

Radiocarbon Dating and Cultural Models on the Monterey Peninsula, California

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Abstract

The Monterey Peninsula contains a large number of prehistoric sites, but bioturbation and urbanization have severely impacted many, if not most, of these resources. This, along with the limited numbers of artifacts in many sites has led to an increased reliance on radiocarbon dating. Now, with nearly 750 dates available for Monterey County, a high percentage of which are from the Monterey Peninsula, we are able to evaluate cultural models which have been applied to the area. However, a significant number of these radiocarbon dates may be compromised by poor sampling techniques or other problems, and may actually be providing erroneous and misleading information. In this paper we examine the types of sampling and reporting problems which may be leading to erroneous information, the practice of cultural resource management on the Monterey Peninsula, what the data may be trying to tell us, and cultural models which may apply to the area. We conclude with directions for future research.

Introduction

The Monterey Peninsula is a unique area, and one of the world's great vacation spots (Fig. 1). It was clearly attractive to prehistoric populations in the past as well. Occupation of the area has been documented to nearly 6000 years ago.

The peninsula, along with other areas of California, saw a marked increase in archaeological research as cultural resource management (CRM) laws and regulations were implemented in the early 1970s. Prior to the 1970s there had been only limited investigations,

and the prehistory of the Monterey area was virtually unknown except for assumptions based on a sketchy historical record.

Conducting archaeological research in the urban environment of the Monterey Peninsula area (Fig. 2) presents unique problems. First, because the area was largely developed by 75 to 100 years ago, prior to archaeological investigations, many of the archaeological projects are small. For example, the majority of CRM projects currently being conducted in Pacific Grove consist of foundation replacements or small additions to older single-family dwellings. There is little opportunity for large-scale excavation in this type of project; indeed, many projects involve only monitoring, which presents even less opportunity for data recovery and detailed archaeological research.

A second problem in conducting archaeological research on the Monterey Peninsula is the quantity and complex nature of the cultural resources. Much of the eastern edge of the Monterey Bay has a sandy shore, which contained relatively few resources of interest to the prehistoric inhabitants. As a result, from just south of Moss Landing through Seaside there are very few archaeological sites. However, beginning at about the Monterey Fisherman's Wharf and extending along the entire shoreline of the Monterey Peninsula—from

This article was submitted for publication on June 1, 2004.

Monterey to Carmel, a distance of about 12 miles—there is a rocky shore which contained a wide variety of easily accessible resources. Not surprisingly, the archaeological deposits are virtually continuous in this area, and often extend from the coast to 500 or more meters inland.

Because of the almost continuous nature of the prehistoric resources, and our inability to conduct a thorough reconnaissance over hundreds, if not thousands of back yards and planter beds, decisions made while defining boundaries are frequently arbitrary. These decisions may be made for practical reasons, and as such, our site boundaries may not accurately reflect prehistoric usage. Prehistoric peoples moved about the landscape for a variety of reasons, and these reasons changed through time as populations fluctuated and as settlement and subsistence patterns shifted in response to cultural preferences as well as numerous environmental factors.

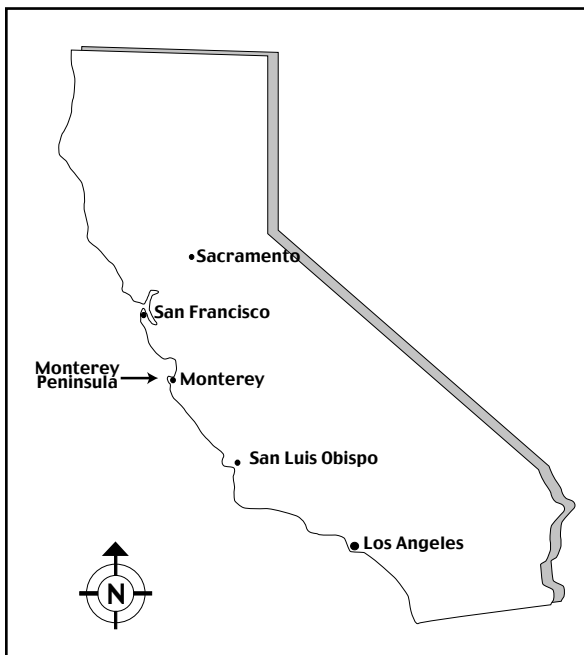


Fig. 1. Location of the Monterey Peninsula.

The problem is especially noticeable along the north-facing shoreline of New Monterey and Pacific Grove (Fig. 3). This area seems to be virtually one continuous archaeological deposit with few definite boundaries. Within this deposit are a series of activity areas; some are attributable to the Early Period, some to the Middle Period, and some to the Late Period. In many cases, burrowing rodents have partially or thoroughly intermixed the smaller midden constituents, although larger features are usually still intact.

As a further difficulty, many of these sites contain relatively few formal artifacts. When we began our investigations, it quickly became clear that the techniques which were then commonly employed in other parts of California did not work very well on the Monterey Peninsula. The use of 1/4 inch screens and dry field sorting, which was standard in most areas of California in the 1960s and 1970s, simply did not produce the data needed to adequately investigate these sites. It was assumed, for example, that obsidian was not often found on the Monterey Peninsula. However, we have found small fragments of obsidian in virtually every site we have tested. Many of the smaller artifacts and midden constituents were significantly underrepresented due to the field techniques which were being employed. The switch to 1/8 inch mesh and water-washing helped, but there are still fewer formal artifacts and fewer varieties of artifacts in many local sites than is typical for much of the San Francisco Bay area or the lower Sacramento Valley.

This combination of relatively few artifacts, even using advanced data recovery techniques, and generally small projects has led us to an increased reliance on *dated site component* analysis, as opposed to *artifact* analysis. Archaeologists accustomed to looking at populations of artifacts sometimes tend to overlook the importance of accurately dated site components, and since many small projects on the Peninsula simply do not produce those artifacts, they may fail to recognize the underlying value of their sites.

Site component analysis, in turn, requires more, and more accurate, radiocarbon dating. But while radiocarbon dating has been practiced in California for over 50 years, many archaeologists who have worked on the Monterey Peninsula do not realize the full potential of the technique in their analyses. There are a number of reasons for this, but two of the primary ones are poor sample selection and dating too few samples.

This paper focuses primarily on radiocarbon dating and temporally-sensitive artifacts which can be directly dated, such as shell beads and fishhooks. There are, of course, other materials and techniques which can be used for dating, for example obsidian hydration readings provide valuable information and projectile point styles have been shown to change through time. However, these subjects will be left for a future paper.

The Problem of Sample Selection in Radiocarbon Dating

A Brief Overview of Radiocarbon Dating on the Monterey Peninsula

When radiocarbon dating was first employed on the Monterey Peninsula, most of the samples were obtained using abalone shell (primarily *Haliotis rufescens*, the red abalone). These shells are large and dense, very common in most local sites, and are an excellent material for dating. They provide dates for specific cultural activities within the sites, even though they may have been slightly relocated by bioturbation or historic disturbance. They also provide consistent dates among local sites regardless of the correction factors being used for calibration. Another advantage is that, because of their large size and dense makeup, virtually all abalone dates were obtained using a

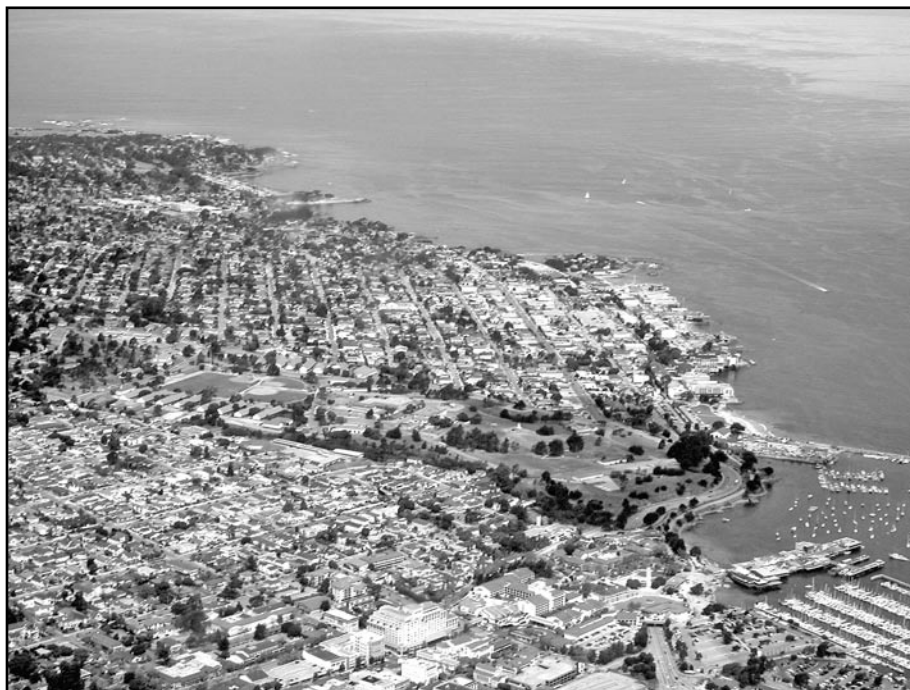


Fig. 2. Monterey and Pacific Grove from the air. The lower right portion of the photograph includes downtown Monterey and Fisherman's Wharf; the center right includes New Monterey and the Cannery Row area; shown in the upper left is Pacific Grove and the northern tip of the peninsula.

single piece of shell. This is the technique Dietz and Jackson (1981) used in their 1977 examination of 19 archaeological sites in Pacific Grove for a sewer line project, and it contributed several solid dates to what was then a fledgling database (18 of 23 dates were on abalone shell).

Dating most Late Period sites was relatively easy, as the majority of these sites consist of an “abalone pavement,” an often dense but thin (10-40 cm) horizontal layer in which abalone often made up about 98 to 99 percent of the shell by weight (Fig. 4). With these sites, selecting large abalone samples results in dates rarely much older than ca. A.D. 900. For example, the abalone layer in Fig. 4 yielded five dates with calibrated intercepts ranging between A.D. 970 and 1275 (CA-MNT-1084). The only artifacts were possible pounding tools (probably for tenderizing abalone)

and a possible piece of cut abalone shell. Based on nearly two dozen sampled components, a decade ago we defined these abalone pavements as Late Period Coastal Shellfish Processing Sites (abalone subtype) (Breschini and Haversat 1991).

However, while a sufficient number of abalone shells will provide a reliable age estimate for abalone pavements, over 20 years ago we became aware that abalone shells did not always represent the full temporal range we expected for some other types of archaeological sites. This was particularly true of some Early Period sites.

While the abalone shells in Early Period sites are highly visible, Early Period sites are always dominated by mussel shell, which generally makes up 75 to 95 percent of all shell by weight. In Early Period sites it is common to find a very sparse layer of abalone shells at about 30 to 50 cm depth. Large areal exposures, such as were obtained at CA-MNT-391 (Fig. 5), make these appear to be a discrete layer, but radiocarbon dating has shown that these shell “layers” can actually span one to two thousand years. They are not actually discrete features but accumulated over time, with possibly some concentration by burrowing rodents. In their lowermost levels many Early Period sites contain relatively few abalone fragments which are large enough to date using standard methods. (With Accelerator Mass Spectrometry or AMS dating, this is less of a problem than it was 20-30 years ago.)

As we became aware of increasing evidence that abalone shells alone do not necessarily provide an accurate estimate of the full range of occupation of many sites, we started including more samples of mussel shell (*Mytilus californianus*) in our dating strategies.

