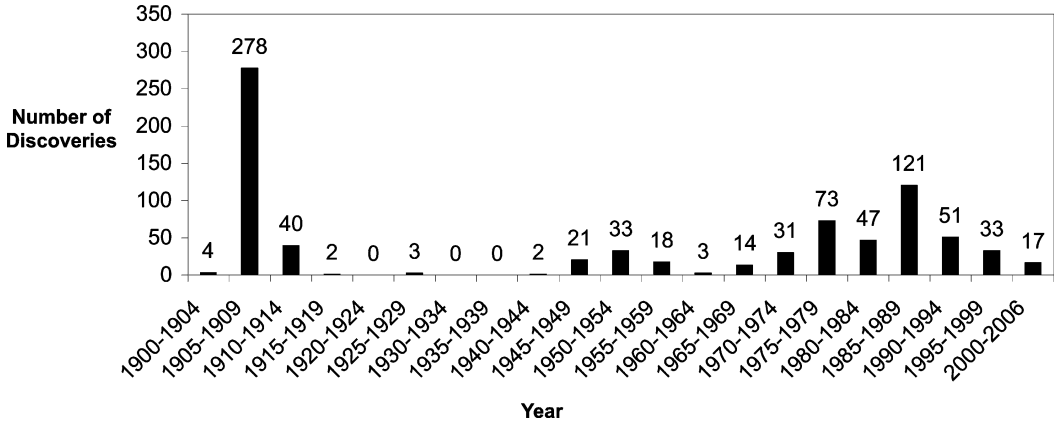

Figure 2. *First-time site discoveries in the San Francisco Bay area (x = year; y = number of discoveries).*

"North Bay" (10 quadrangles), "South Bay" (7 quadrangles), and "Central Bay" (3 quadrangles). This division is based on observations that minor differences exist between these areas with respect to microclimate, the association of amount of shell with archaeological sites, and associated cultural groups, as well as on several syntheses of San Francisco Bay area archaeology, in which the importance of local variation is recognized and described in broadly similar terms (e.g., Erlandson and Glassow 1997; Erlandson and Jones 2002; Moratto 1984). Nels Nelson also visited many of these 20 quadrangles in the early 1900s and identified shell mounds in virtually all of them. Most of them were located in areas immediately adjacent to the bay shore, although in order to include a more diverse sample of sites from more inland areas, we incorporated one quadrangle with little or no bay shore area into each of the three geographic groups.

Although there were multiple site records for most sites, we could identify the first time a site was discovered, if the date of recording was used as an indicator. The three general phases referred to earlier—Phase 1 (1901–1925), Phase 2 (1940–1959), and Phase 3 (1960–2006)—can be identified on Figure 2. Not surprisingly, new sites were discovered in all of the topographic quadrangles during the most recent phase of archaeological activity in the area. Indeed, in the South Bay, approximately 75% of the observations were for newly discovered sites recorded during the third phase of archaeological activity, while in the Central Bay, approximately 65% of the observations were recorded at this time (Table 2). In contrast, most sites in the North Bay

Table 2. **Number of first time site recordings across all areas divided by phase (*n* = total number of first time site recordings).***

Study Area	Phase 1	Phase 2	Phase 3
North Bay (n = 483)	56% (278)	10% (49)	32% (156)
Central Bay (n = 43)	7% (3)	26% (11)	67% (29)
South Bay (n = 265)	17% (46)	7% (17)	76% (202)

*Phase 1: 1901–1925; Phase 2: 1940–1959; Phase 3: 1960–2006.

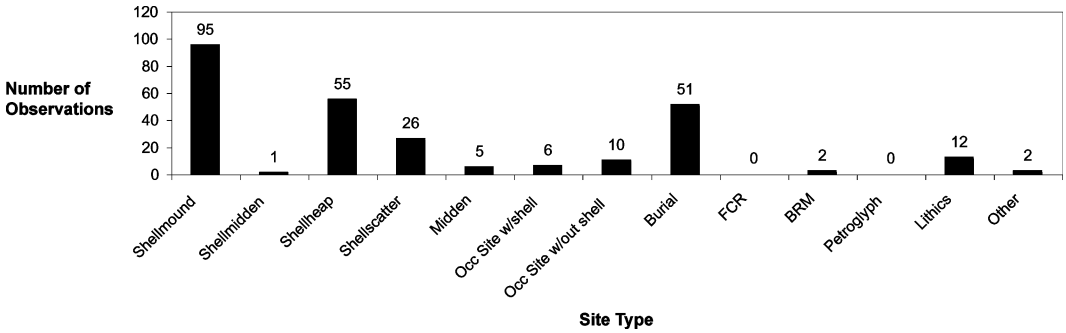

Figure 3. *North Bay site types during Phase 1 (x = site type; y = number of observations).*