Unfortunately, dating mussel shells is not as convenient. The red abalone shell is usually found in large pieces which are easily dated (pieces weighing 300-500 grams or more are very common). Mussel

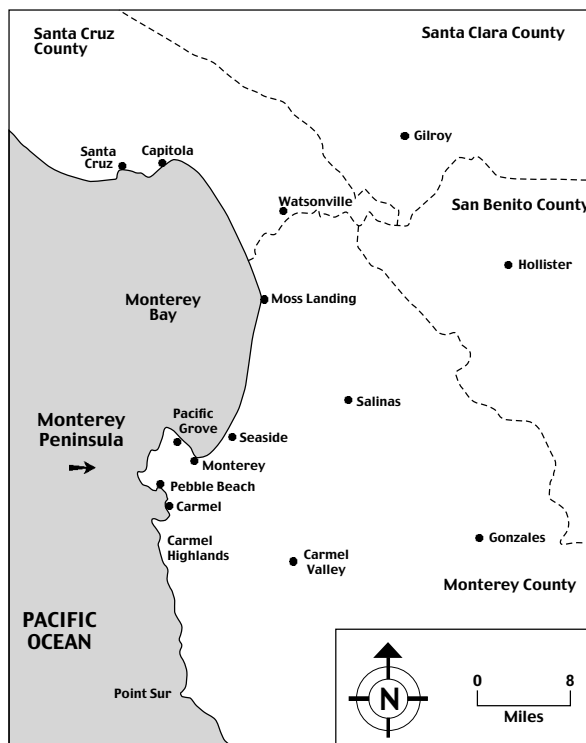


Fig. 3. The Monterey Bay area. The area discussed in this report extends from Moss Landing through the Carmel Valley to about halfway between the Carmel Highlands and Point Sur.

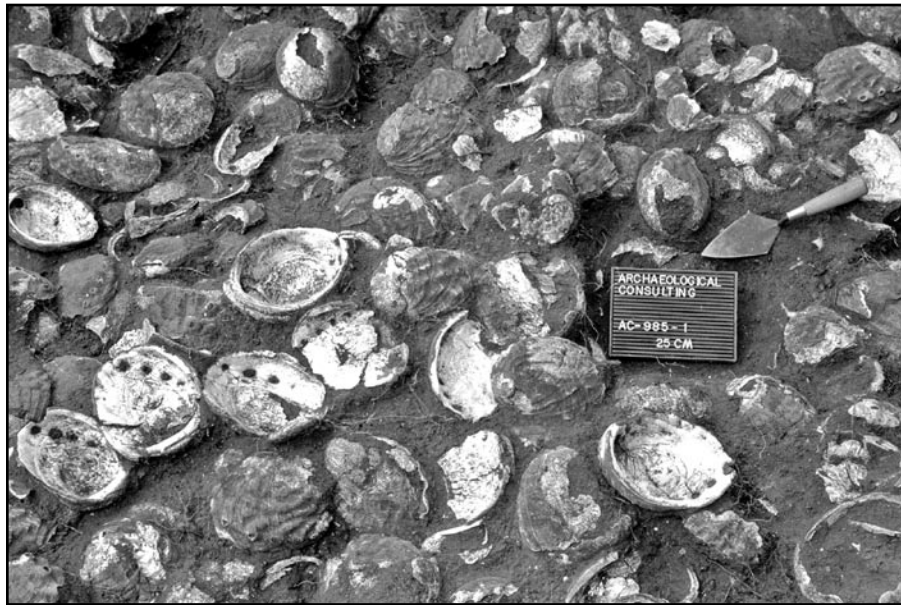


Fig. 4. Example of a Late Period “abalone pavement” (CA-MNT-1084).

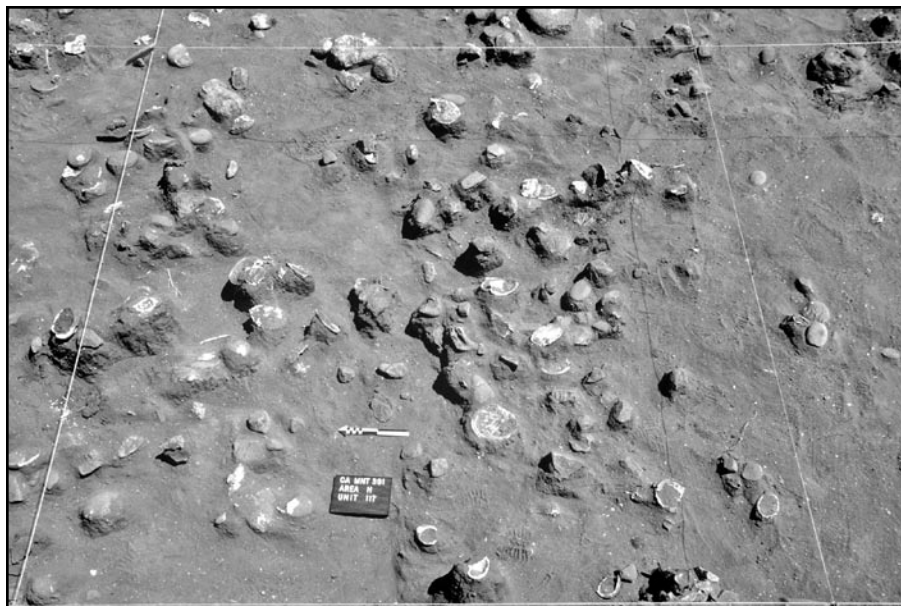


Fig. 5. Example of abalone shells in an Early Period deposit (CA-MNT-391). The ages of these shells actually span thousands of years.

shells, on the other hand, are often found in very small pieces because the shell is smaller and thinner. Deliberate breakage or mechanical damage from people walking on a site for a few years/generations/centuries resulted in many tiny pieces. The few remaining large pieces, it seemed, were seldom where we wanted to obtain radiocarbon dates.

At this point we need to include a brief note on our standard technique for excavating shell-rich coastal sites. Unless there are evident strata, we excavate in 10 cm arbitrary contour levels using 1/8 inch (3 mm) mesh portable shaker screens. We do not do any sorting in the field, although any artifacts we observe are removed and bagged separately. Bulk rock is removed, weighed, and discarded, but other than that all materials which do not pass through the screens are bagged and transported to the laboratory. In the laboratory the materials are wet screened through 1/8 inch mesh, dried on window screens (1/16 inch or smaller mesh), and then sorted. This has the advantage of providing very good recovery of small constituents and artifacts, and the disadvantage of increasing the laboratory time (and budget) considerably.

The reason for the above interlude is to explain a technique we used for obtaining radiocarbon samples during the 1980s. During the laboratory sorting, we generally recovered two 50+ gram samples of mussel shell from each level of each unit within each site we tested. These samples supplemented the abalone shells and (infrequent) large mussel shells we recovered in the field. These bulk samples recovered in the laboratory typically included several hundred individual fragments of mussel shell. Our preferred method of dating these was to select a unit and submit a sample from every second or third level, or some other systematic strategy, throughout the entire vertical span of the deposit. This dating strategy was designed to provide a systematic look at a single unit. We believe that this is preferable to scattering dates about a variety of units and depths.

This approach had the advantage that it was systematic; ideally, if four or five or six dates are obtained in this manner, any which are out of place can be readily identified. Also, by submitting samples which are organized in a systematic manner, hopefully the results will be more easily interpreted. When radiocarbon dates are scattered about a site almost at random, it is likely that the results will be much more difficult to interpret in all but the simplest of deposits.

However, using multiple-shell samples introduced another variable—these samples mixed a number of individual pieces together, and these pieces may have originated in different levels. Thus, in spite of the systematic approach, the results were sometimes not what we expected. For example, one site on the Monterey Peninsula, a small deposit extremely rich in mussel shell, but with virtually no abalone shell, produced the results shown in Table 1 (CA-MNT-149; Breschini and Haversat 1986:8).

These dates appeared to have two serious problems: First, and most obvious, were the reversals, with deeper samples returning younger ages than shallower samples, and the oldest date of all coming from the uppermost layer. However, on closer examination all four dates are so close together in relation to the range that the ages can be considered virtually identical at 2 sigma. As such, the reversals cannot be considered significant.

The second problem is potentially more serious. These dates, each consisting of hundreds of individual pieces of shell, all centered around A.D. 730, and had a very limited temporal range. These results could be the result of averaging. We could have:

- Much older and much younger mussel fragments mixed in roughly equal proportions, or
- A few much older and many slightly younger mussel fragments mixed together, or
- All samples actually within a very narrow temporal range as indicated by the dates.

Table 1. Radiocarbon Dates from CA-MNT-149.

Meas. Age/Range	Lab. No.	Provenience	Sample & Size	Cal 2 sigma*
1560 ± 65	WSU-3143	Unit 1, 0-10 cm	<i>Mytilus c.</i> , 62 g	A.D. 480 (665) 810
1400 ± 55	WSU-3144	Unit 1, 20-30 cm	<i>Mytilus c.</i> , 83 g	A.D. 667 (798) 991
1500 ± 70	WSU-3145	Unit 1, 50-60 cm	<i>Mytilus c.</i> , 86 g	A.D. 554 (699) 898
1445 ± 95	WSU-3146	Unit 1, 70-80 cm	<i>Mytilus c.</i> , 74 g	A.D. 567 (764) 1006

* Calibrated using CALIB rev. 4.3, by M. Stuiver and P. J. Reimer. Adjusted for local reservoir correction using a Delta-R of 225 ± 35.

In other words, these dates by themselves are insufficient to tell us either the age or the temporal span of the deposit. There are far more variables than we can control. At this point we could not determine if the site deposit had multiple components which were entirely intermixed, perhaps by rodents and shifting sands (the site is in an area of sand dunes), or whether the deposit was actually very narrow in temporal span. Any analyses we attempted on this site would have to take this problem into consideration! (See also Example 5, below.)

To take this example to its extreme, if a site is sufficiently mixed and the samples include a sufficiently large number of fragments, the resulting dates will all be the same age.

Problems of this nature persisted until the common availability of AMS dating, which permits dating very small pieces of mussel or other shells. Along with this, the advances in counting techniques allow smaller fragments to be analyzed using standard radiocarbon methods without getting a range too large to be of much use. Together these techniques have changed the way we are able to date archaeological deposits in the Monterey Bay area.

To summarize to this point, radiocarbon dating on the Monterey Peninsula is more complicated than it first appeared. The use of different shell species may be a significant factor in the dates obtained, and multiple-

shell samples may provide only limited data on the temporal age and range of a deposit.

An experiment in late 1999 showed how serious these problems can be.

Example 1: CA-MNT-103, A Surprise from Cannery Row

With the advent of AMS dating, and the ability to analyze smaller samples using standard radiocarbon techniques, we began collecting and dating small pieces of mussel shell from a variety of sites. But the opportunity to obtain a really large, systematic sample for AMS dating did not occur until late 1999 when CA-MNT-103, in the Cannery Row area of Monterey (Fig. 6), was significantly damaged by construction.

The damage consisted of completely hauling away an approximately 40 x 40 foot section of the site, with an estimated depth of 2.5 feet (approximately 148 cubic yards of cultural material) with no concern for cultural resources.

The Approach

We were asked to provide mitigation recommendations. As the site materials were already gone, we recommended a project to obtain approximately 16 radiocarbon dates in a vertical column using AMS dating techniques, so that very small samples of mussel shell could be utilized.