were discovered during the first phase of archaeological activity. Roughly 30% of all sites were recorded during the third phase, indicating that most sites in the North Bay had been discovered during the period prior to the development of CRM.

If the distribution of site types across the three geographic areas is examined according to the phase of archaeological activity, a number of interesting points also emerge. During the earliest phase, for example, there are more than six times more observations in the North Bay than in the South Bay, and almost 100 times more observations in the North Bay than in the Central Bay. In addition, during the earliest phase, if the ambiguous category of "assumed shell" is removed from consideration, nearly 75% of the site types in the North Bay are associated with shell (Figure 3), whereas only 25% of the site types are associated with shell in the Central Bay (Figure 4), and just over 33% in the South Bay (Figure 5). Furthermore, based on a careful reading of the evidence, many site record observations could be assigned to specific site type categories. The site type category "burial," for

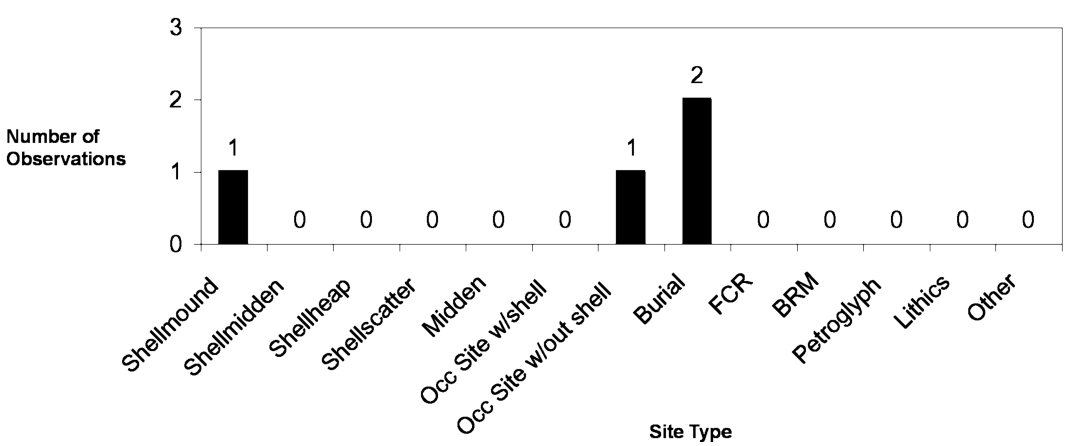

Figure 4. *Central Bay site types during Phase 1 (x = site type; y = number of observations).*

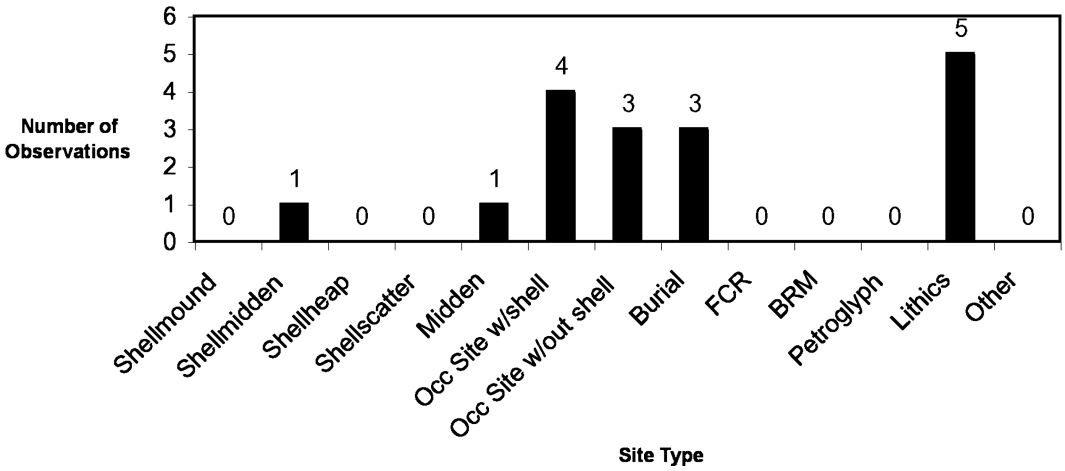

Figure 5. *South Bay site types during Phase 1 (x = site type; y = number of observations).*

example, could be assigned to sites in all three geographic areas during the earliest phase, "midden" and "occupational site without shell" could be assigned to sites in both the North and South Bay, and "bedrock mortar" could be assigned to sites in the North Bay. Significantly, however, the site type categories "fire-cracked rock" and "petroglyph" were not described by the region's earliest archaeologists.

During the second phase of archaeological activity, shell-bearing sites continue to be identified in all three geographic areas, though still in much higher proportions in the North Bay than in the South or Central Bay. Specifically, shell-bearing sites account for almost half of the observations made during this period in the North Bay (Figure 6), less than 20% of the observations made in the Central Bay, and approximately 25% of the observations made in the South Bay (there are no cases of "assumed shell" in any of the three areas). Observations of non-shell-bearing site type categories

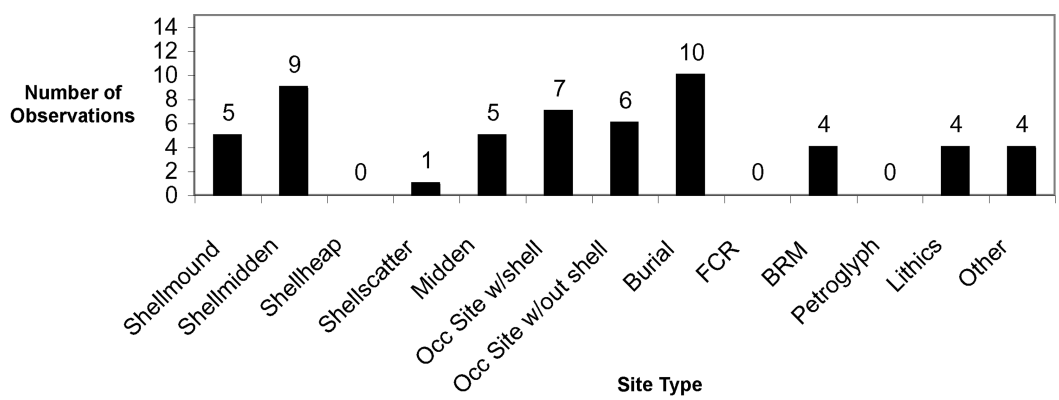

Figure 6. *North Bay site types during Phase 2 (x = site type; y = number of observations).*

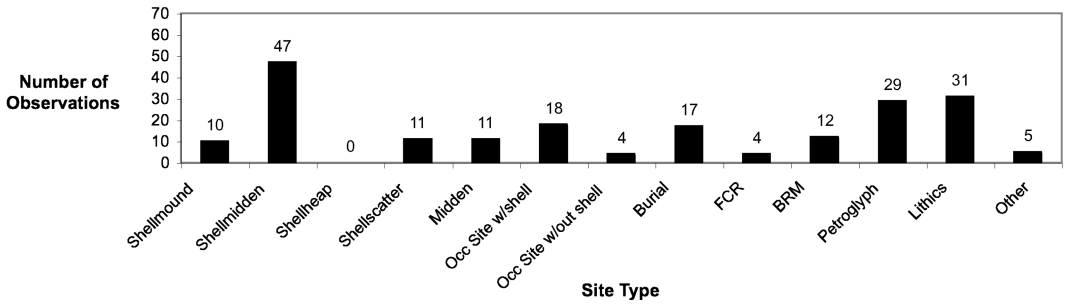

Figure 7. *North Bay site types during Phase 3 (x = site type; y = number of observations).*

are more common in the South and Central Bay areas than in the North Bay. During the second phase of archaeological activity, "petroglyphs" and "fire-cracked rocks" were not identified, although several examples of "bedrock mortars" were identified throughout the North and Central Bay.