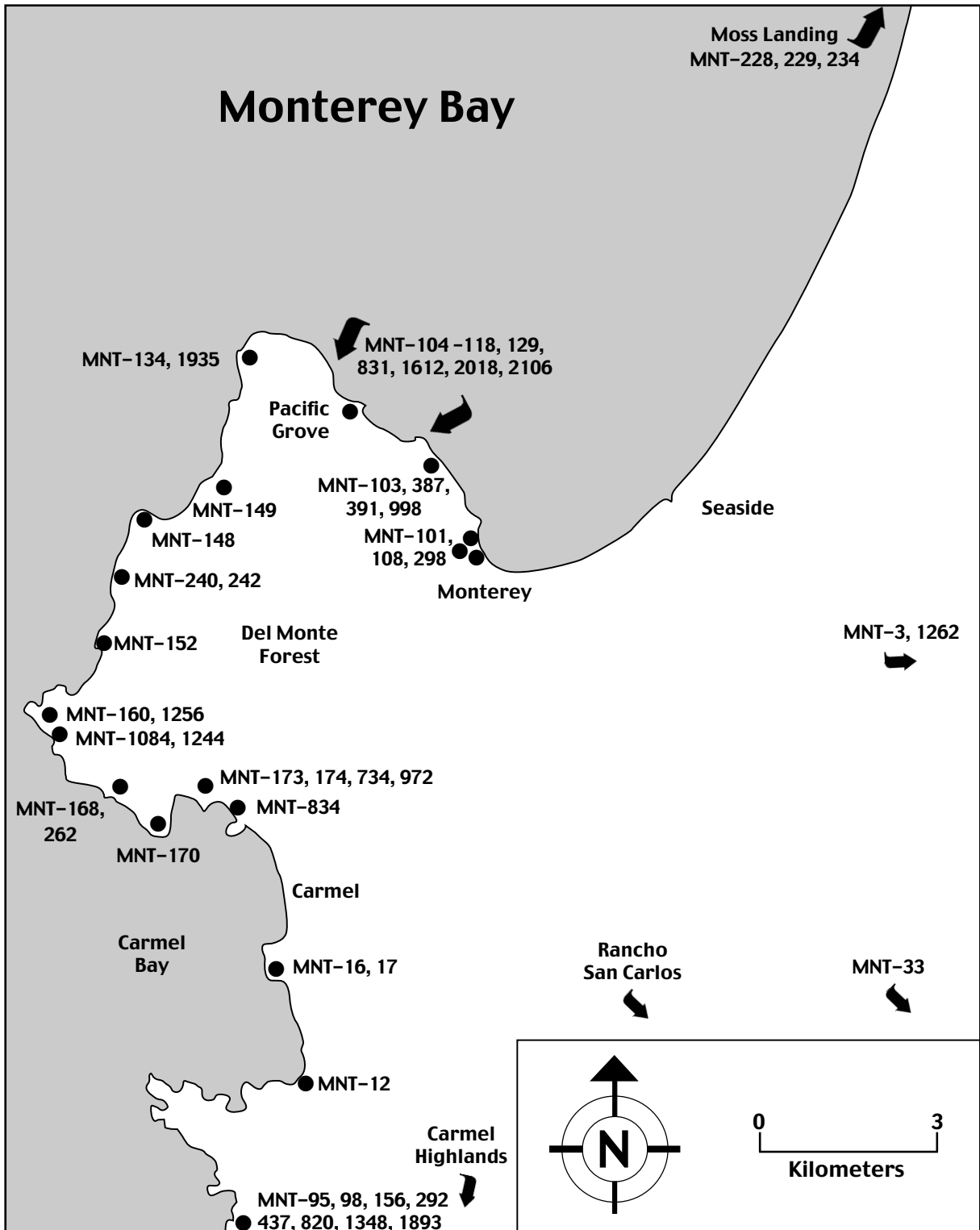


Fig. 6. Monterey Bay area archaeological sites mentioned in the article (a few smaller or outlying sites have been omitted).

The use of single pieces of shell avoids the problem of mixing together a number of small fragments. As often had been the case when using mussel shells as a dating material, the resulting dates could have several interpretations (as we saw at CA-MNT-149, above).

However, you don't get something for nothing. Just as multiple-shell samples may contain fragments from different time periods, single-shell fragments may not necessarily represent the provenience from which they were obtained! The smaller the shell fragment, the easier it is for human activity (then and now), rodents, and various natural phenomena to move it around within a deposit. Thus, it would be dangerous to rely on a single small piece of mussel shell, or even a small number of samples, to provide an estimate of the time period(s) during which a site was used or occupied. Each sample may provide an accurate date on a specific event, but the correlation between age and depth may be low. Larger numbers of radiocarbon samples may be needed to correct for this, but the results should be more accurate in the long run.

Due to these problems, it was our goal to systematically date, using AMS techniques, the entire vertical extent of the deposit based on a column sampled in 5 cm vertical increments. Each sample would consist of a single piece of mussel shell. However, because the lowermost soil sample contained no shell, we replaced it with two abalone shells collected from a sparse abalone layer between 20 and 30 cm, using standard radiocarbon dating.

Our initial assumption, based on a visual examination of the site deposit, was that the site probably dated between about 2500 and 5000 years ago. Using the dating method described in the following section, we expected to obtain information within the following research areas:

- To obtain a better estimate of the temporal range(s) during which this site was occupied than

previous dating approaches used on Monterey Peninsula sites have provided.

- To determine the degree to which mixing multiple fragments of mussel shell together into a single dating sample may be providing inaccurate results.
- To obtain information on the accuracy of dating archaeological sites using only abalone shells, which are often concentrated in a horizontal layer, by comparing two abalone samples from such a layer with 15 mussel shell samples representing the entire vertical range of the deposit.
- To examine the problem of bioturbation (the disturbance of soils by rodents and other organisms) by using a systematic sampling method and a sufficiently large number of samples.

Field Methods

Our dating samples were obtained in 5 cm increments from a column in the sidewall that was exposed during the construction project. We actually obtained samples from two separate columns. The details on these column samples, and the methods used to obtain them, are included below.

The individual samples from the two columns were each obtained in the same manner. After the sidewall was cleaned of loose soil and roots, a metric tape measure was extended vertically along the midden profile (beginning at the top of the intact midden deposit, rather than at the surface; see Fig. 7). From this point, samples were collected in 5 cm increments beginning with the lowermost samples and working upwards. This was done to avoid contamination of samples, as soil is naturally spread downwards from the area being sampled.

Each sample area was first marked with a line drawn parallel from the tape measure. The sample was then collected in a flat pan by excavating into the sidewall with a trowel. After each sample was obtained, that

area of the column was cleaned so that no extraneous material remained to contaminate the next sample. The trowel, pan, and 1.7 mm soil screens were also cleaned after each level to avoid contamination. We realize that rodent runs may move shell up and down within the deposit, and so tried to avoid any rodent runs within the area sampled. However, rodent runs were obvious within the caliche layer underlying the midden deposit, and so it is likely that some of the samples did come from rodent-disturbed contexts. Photographs were taken of the sample areas, the sampling process, and the project area.



Fig. 7. The area of CA-MNT-103 used for the column sample.

It is likely that at least 10 to 15 cm of midden, or more, has been removed from the top of the deposit at some time in the past, so these columns may not represent the entire temporal span of the original midden deposit.

Column 1. This column spanned approximately 70 cm of intact midden deposit, resulting in 14 separate samples. This column began approximately 17 cm below the existing surface as the top 17 cm was judged to be imported or extensively disturbed soil (a clear-cut bulldozer cut was evident at 17 cm). Below 17 cm, there appeared to be at least 60 cm of intact midden, below which point the cultural deposit abruptly ended and a distinct caliche layer began. This was a fairly sharp demarcation, with the midden soil being a dark gray silty loam, and the layer underlying it being a tan silty clay with extensive caliche development. The column was extended approximately 10 cm into the caliche layer for a total length of 70 cm (14 individual radiocarbon samples at 5 cm increments).

Column 2. This column spanned approximately 75-80 cm of intact midden deposit. This column was obtained approximately 4 meters south of Column 1, in an area where less midden soil appears to have been removed from the surface of the archaeological site by construction in the past. In this area, an overburden of 14 cm of imported or extensively disturbed soil was noted. This was overlying an apparently undisturbed midden deposit, consisting of a dark gray silty loam, with a vertical extent of approximately 75-80 cm from which samples were recovered (for a total length of 80 cm, or 16 individual radiocarbon samples). However, the lowermost sample contained no shell, reducing the total to 15 (Fig. 7).

In this column, at a depth of 20-30 cm below column datum, a sparse layer of abalone (*Haliotis r.*) shells was noted. This layer represented the only stratigraphy noted within the column sample. In addition to the 15 individual soil samples from the column, which

extended from 0-75 cm, four samples were obtained from abalone shells within or immediately adjacent to the column in the 20-25 and 25-28 cm levels.

Laboratory Methods

In the laboratory each soil sample was wet screened using the same 1.7 mm soil screen used in the field. All materials remaining in the screens were recovered, air dried, and bagged by provenience. From these, individual samples were selected for radiocarbon dating.

Based on the longer span of samples (15), and the presence of additional samples from the abalone layer, Column 2 was judged to be more suitable than Column 1, and all samples were submitted from that column.

Following our basic strategy of sampling the deposit uniformly, 15 samples were selected—one sample from each 5 cm level of Column 2. Each sample consisted of a single piece of mussel (*Mytilus c.*) shell weighing between 0.4 and 1.5 g.

Two additional samples were selected from the sparse abalone layer which extended roughly between 20 and 30 cm. These samples consisted of large pieces of abalone (*Haliotis r.*) shell (125.5 and 57.7 g), and provided additional information on the abalone layer which occurred in the upper levels of the deposit.

Finally, some months after obtaining the results from the initial 17 samples, and while preparing for a speech to the Society for California Archaeology (Breschini and Haversat 2002a), a multiple-shell sample was extracted from the 30-40 cm level of Column 1 and submitted for dating. This included 324 individual pieces of mussel shell. This sample was obtained to document the errors which potentially can arise from using such a multiple-shell sample.

Two different methods of radiometric analysis were used. First, because of their small size, the 15 individual samples of mussel shell were analyzed using the AMS technique. This technique includes measurement of the stable isotope ratios for C13/12.

The two abalone samples and the one multiple-shell mussel sample were analyzed using the Standard Radiometric Technique. For consistency with the AMS dates, the two abalone samples included a C13/12 stable isotope ratio measurement, but a C13/12 measurement was not obtained for the multiple-shell sample; rather, an estimate based on numerous previous samples of mussel shell was used.

The 18 radiocarbon samples obtained from the CAMNT-103 project are listed in Table 2.

Results

These results of the 18 radiocarbon samples are presented in Tables 3 and 4, and illustrated in Fig. 8.

Lessons

The results of the investigations were detailed in a 2000 report (Breschini and Haversat 2000a) and summarized in a paper presented to the Society for California Archaeology (Breschini and Haversat 2002a). The most important findings of this dating study are as follows:

The site has two components and they are substantially mixed together. The area tested is characterized by two components, with occupation during the Early Period (average 2141 B.C.) and during the Late Period (average A.D. 1176). Small midden constituents from these two occupations have been thoroughly mixed together, probably by the actions of rodents, possibly assisted by the prehistoric occupants of the site as well. Features and larger midden constituents, such as the abalone shells, which we found in a distinct layer

Table 2. Provenience and Material of Radiocarbon Samples at CA-MNT-103.

Sample No.	Provenience	Weight	Material	Analysis
1	Col. 2, 0-5 cm	0.4 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
2	Col. 2, 5-10 cm	0.6 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
3	Col. 2, 10-15 cm	1.5 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
4	Col. 2, 15-20 cm	0.7 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
5	Col. 2, 20-25 cm	1.5 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
6	Col. 2, 25-30 cm	0.7 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
7	Col. 2, 30-35 cm	0.4 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
8	Col. 2, 35-40 cm	0.5 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
9	Col. 2, 40-45 cm	1.3 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
10	Col. 2, 45-50 cm	0.7 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
11	Col. 2, 50-55 cm	1.2 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
12	Col. 2, 55-60 cm	0.6 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
13	Col. 2, 60-65 cm	1.3 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
14	Col. 2, 65-70 cm	1.0 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
15	Col. 2, 70-75 cm	0.4 g	Shell- <i>Mytilus c.</i> (1 pc)	AMS
16	Col. 2, 20-25 cm	125.5 g	Shell- <i>Haliotis r.</i> (1 pc)	Std + C13/12
17	Col. 2, 25-28 cm	57.7 g	Shell- <i>Haliotis r.</i> (1 pc)	Std + C13/12
18	Col. 1, 30-40 cm	25.35	Shell- <i>Mytilus c.</i> (324 pcs)	Std

AMS = Accelerator Mass Spectrometry Technique

Std = Standard Radiometric Technique

Std + C13/12 = Standard Radiometric Technique with C13/12 Stable Isotope Ratio measurement

between 20 and 30 cm, are less likely to be affected by burrowing animals.

The length of time represented by each component could have been extremely limited. While the radiocarbon dates have maximum 2 sigma ranges of A.D. 990-1385 (395 years) and 2475-1675 B.C. (800 years), the intercepts for these two components have narrower ranges of 170 and 515 years for eight and nine radiocarbon dates, respectively. Given the inherent errors of radiocarbon dating, the actual occupation periods of these two components could have been measured in years or decades, rather than generations or centuries.

Multiple-fragment samples may produce inaccurate results. In the area we tested there was no linear relationship between the age and the depth of the mussel fragments (Pearson's $r = 0.168$; decision point for 15 samples = 0.514). This suggests that radiocarbon dates obtained from this portion of the site which rely on multiple-fragment mussel samples will definitely produce inaccurate results. The final sample, obtained from 324 individual pieces of mussel shell, clearly demonstrates this.

Sample selection is important. In this site, and probably many others, dating different species of shell may lead to different results. For example, a misleading picture of the overall age of the site would be obtained by dating only abalone shells from the horizontal

Table 3. Radiocarbon Determinations from CA-MNT-103.