During the third phase of archaeological activity, the number of site observations across all three geographic areas increased dramatically, compared with the second phase: This increase was nearly two-fold in the Central Bay, more than three-fold in the North Bay, and more than ten-fold in the South Bay. Across the region, "petrogylphs" and "fire-cracked rocks" are identified for the first time, and identification of "bedrock mortars" increased by a minimum of five-fold. In the South Bay, site type categories such as "fire cracked rock," "petroglyphs," and "shell scatter" are described for the first time, and an average of six new site types per quadrangle is present. The site type "fire-cracked rock" predominates, though most of these observations are associated with one quadrangle. In the North Bay, all site types are represented, including the newly detected petroglyph sites, except for "shellheap" and "assumed shell," which are described during the first phase only (Figure 7). An average of two new site types per quadrangle is present in the North Bay. In the Central Bay, site types such as "shell scatter" and "fire cracked rock" are described for the first time, though most new sites in this area are associated with "bedrock mortars."

By examining the distribution of site types in each of the geographic areas, we could make several general observations of the archaeological landscape of the San Francisco Bay area. First, in the North Bay, approximately 65% of observations of site types are associated with shell (Figure 8), while this percentage drops to approximately 30% for both the Central and South Bay. Second, as a percentage of all observations, the site type "midden," which connotes a site with a relatively low percentage of shell (as opposed to the site type "shellmidden"), is almost twice as common in the South Bay as in the North Bay. Third, across all three geographic areas, site types involving burials are either the first or second most common observations. Finally, as a percentage of all observations, "fire-cracked rock" increases by more than ten times moving from north to south; "petroglyphs" are found in all three areas, but are almost five times more common in the North Bay than in the South Bay, and, as a percentage of all observations, "lithics"

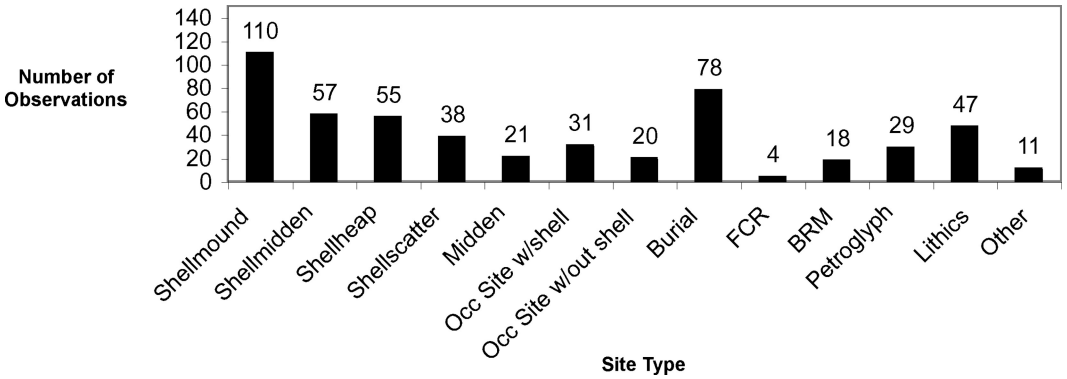

Figure 8. *North Bay site types during all phases (x = site type; y = number of observations).*

are highest in the North and South Bay, while "bedrock mortar" is highest in the Central Bay and less common elsewhere.

DISCUSSION

Our systematic review of site records compiled over the last century in the San Francisco Bay Area indicates that whereas several new site types have been detected in the last 40 years, the basic types of sites have remained fairly constant, especially for those site types associated with shell. Although new site types such as petroglyphs have been defined and detected, numerous examples of previously known site types were also identified, ranging from shell middens and shell scatters to burials and bedrock mortars. This observation suggests that from the outset, early archaeologists in the region had outlined a range of diverse site types, especially shell-bearing sites, and had not just focused on large shell mounds. The recent identification of numerous examples of shell-bearing site types throughout the region, together with the detection of new site types, also suggests that a fundamental re-evaluation of the archaeological landscape of the San Francisco Bay area is needed, one that acknowledges the importance of early observations, but integrates them with a detailed consideration of newer site types.

This is not to say that all the diversity within these site types is fully understood or that these categories should not be reevaluated. On the contrary, a "shellmidden" or "shellmound" in the North part of the bay, for instance, appears to be quite different from one in the South. The work of CRM has been invaluable in supplying many examples of previously identified site types, and a more nuanced understanding of site type and diversity will undoubtedly emerge from a review of the region's grey literature. At the same time, CRM has clearly made significant contributions in identifying examples of sites in categories which archaeologists previously had not recorded. This continuing review is likely to be especially useful in the South Bay where many site types were observed for the first time only recently, and where sites may have been forced into categories that have been used more effectively in the North Bay. More importantly, however, it is clear that we need to better understand diversity within site types on a micro-regional level of analysis. The more we compare and contrast the constellation of sites with one another within this relatively compact geographic area, the more we

will appreciate the complexity of the archaeological landscape.

Even if we assume that sites associated with shell are uniformly more visible than sites not associated with shell, our analysis suggests that shell-bearing sites were much more common in the North Bay (60% of all site types) than in the Central and South Bay (33% and 35%, respectively). While this difference may not be surprising to area archaeologists, it is now documented on the basis of site record data. To define this difference more clearly, however, requires a better understanding of the shell-bearing site types that are apparently less common in the South Bay, such as "assumed shell" and "shellmound". Key questions include whether these sites were very similar to "shellmounds" in the North Bay, or mounded, earthen sites with dramatically lower levels of shell that possessed a function unique to the area. Unfortunately, these sites, mostly described during the first phase of archaeological activity in the area, have now been largely destroyed, although a reanalysis of several associated museum collections could supply important insights into their similarities with the many mounded, shell-bearing sites to the north.

In characterizing this pattern of north–south differences across the San Francisco Bay area, it is also interesting to note that shell-bearing sites were less likely to be associated with sites composed of fire-cracked rock or lithics, though fire-cracked rock and lithics were undoubtedly described less often by early archaeologists. In addition, although an association between shell-bearing sites and bedrock mortars (traditionally a marker of some form of sedentary behavior) is still unclear, petroglyphs appear to be more common in areas with shell-bearing sites, as they are found four times more often in the North Bay than in the South Bay. Burials are a constant and key part of the landscape, however, and their possible association with likely shell-bearing site types, as well as "middens" or "earthen" mounds in the South Bay, is of particular interest since a link between burials and *mounded* sites may exist and have important implications for interpreting larger clusters of mounded sites.

From this perspective, any north–south pattern of shell-bearing sites across the San Francisco Bay area must be understood in multi-dimensional terms, with careful consideration given to likely ecological, cultural, and historic components. Questions to explore include:

1. What is the impact of the many micro-variations in water temperature and salinity levels across the region on site composition and shellfish constituency?
2. How does the presence of so many burials in a site with little or no shell relate to its duration of occupation, and are these types of sites in the South Bay more properly characterized as "cemeteries"?
3. Did groups in the South Bay emulate shellmound communities in the North Bay, or were there distinct intra-regional differences that revolved around shell as a major or minor site constituent?
4. How do petroglyphs, with their clear symbolic importance, relate to shell-bearing site types or to possible mounded clusters, given that they are found in both the North and South Bay?

FUTURE DIRECTIONS

The next phase of the integrated approach to San Francisco Bay area mounded landscapes is to expand the number of topographic quadrangles, review the grey literature, and address

some of the challenges identified earlier so that the analysis can be moved entirely into a GIS environment and the spatial patterning of sites examined on a micro-regional level. We have already completed a preliminary spatial analysis of recorded sites using five representative topographic quadrangles from all three geographic areas.