Laboratory No.	Meas. age	Conv. age	Conv. age*	Provenience	Material
Beta-139667	1010	1430	1210	Col. 2, 0-5 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139668	3790	4210	3990	Col. 2, 5-10 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139669	1020	1440	1220	Col. 2, 10-15 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139670	1070	1500	1280	Col. 2, 15-20 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139671	3950	4370	4150	Col. 2, 20-25 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139672	3990	4410	4190	Col. 2, 25-30 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139673	3610	4030	3810	Col. 2, 30-35 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139674	990	1420	1200	Col. 2, 35-40 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139675	3910	4340	4120	Col. 2, 40-45 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139676	3980	4400	4180	Col. 2, 45-50 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139677	3960	4390	4170	Col. 2, 50-55 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139678	3840	4250	4030	Col. 2, 55-60 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139679	1110	1530	1310	Col. 2, 60-65 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139680	1110	1530	1310	Col. 2, 65-70 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139681	3730	4150	3930	Col. 2, 70-75 cm	Shell- <i>Mytilus c.</i> (1 pc)
Beta-139682	920	1380	1160	Col. 2, 20-25 cm	Shell- <i>Haliotis r.</i> (1 pc)
Beta-139683	950	1400	1180	Col. 2, 25-28 cm	Shell- <i>Haliotis r.</i> (1 pc)
Beta-163546	3030	3450	3230	Col. 1, 30-40 cm	Shell- <i>Mytilus c.</i> (324 pcs)

* Adjusted for local reservoir correction using a Delta-R of 225 ± 35 .

layer. That layer associates with the Late Period, but not with the Early Period; the Early Period component is characterized by very few abalone shell fragments. If the experiment is reversed, a reasonably accurate estimate of the temporal periods during which this site was occupied can be obtained by dating only the mussel shell *provided* that a sufficient number of samples is obtained. But, note that the two abalone shells average about 115 years younger than the six Late Period mussel shell dates. It was important to the overall dating strategy to have included samples from this feature.

A large number of samples may be needed to accurately characterize a complex site. To accurately date a site of the kind we find in the Monterey Bay area, it is necessary to use single-shell samples and to

date both the abalone layer (if present) and a representative sample of mussel shells. It is equally important to date a sufficiently large number of samples to characterize the full range of the different components which may be present. There will frequently be gaps between components, so the number of samples needs to be high enough to characterize these as well. The number of dates required to characterize a complex site can't be determined in advance; it can only be determined by obtaining a large enough suite of dates so that you know you have *too many*. The common practice of submitting a few samples to the laboratory and writing up the results as soon as the numbers come back may not be adequate. You may need to submit more samples to figure out what's really going on. And you may need to do this three or four times!

Laboratory No.	C13/12	Conv. age	Intercept with calibration curve	2 sigma calibrated results
Beta-139667	0.2	1210	A.D. 1215	A.D. 1070-1290
Beta-139668	0.7	3990	B.C. 2025	B.C. 2225-1865
Beta-139669	0.7	1220	A.D. 1205	A.D. 1050-1295
Beta-139670	0.9	1280	A.D. 1125	A.D. 1015-1260
Beta-139671	0.3	4150	B.C. 2270	B.C. 2455-2050
Beta-139672	0.5	4190	B.C. 2315	B.C. 2455-2180
Beta-139673	0.4	3810	B.C. 1800, 1790, 1785	B.C. 1925-1675
Beta-139674	0.8	1200	A.D. 1220	A.D. 1080-1295
Beta-139675	0.8	4120	B.C. 2205	B.C. 2400-2035
Beta-139676	0.2	4180	B.C. 2300	B.C. 2475-2120
Beta-139677	0.9	4170	B.C. 2290	B.C. 2445-2140
Beta-139678	-0.2	4030	B.C. 2110	B.C. 2225-1950
Beta-139679	0.3	1310	A.D. 1070	A.D. 990-1230
Beta-139680	0.2	1310	A.D. 1070	A.D. 990-1230
Beta-139681	0.5	3930	B.C. 1950	B.C. 2140-1760
Beta-139682	2.8	1160	A.D. 1260	A.D. 1065-1385
Beta-139683	2.4	1180	A.D. 1240	A.D. 1050-1335
Beta-163546	--	3230	B.C. 1090	B.C. 1200-990

Intrasite variation. Not all parts of a site will date to the same time period or periods. Our results from this small portion of CA-MNT-103 may not apply to other portions of the site. Only additional dating can clarify that question. Intrasite variation is one of the least studied and least understood problems still facing radiocarbon dating in Central California.

Questions

Even with 17 radiocarbon samples we cannot guarantee to have established the full temporal range of even this one area of the site. For example, we have only two samples of abalone shell. Would dating of abalone shells from the lower areas of the midden identify the Early Period component? Would the resulting dates have agreed with the mussel shell dates?

Example 2: CA-MNT-234, Hidden Data at Moss Landing

This large site in Moss Landing, just north of the Monterey Peninsula, is one of the best-dated sites in California. During two major projects, a total of 63 radiocarbon dates were obtained (Breschini and Haversat 1995a; Milliken et al. 1999). Subsequently, three additional radiocarbon dates were obtained on single pieces of marine mammal bone from the Breschini and Haversat project (Rob Burton, personal communication 2002). We have recalibrated these samples using the Radiocarbon Calibration Program CALIB, rev. 4.3 by M. Stuiver and P. J. Reimer, using the 1998 calibration curve for marine organisms. Of these 66 dates, unfortunately, only 32 dates are on single-piece samples; the remaining 34 samples are on bulk soil, bulk shell, and unspecified "charred material."

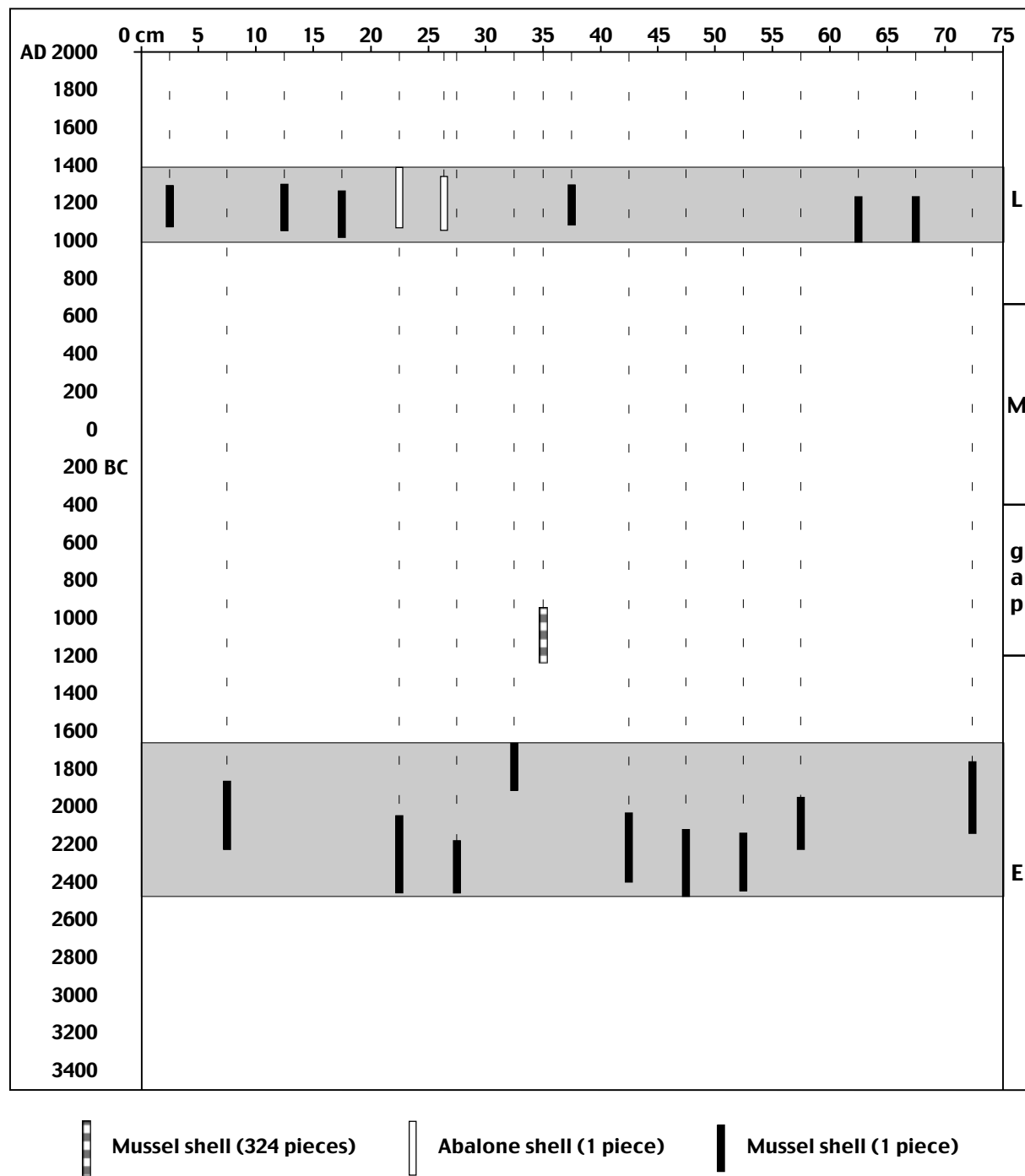


Fig. 8. Radiocarbon dates from CA-MNT-103. Dates are graphed by calibrated age and depth. Black vertical bars summarize the calibrated range for each sample (2 sigma) while horizontal gray bars summarize the two periods of occupation documented for this portion of the site. The “early,” “middle,” and “late” radiocarbon date ranges, as well as the “gap” identified in this paper, are shown along the right side.

Fig. 9a shows all 66 of these radiocarbon dates. They form a nice, generally smooth line on the chart, suggesting a nearly continuous occupation of almost 10000 years (calibrated age B.P.). The only gaps are a substantial one between 8400 and 9600 B.P. and a small one between 2300 and 2750 B.P.

But if you leave out the bulk soil samples, multiple-shell samples, and miscellaneous charred material (34 samples—over half of the database!), you may actually see an improved picture of prehistoric habitation at this site (Fig. 9b). Notice the nearly three thousand year gap—during which the site was possibly abandoned—between 4000 and 6800 years B.P., and the smaller one thousand year gap between about 2300 and 3300 B.P., and the eight hundred year gap between 6700 and 7000 B.P., and the over six hundred year gap between about 950 and 1600 B.P. These gaps could represent periods of site abandonment, which in turn could provide significant data on prehistoric changes in the Elkhorn Slough/Salinas River habitat and/or major changes in subsistence-settlement strategies. They could also be artifacts of the radiocarbon sampling strategy—only a significant number of additional high quality dates could allow us to make this determination.

The important point here is that the inclusion of multiple-shell and bulk soil samples produced low quality dates which significantly clouded the picture of prehistoric occupation at this important site—half of our radiocarbon database for this site may have to be discarded! But narrowing the database to single-piece samples may lead to important additional research questions, or to important conclusions about the settlement-subsistence strategies at this site.

Lessons

It was shown at CA-MNT-103, and again at CA-MNT-234 that multiple-shell and bulk soil samples mix a lot of individual things together. Dating “many old

things” may be no more accurate than dating “any old thing.” In many types of sites, this intermixing may obscure significant data, or even worse, produce erroneous data.

Questions

The three marine mammal bone samples (the dots just slightly older than 2000 years in Fig. 9b) were calibrated using the marine dataset, and group together in close proximity to four calibrated shell dates. Are these three dates really a part of this group, or was marine mammal exploitation conducted slightly earlier in time in place of shellfish gathering? Would additional dates on marine mammal bone cluster into the groups of shell dates, or would they fall in between those groups?

Example 3: CA-MNT-437, A Disturbed Site in the Carmel Highlands

Radiocarbon dates from CA-MNT-437, in the Carmel Highlands south of Carmel, illustrate two of the potential sampling problems of which archaeologists should be aware.