Building on an observation initially made by Nelson (1909:328–329) and again by Heizer and Baumhoff (1956:37) that San Francisco Bay sites tend to be found in discrete groups or clusters, Banks and Orlins (1979, 1981, 1985) delineated several site clusters in the East Bay that were composed of four to six shell mounds situated along the bay shore and/or streams flowing into the bay. Our preliminary GIS study indicates that a more complicated spatial patterning exists. The five quadrangles we analyzed contained site clusters consisting of 3 to 14 sites that were distributed in elliptical or linear arrangements along the bay shore or along streams or creeks. Most of the clusters we identified were complex in composition with a "shellmound" associated with a diverse range of shell-bearing sites, such as "assumed shell," "shellmidden," and "shell scatter." In other words, it appears that when site clusters were associated with shell mounds, the other kinds of sites found in the group consisted mostly of other shell bearing sites. At the same time, any non-shell-bearing sites associated with these clusters were not substantial enough to suggest that they may have served as village sites. Although this pattern is less clear in the South Bay (because sites that were assumed to be shell mounds were included in the analysis), this suggests that some of the shell-bearing sites in clusters must have been associated with residential practices, and further, that shell mounds, in particular, did not function simply as refuse dumps for nearby non-mounded village communities. Instead, we are currently considering two possible scenarios in our future work. One interpretation is that the shell mounds may have served as "vacant ceremonial centers," which were occupied primarily during the ceremonial cycle of the year (see Sassaman 2004). The other interpretation is that they were occupied as mounded villages where local communities resided most of the year (Nelson 1910).

These two scenarios may actually represent polar extremes along a continuum of shell mound residency and use that varied across time and space. In considering this continuum, it is important to note that some of these site clusters may have contained a number of contemporaneous sites that made up broader mound complexes (see Lightfoot 1997; Lightfoot and Luby 2002). Thus, some of the site clusters may have consisted of large and medium sized mounds, as well as other shell-bearing sites that have been defined as "shellmiddens," "shell scatters," or "shell heaps." In some places and times, these shell-bearing site complexes may have been the loci of sizeable communities of people who used these places as bases of operation for most of the year (a la Binford's Collector's Model). In other places and times, the shell-bearing site clusters may have been periodically abandoned as task groups targeted more distant resource patches for exploitation, while a small residential group remained at the mound centers. In still other times and places, the mounded sites may have been largely abandoned for some period of the yearly cycle, with the broader community splitting into smaller groups that practiced a more mobile, foraging-like seasonal round. But even in this scenario, it still seems possible that the broader community would have assembled together at the shell

mounds for scheduled rites, feasts, and dances.

One way to evaluate these scenarios is to closely examine the best documented settlement clusters from each of the three geographic areas. By assessing the CRM-related literature and gathering the latest information on site date, site size, and other areas, the best understood clusters can be examined in a GIS environment. This will be especially useful in integrating the work of early archaeologists who excelled at providing a snapshot of the geographic distribution of important sites, just as these sites began to disappear, with the high-quality, detailed work recently completed by CRM archaeologists. With the latest temporal information, accurate geographic locations, and detailed data on site characteristics, it will be possible to compare the three areas and to ask questions about broader communities in the region, including how newer site types, such as petroglyphs, were tied to mounded clusters.

Although it is still premature to make any major conclusions until the full review of site records is completed, our preliminary observations suggest that a comprehensive regional analysis focusing on fine-grained differences would be revealing. Furthermore, it also suggests that an assessment of site record data in a GIS environment, with the most recent temporal information, and including all relevant topographic quadrangles, is long overdue for the region.

Finally, in addition to a GIS-based micro-regional analysis, examining the archaeological record of the San Francisco Bay area through a broad comparative framework would be enlightening. Not only would it be interesting to investigate the hundreds of large, burial-associated, and little-understood earthen mound sites in the region immediately adjacent to the Bay area, the Sacramento–San Joaquin Delta region, but it would be useful to examine variations in shell-bearing sites from other coastal areas and estuaries across North America, especially in view of the many shell structures and mounds in the interior and coastal Southeast. In the end, however, it is important to recognize that despite rampant development in the San Francisco Bay area over the past 100 years, there is great potential to work with earlier archaeological data from the region. Whether this information is derived from site records, grey literature, or historic museum collections, it must be recognized that an integrated approach—where the results of ongoing excavations are analyzed together with this earlier information—will likely yield the most helpful insights about mounded landscapes in the San Francisco Bay area, and possibly other regions worldwide.

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