The first investigations conducted at CA-MNT-437, by Werner (1988) included both post-hole excavations and subsequent monitoring. Werner (1988:7) correctly points out, “it is likely that C-14 samples from CA-MNT-437 shell samples would be useful in placing the site temporally,” and he obtained two radiocarbon dates from one area of the deposit. However, the results obtained from these samples are problematical for two reasons: first, the vertical provenience of the samples is uncertain (the proveniences were given as “Posthole 2: 0-60 cm” and “Posthole 4: 0-90 cm”) and second, there is no information on which shellfish species were used, or the number of separate fragments comprising each sample. The results are illustrated in the two left columns of Fig. 10.

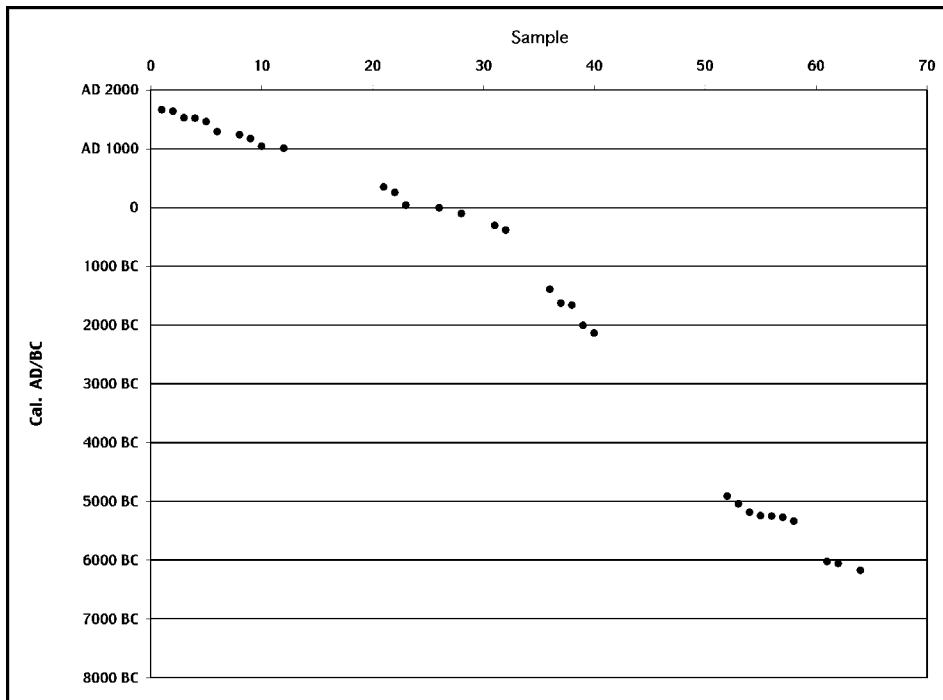
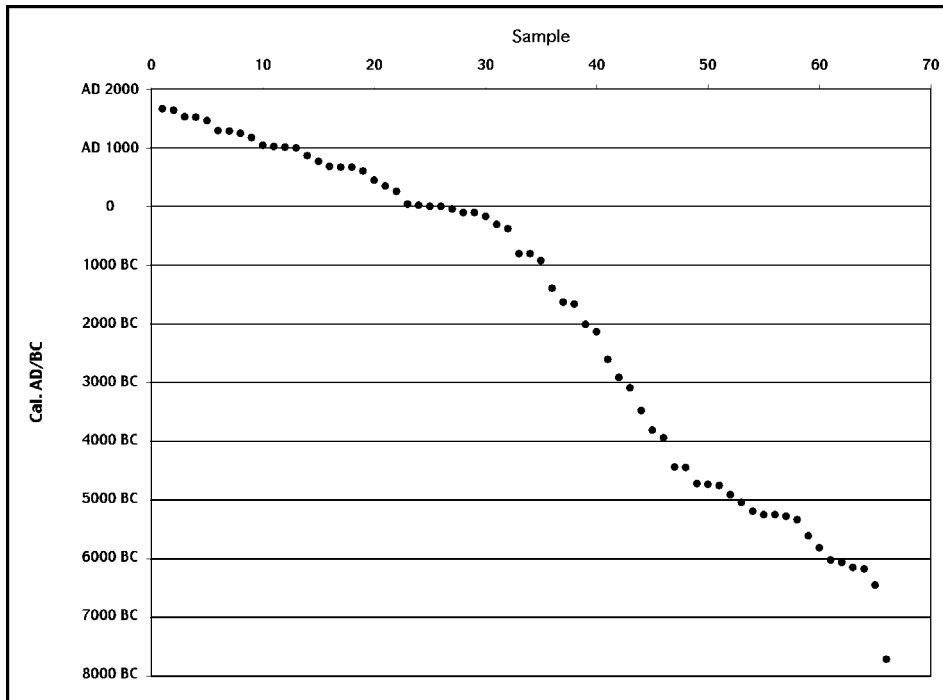


Fig 9. Radiocarbon dates from CA-MNT-234. The upper chart (Fig. 9a) includes all dates, while the lower graph (Fig. 9b) includes only single-piece samples.

The second investigation, completed by the authors, involved the excavation of two units and subsequent monitoring (Breschini and Haversat 1991). Only extremely small quantities of shell, vertebrate faunal remains, and lithics were recovered during excavation. Two shell specimens were retrieved for radiocarbon dating. Based on the mixed nature of the stratigraphy and the presence of historic debris in all levels, it was concluded that the project area had been extensively disturbed (Breschini and Haversat 1991:7). Two additional shell samples, also from probably disturbed contexts, were recovered during monitoring and submitted for dating, bringing the total number of radiocarbon dates for this project to four, three *Haliotis* and one *Mytilus* (all samples consisted of single pieces of shell).

A third subsurface investigation took place in 2001. It included mitigation excavations conducted by Far Western, Inc. (Ruby and Hildebrandt 2003). The project obtained six additional radiocarbon dates, three on *Mytilus* and three on *Haliotis* (all samples consisted of single pieces of shell). At least four of these samples appear to have come from disturbed contexts.

Finally, we conducted monitoring of an underground cable installation as part of this third project. To offset the damage to the site caused by the project, we obtained five additional radiocarbon dates during monitoring. Two were on *Haliotis* (including one sample of *Haliotis fulgens*, the green abalone), and three were on *Mytilus*. Again, all of these samples consisted of single pieces of shell, and most or all were probably from disturbed contexts. This brought the total number of radiocarbon dates for CA-MNT-437 to 17, with eight being obtained from *Haliotis*, seven from *Mytilus*, and two from an unknown mixture of shells. These dates are illustrated in Fig. 10.

The results of the single-shell samples, even though from disturbed contexts, appear generally consistent and provide seemingly believable information about

the dating of what most likely are two components. Of the single-shell samples, only the *Haliotis fulgens* specimen produced an anomalous date. One of Werner's mixed shell samples fits into the pattern established by the single-shell samples, while the other does not.

The most interesting information to come from these radiocarbon dates, however, is that the age of this site as established by a test excavation may depend not so much on the context of the samples (most were disturbed) but on *which shellfish species you choose for your samples!* As shown by Fig. 10, the *Mytilus* shell dates provide a reasonably good idea of the overall age of the deposit, identifying what appear to be two components, but the *Haliotis* shell dates completely miss the Middle Period component.

Lessons

In the investigations conducted at CA-MNT-437, abalone shells date only the upper component, but miss the Middle Period component. Mussel shells provided dates on two components. The disturbed nature of the samples appears not to have been a factor in obtaining believably consistent results, but only a significantly larger number of samples would allow this determination to be made with certainty.

Questions

Would more *Haliotis* samples identify the Middle Period component? Would more samples, or samples on a different shellfish species, identify still more components? Were enough samples obtained to accurately assess the temporal ranges of the components that were identified?

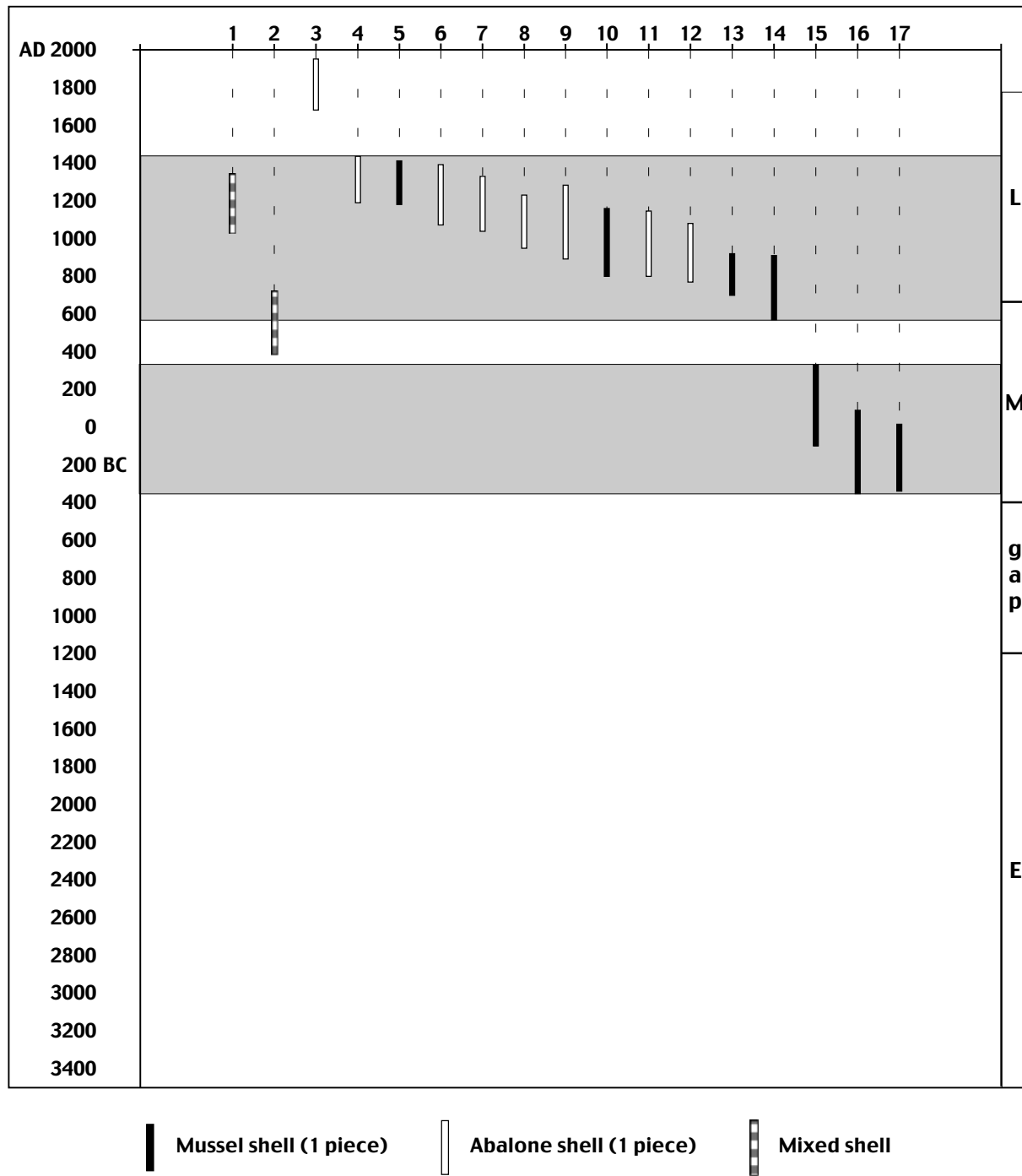


Fig. 10. Radiocarbon dates from CA-MNT-437. Dates are graphed by calibrated age.

Example 4: CA-MNT-820, More Data from the Carmel Highlands

Initial testing at CA-MNT-820, situated in the Carmel Highlands about 700 meters north of CA-MNT-437, produced two dates on mixed shell (Cartier 2000a). The proveniences were given as “Column, Unit 1, 60-70 cm” and “Column, Unit 2, 0-20 cm.” We met with Cartier prior to his larger mitigation project and suggested that using single-shell samples, including a mix of both *Mytilus* and *Haliotis*, might produce more reliable results. From that project, he submitted nine single-shell samples of *Haliotis*, and obtained the results shown in Fig. 11 (Cartier 2000b).

Abalone shells identify both a Late and an Early component, whereas the two multiple-shell samples fell generally in the Early/Middle and Middle/Late Transitions, temporal spans within which there are generally few, if any, dates in most local deposits.

Lessons

This is another example where the first two dates on mixed shell provided incomplete, misleading, or false information. Additional dates using single pieces of abalone shell provided what appears to be better information.

Questions

Would mussel shells have provided additional information, perhaps documenting a Middle Period component such as was found at CA-MNT-437, nearby?

Example 5: CA-MNT-149, Stirred but Not Shaken in the Del Monte Forest

CA-MNT-149, mentioned above, produced four radiocarbon dates in the early 1980s (Breschini and Haversat 1986). These grouped within a tight range (Table 1), but the samples consisted of 50+ g samples

of *Mytilus c.* shells (i.e., hundreds of individual pieces). The alternatives for site interpretation ranged from much older and much younger mussel fragments mixed in roughly equal proportions to a deposit which actually occupied a very narrow temporal range, as indicated by the dates.

As a test, we obtained an AMS date on a single shell fragment from near the base of the deposit. The date fell within the range of the previous samples, A.D. 665-798 (Fig. 12). This suggests that, in this case, it is possible that the site did indeed occupy a narrow temporal span, and that it has probably been completely mixed by burrowing rodents or other causes.

However, a single *Olivella* G2a bead was recovered from the CA-MNT-149 deposit, and this provides a second opportunity to estimate the age of the site. In previous investigations in the San Francisco Bay area and in San Luis Obispo County, a total of 14 radiocarbon dates have been obtained on the G2 bead type (Fitzgerald 1998; Mikkelsen et al. 2000; Groza 2002). The age range for these samples is 209 B.C.-A.D. 542. At its closest point, this range is 123 years older than the oldest radiocarbon date for CA-MNT-149. There is thus a discrepancy between the radiocarbon dates obtained from five *Mytilus c.* shell samples at CA-MNT-149 and the range for 14 *Olivella* G2 beads obtained from regional contexts. It is likely that additional samples could clarify this.

Lessons

In sites with a very narrow temporal range, mixed shell samples may return representative results. But, it is probably safer not to bet the rent money on it.

Questions

Are the four original dates from CA-MNT-149 seriously compromised by intermixing, and did the fifth date just happen to fall within that range? Is the

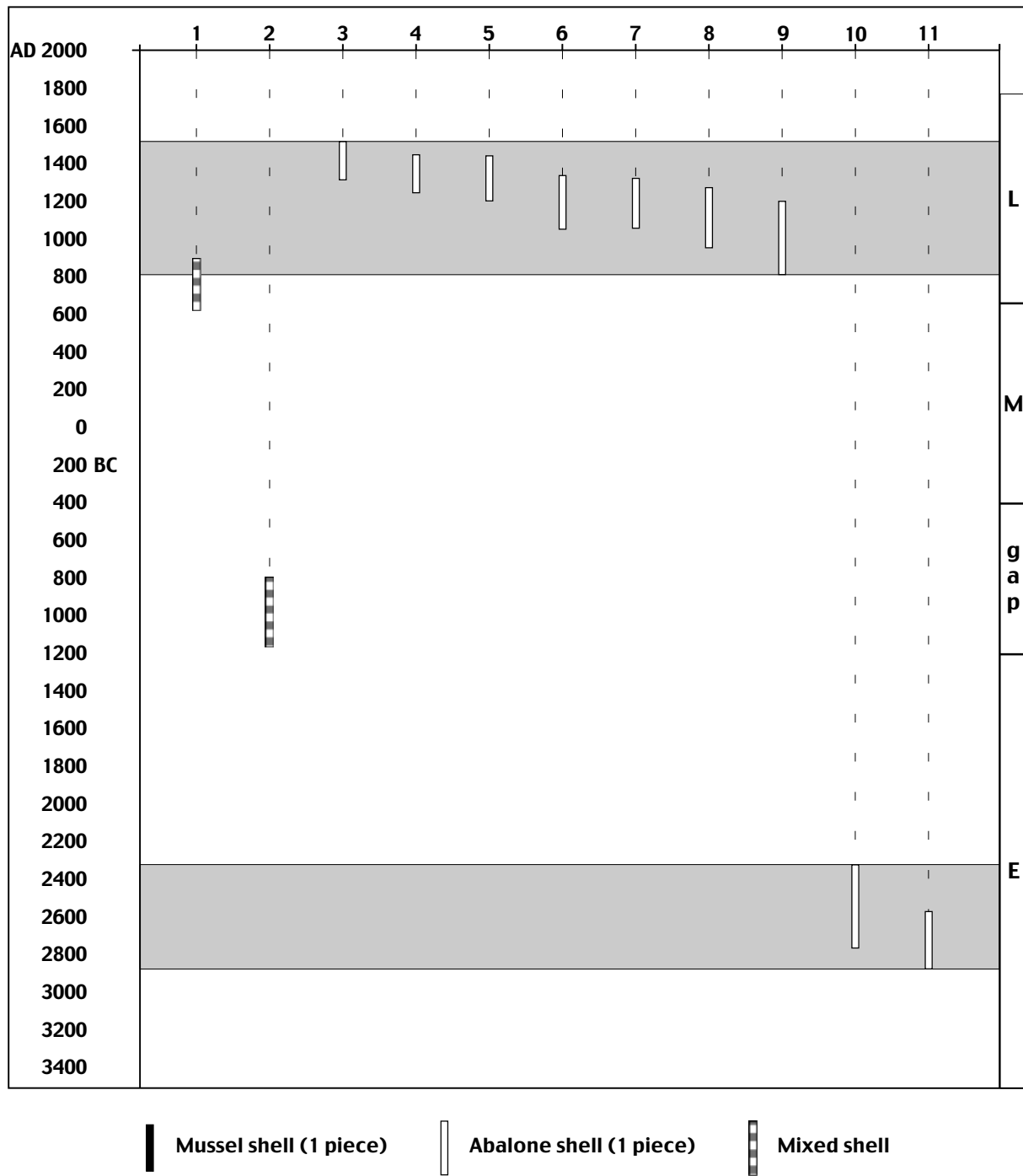


Fig. 11. Radiocarbon dates from CA-MNT-820. Dates are graphed by calibrated age.

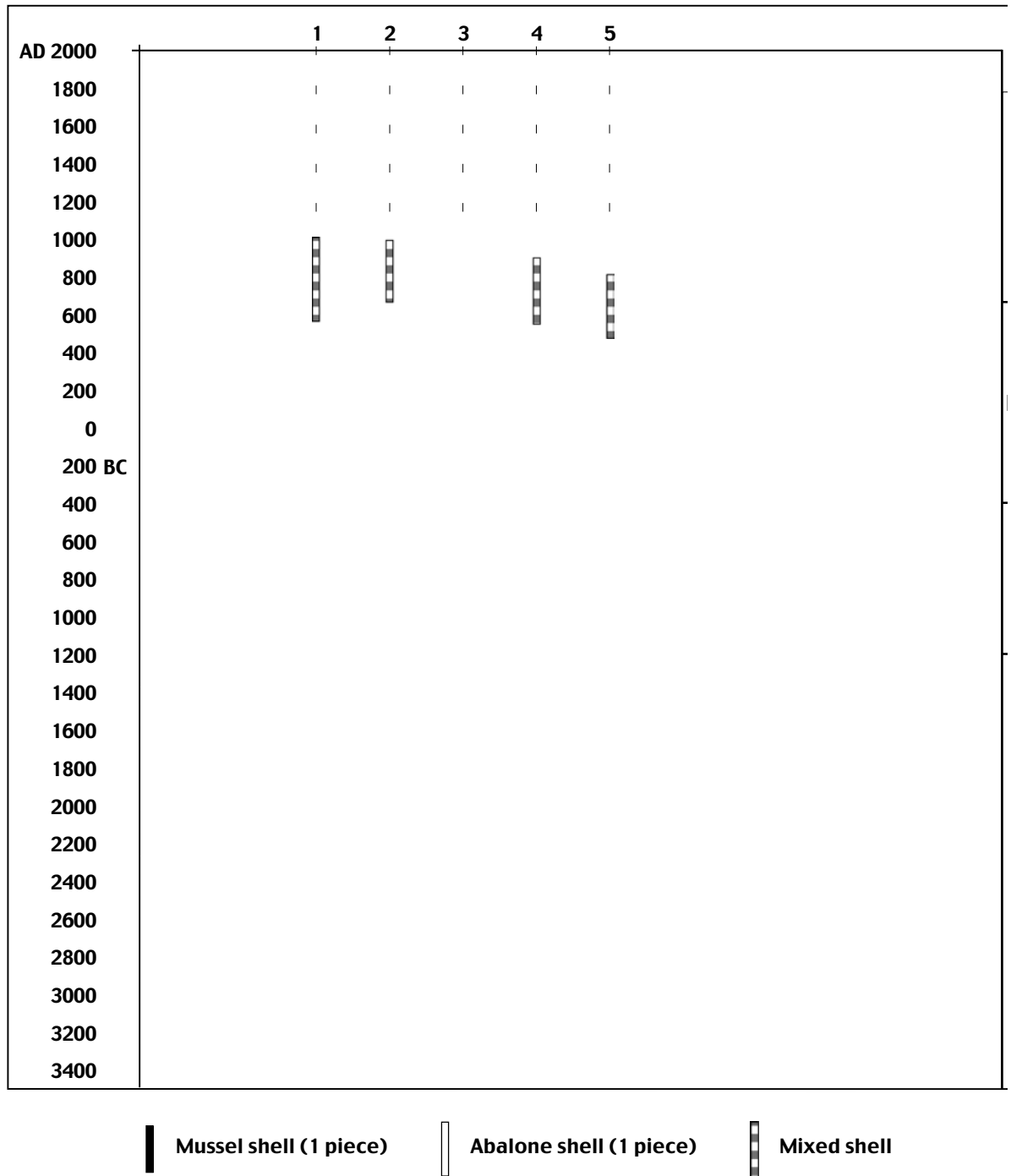


Fig. 12. Radiocarbon dates from CA-MNT-149. Dates are graphed by calibrated age.

age established for the *Olivella* G2 bead in the San Francisco Bay area and San Luis Obispo County applicable to Monterey County? Are the five dates from CA-MNT-149 some 123 years younger because of sample intermixing and Murphy's Law? (If someone has a grant, we can date the G2a bead from CA-MNT-149 and find out.)

Example 6: CA-MNT-1612, a Complex Puzzle in Pacific Grove

This site perhaps typifies the problems we face in the Monterey Peninsula better than any other: we have radiocarbon dates and other information from

at least seven projects conducted between 1977 and the present (Fig. 13). We recorded CA-MNT-1612 in 1992, but did not have a good estimate of its true size until 1999.

The initial investigation in this area was Dietz and Jackson's 1977 sewer line project. In 1977 they examined sites CA-MNT-116 (subsequently renumbered CA-MNT-113D) and CA-MNT-117 and obtained seven radiocarbon dates from three separate areas, all on single pieces of *Haliotis*. Subsequent investigations are as follows:

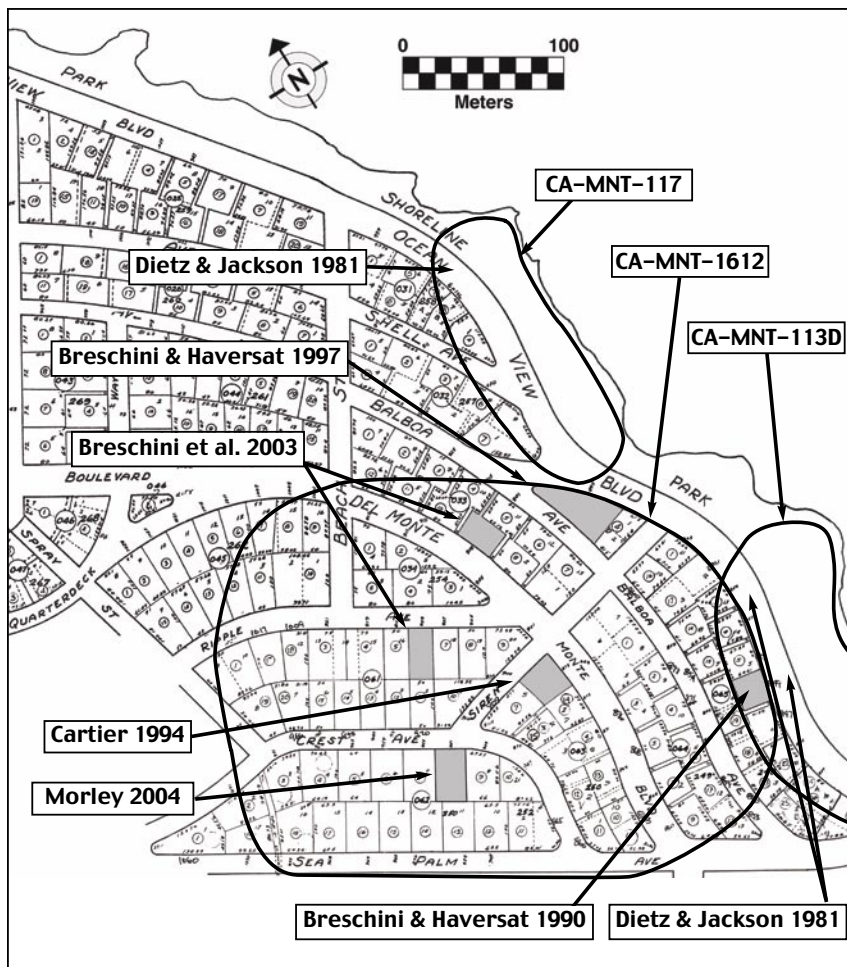


Fig. 13. Projects in and around CA-MNT-1612, Pacific Grove.

- In 1990 we reported on a very small test in the area thought to be CA-MNT-116 (subsequently renumbered CA-MNT-113D), which appears now to be a part of CA-MNT-1612. We obtained a single radiocarbon date on mixed mussel shell.
- Cartier's (1994) investigation obtained two radiocarbon dates, both on mixed shell samples.
- Subsequently, we placed a single unit at the southern edge of CA-MNT-117 (an area now included within CA-MNT-1612) and obtained two single-shell radiocarbon dates, one on *Haliotis* and one on *Mytilus* (Breschini and Haversat 1997).
- In 2003 we reported the results of two very small foundation projects (Fig. 14), and included in the report both Cartier's 1994 data and our 1997 data from CA-MNT-117, by then included within CA-MNT-1612. We obtained four radiocarbon dates, two for each project, on single pieces of *Haliotis* and *Mytilus* shell, as well as a date on an *Olivella* Type L2a bead (Fig. 23c). (Several of the photographs of materials from this project were used to illustrate the cover for the 2004 reprint of Moratto's classic *California Archaeology*.)
- Finally, Morley (2004) examined another small section of the site for a demolition/rebuild project. Following our suggestion, she obtained two dates on single pieces of *Haliotis* and *Mytilus* shell.

In all, there are now 18 radiocarbon dates from CA-MNT-1612 and the immediately adjacent sites CA-MNT-113D and CA-MNT-117 (Fig. 15). However, the degree to which these occupation and use areas can be neatly circumscribed by lines on a map and treated as discrete sites is unclear. Prehistoric peoples appear to have used this entire area during parts or all of the past 4000 years. CA-MNT-1612, for example, has produced eight radiocarbon dates attributable to the Late Period and six attributable to the Early Period. A recently obtained date (generally confirmed by the presence of an *Olivella* G2a bead: see the discussion below) now suggests Middle Period use as well.

Drawing firm site boundaries around these sites implies an accuracy which may not be present. This is the reason CA-MNT-1612 has been expanded to include portions of two adjacent sites, and four previously recorded sites (CA-MNT-113, -114, -115, and -116) have been combined into one site with separate activity foci (CA-MNT-113A through D) (Fig. 16). That site has the same approximate date range as CA-MNT-1612, but the Middle Period component (CA-MNT-113B and -113C) is much more distinct.

Lessons

Because this area is so complex, and the property ownership is so diverse, it is unlikely that any single project will be able to provide a huge amount of data. However, the data which has come from this site suggests that it was one of the more important occupation and use areas on the Monterey Peninsula. Accordingly, it is incumbent upon each small project to make some contribution, and for archaeologists to try to pull together the data from time to time in order to make some meaning of it. Even individual monitoring projects within sites such as this should obtain one or more radiocarbon dates at the very least.

Questions

Just how complex are CA-MNT-1612 and the immediately adjacent sites? How many discrete use areas, often dating to different time periods are there? How intermixed are these use areas?

Example 7: CA-MNT-17, No Data from Carmel

Some archaeologists, for one reason or another, seem reluctant to obtain radiocarbon dates on shells or shell fragments obtained during monitoring. A recent example from CA-MNT-17 stands out.

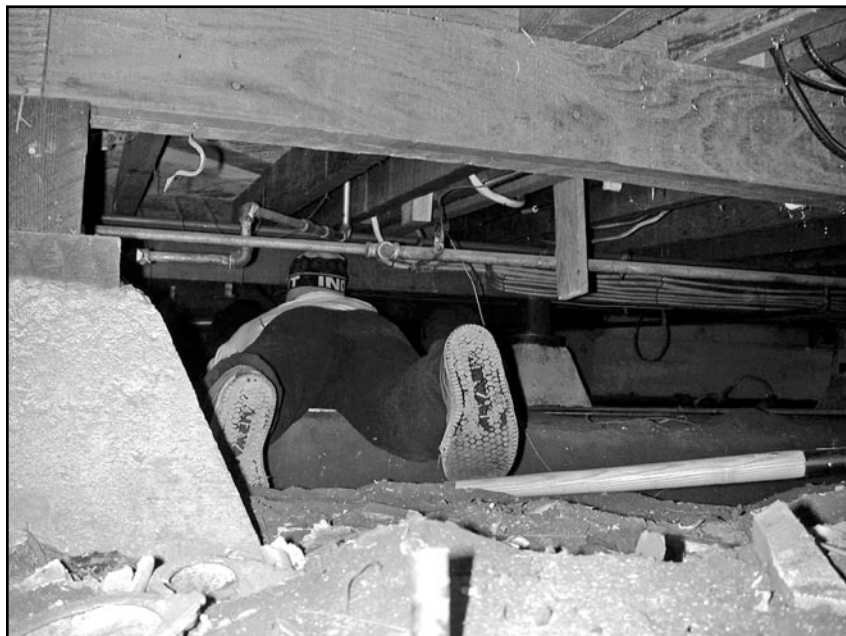


Fig. 14. Working conditions at one of the CA-MNT-1612 projects.

Permit condition (9.D) for the project read, in part:

A large sampling of shell suitable for radiocarbon dating and any archaeological features exposed during project excavations shall be subject to archaeological recovery and analysis, which will include, at a minimum, the following:

1. At least 10-12 radiocarbon dates, 5-6 standard and 5-6 AMS, shall be obtained from suitable shell samples.

In the compliance report, Busby wrote:

...no samples suitable for standard and AMS radiocarbon dating were present. This was primarily due to the prior disturbance from previous residential construction, introduced landscaping, etc., and the lack of archaeological features amenable to radiocarbon dating [2003:2].

And in the attached Monitoring Closure Report, Busby wrote:

Permit conditions required the acquisition of 10-12 suitable shell samples for standard and AMS radiocarbon dating. These shell samples were to be obtained from areas that not previously disturbed or impacted by previous construction. Standard sample collection and documentation procedures were to be followed (Note: See Footnote 1) [2003:3].

Footnote 1, in turn, reads:

For example, suitable samples mean the acquisition of shell samples from areas that appear, in Basin Research Associates' professional judgment, not to have been disturbed or impacted by previous activities on the parcel (i.e., has integrity, has not been contaminated by sediment mixing). "Undisturbed" midden at the project was inspected by the Principal Investigator to determine for suitability and dating [2003:2].

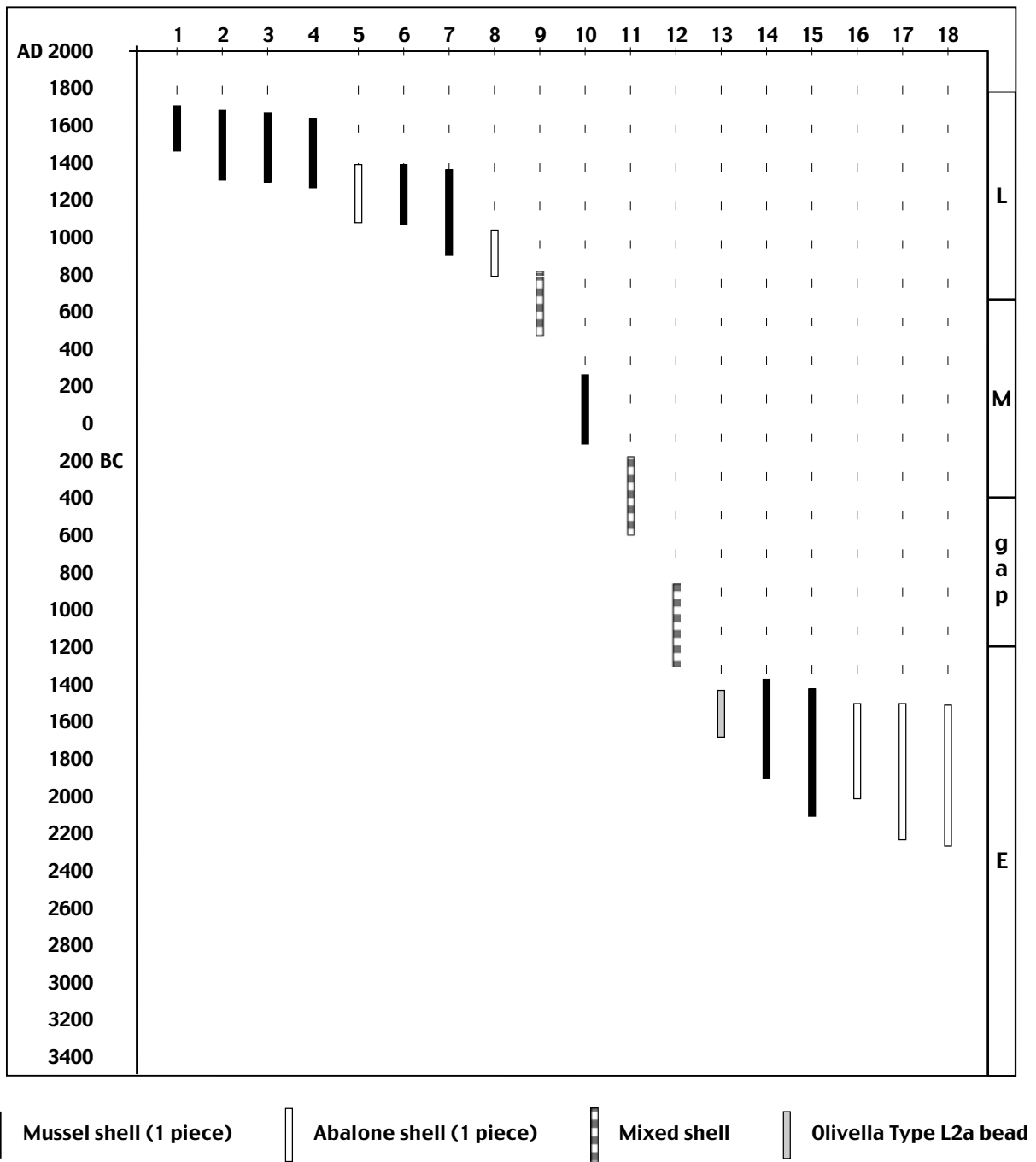


Fig.15. Radiocarbon dates from CA-MNT-1612 and adjacent sites CA-MNT-117 and CA-MNT-113D. Dates are graphed by calibrated age.

Lessons

This type of approach will almost certainly assure that no radiocarbon samples will be obtained during monitoring projects, even though the permit conditions may require that they be obtained. It will also prevent the type of gradual data acquisition which has been shown to be successful at CA-MNT-1612. The two sites are very similar in that they have both been developed for many years, and are now undergoing gradual, house-by-house improvements.

Question

Is this approach, which gives no “benefit of the doubt” to disturbed materials, appropriate for such a project area?

Discussion

The examples above have documented that significant information can be gathered from radiocarbon dates obtained during monitoring, even from isolated, “disturbed” shell fragments.

We know from the investigation at CA-MNT-103 that most, if not all, coastal sites on the Monterey Peninsula have been subjected to severe bioturbation. It is likely that a significant percentage of small midden constituents, and some of the larger midden constituents, have been relocated within the deposits. However, a single piece of shell constitutes an accurate representation of a single event—an individual gathering shellfish at the coast and transporting it to an inland location, whether it be a gathering site or a village. It follows, then, that dating a single piece of shell, large or small, dates a specific cultural event. Now, it may be argued that



Fig. 16. Pacific Grove, looking northwest from the area of CA-MNT-112 toward CA-MNT-1612 and adjacent sites CA-MNT-117 (right side of the picture) and CA-MNT-113D (left side of the picture). CA-MNT-1612 is situated on the hill.

such a shell is not in context, it has been disturbed by construction or some other historic influence. But the fact remains—it dates a specific trip to the coast by a specific individual, who brought a specific shellfish back to the site and, as such, it provides valuable cultural information. To claim, as some still do, that such shellfish remains are “disturbed” and do not constitute “cultural materials” is to argue against a preponderance of evidence to the contrary.

The information gathered through these small projects is not an end in itself, even though its acquisition fulfills some of the requirements of state law. Rather, this information is valuable for what it can tell us about past peoples. Some applications of this information are discussed in a subsequent section.

The Radiocarbon Database for the Monterey Peninsula

As has been shown by Example 2, at CA-MNT-234, the first step in using radiocarbon dates must be to gather all the dates possible, then eliminate samples that are believed to be inaccurate. We have demonstrated how the bulk soil and bulk shell samples in that example obscured important data.

We have been gathering radiocarbon dates from Monterey County and other areas of California for 25 years, and have published the accumulating dates in eight editions of *California Radiocarbon Dates* (e.g., Breschini, Haversat and Erlandson 1996). More recently we have placed approximately 5,662 radiocarbon dates on line via the website www.california-prehistory.com.

Our current database for Monterey County includes 746 radiocarbon dates. It is likely that additional samples have been obtained within this area of which we are unaware, as there is no easy way to learn who has been conducting projects in which areas, and what

their results are. We gather all the reports we can, but we are sure to have missed some dates.

Of these radiocarbon dates, 390 are either recently calibrated or suitable for recalibration and are believed to be single-shell samples from the greater Monterey Peninsula (the area stretching from Moss Landing through the Carmel Highlands and including the adjacent inland valleys). Three additional samples from CA-MNT-234 are single pieces of marine mammal bone.

A number of other samples have been excluded either because they are from sites outside of the greater Monterey Peninsula area or because we have been unable to obtain information on the precise materials used, either from the report or from the archaeologist who conducted the project. For consistency, we have also excluded 59 dates obtained from charcoal or charred material (45 of these are from outside the Monterey Peninsula, and the remaining 14 fit within the ranges established by the shell dates).

Based on the Moss Landing example, we believe it is safer to discard questionable radiocarbon dates than to take a chance on including erroneous and misleading data. For example, at CA-MNT-391, 16 samples obtained by Cartier (1993a:20) are listed as being obtained from “Shell-*Haliotis*” but the number of pieces is not specified. The text provides information that at least six of these were obtained from single pieces of shell, so these have been included in the database. We have been unable to identify the number of pieces used in the other ten dates in spite of at least three requests for additional information. As such, these ten samples have been omitted from the database as potentially unreliable even though they include the oldest and youngest dates from the site.

All shell samples not recently calibrated by Beta Analytic have been recalibrated using CALIB, rev. 4.3, with the 1998 marine dataset. When the C13 is

unknown, we assume a value of +2.1 ‰ for *Haliotis* samples and +0.5 ‰ for *Mytilus* samples. These figures are based on 49 measurements for *Haliotis* (actual average = 2.055) and 62 measurements for *Mytilus* (actual average = .4871). The three marine mammal bones from CA-MNT-234, all identified as fur seal, have been similarly recalibrated using the Marine dataset.

The Marine dataset calibration incorporates a global ocean reservoir correction. Local effects (that is, the difference—Delta-R—between local reservoir age and the global ocean reservoir) are assumed to be 225 ± 35 for several reasons. First, this is the figure used by Beta Analytic to calibrate their local marine samples, and most samples have been calibrated using this figure. Secondly, a recent test of the Delta-R which we performed at CA-MNT-1935 (Breschini and Haversat 2003) placed dates on *Mytilus*, *Haliotis*, and charcoal from a single late feature within a 30 year span using this Delta-R. In actuality, the two shell dates averaged 20 years older than the single charcoal date, suggesting that a Delta-R of 225 ± 35 may be slightly low, but these figures are so close that they are statistically indistinguishable. Finally, Ingram and Southon (1996) dated two specimens of *Mytilus c.* of known ages from the Monterey Peninsula. The first, from Pt. Pinos, at the northern tip of the Monterey Peninsula, suggested a Delta-R of 255 ± 50 . The second, from Carmel Bay, suggested a Delta-R of 225 ± 50 .

In spite of lingering questions over which samples to include or exclude, and which Delta-R to use, we believe we have assembled the most accurate database currently available for the Monterey Peninsula. To supplement the existing dates, we have been strongly emphasizing radiocarbon dating in our small monitoring projects, and are currently adding as many as 50 reliable dates per year.

Radiocarbon Dating and Cultural Models

In the previous section we made extensive use of the terms Early, Middle, and Late period without providing a definition for them. This section will examine what can be called the “Early/Middle/Late” Period/Horizon model, along with other models, with particular reference to radiocarbon dates and other significant data within the greater Monterey Peninsula area.

But first, before we *impose* any interpretations on the database, let's see what the database might be trying to tell us.

Fig. 17 depicts 377 of the 390 dates which we believe to be reliable for the greater Monterey Peninsula area (the 13 Moss Landing dates older than 4000 B.C. are excluded). The intercept for each date is represented by a horizontal line, and a vertical line representing an arbitrary range of 50 years has been added above and below the intercept. In a few cases, adjacent or closely related sites have been grouped. For example, the 12 Rancho San Carlos sites which have been dated appear very tightly interrelated, and these sites have been grouped together.

One caution at this point: as we use this database we must consider to what degree sampling bias still exists within the data. Although we have eliminated dates on multiple specimens, there are other forms of sampling bias to guard against. We have seen that selection of different shellfish species may play a significant part in establishing the ages of certain site components. Also, while a few sites have a large number of dates, most sites in the Monterey Peninsula area cannot be considered to be adequately dated. Small components can easily be missed with three, five, or even larger numbers of dates. For example, the possible Middle Period component reported by Morley (2004) at the CA-MNT-1612 complex was not evident in the first 15 radiocarbon samples obtained from that area. The 68 dated sites in the “reliable” database average fewer

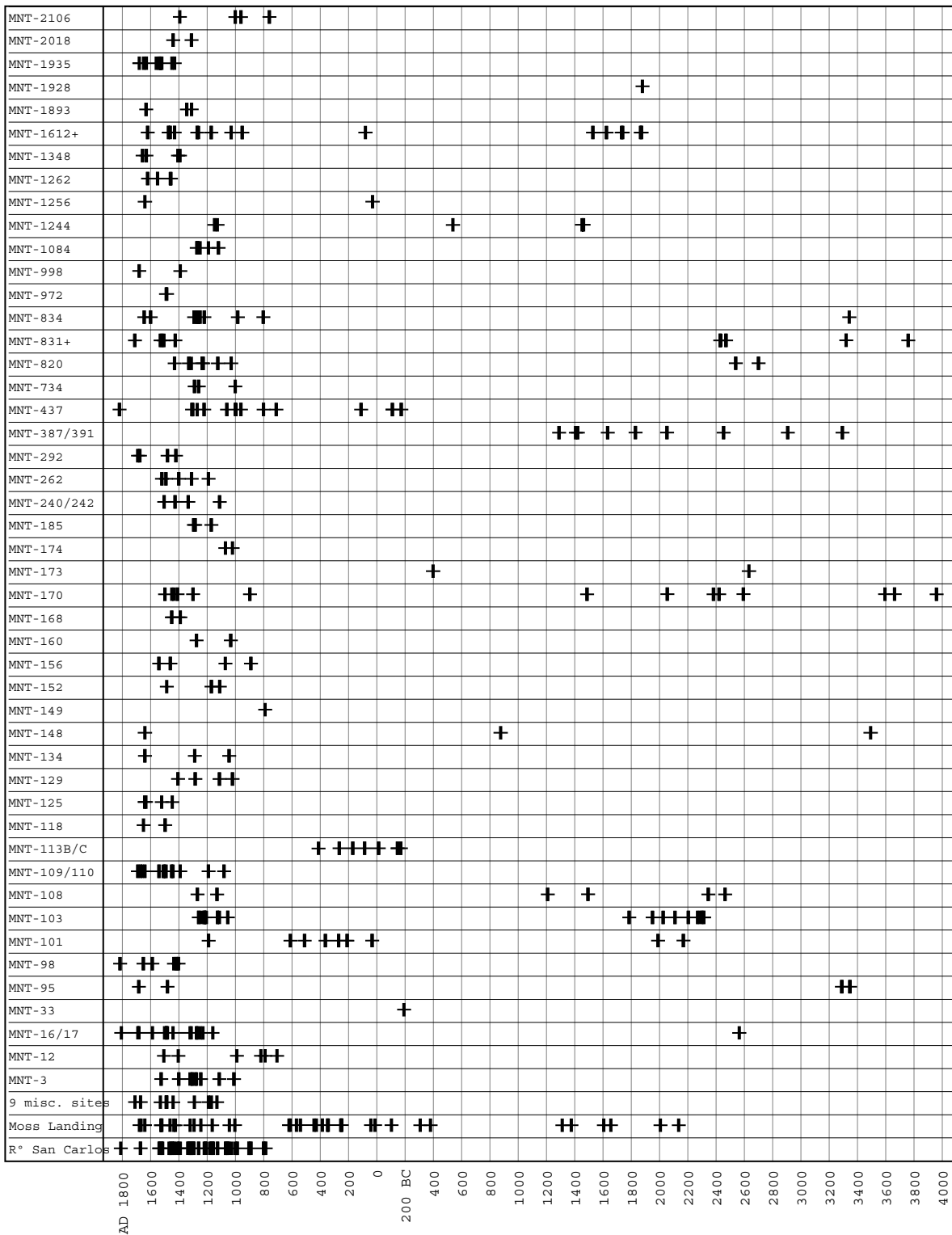


Fig. 17. Radiocarbon dates for the greater Monterey Bay area. Some closely related sites are grouped, and older dates from Moss Landing are omitted.

than six samples each, and nearly a third are represented by a single date.

Finally, the questionable and multiple-shell dates which have been eliminated from this database have to be periodically reexamined, along with other data from the respective sites, to see if they can provide additional clues. For example, the four youngest dates at CA-MNT-391 have been eliminated as potentially unreliable because we cannot obtain information on how many pieces of abalone shell were used for the samples. These dates, ranging from 850-100 B.C., if accurate, would extend across portions of the 1200-400 B.C. “gap” discussed below and into the “middle” range. If they represent a mixture of shell fragments, then they may represent a “late” or Late Period component at the site (this is actually supported by obsidian hydration data and the presence of a single *Olivella* G1 bead). The problem is, we don’t know exactly what they represent because the original report does not specify what was dated.

One of the first patterns that stands out in Fig. 17 is that many sites exhibit reasonably tight clusters of dates. Another noticeable pattern is that the clusters formed by the “late” sites (that is, during the last 1100 years) do not extend earlier than about A.D. 660. Likewise, the clusters formed by the few “middle” sites do not extend later than about A.D. 660 (all of these “middle” sites, in fact, appear to have been abandoned for several hundred years before being reoccupied). In other words, no site yet dated appears to span from “middle” to “late” across A.D. 660. This is the area of the figure which has the largest number of dates, so the presence of a distinct gap appears at this point to be inherent in the data.

There is another area of the figure which stands out. There is an 800 year gap between about 1200 B.C. and 400 B.C. which contains only two dates (from CA-MNT-148 and CA-MNT-1244). We do not see

any way to explain this gap by sampling error or bias alone.

The older end of the figure has relatively fewer dates, so any conclusions will be less reliable. There does, however, appear to be a pattern in that the “early” dates appear to be reasonably continuous between about 1200 B.C. and 2700 B.C. It is possible that the “early” pattern of dates extends another 1200 or so years, reaching nearly 4000 B.C., but this time period has relatively few dated samples. No dates earlier than 4000 B.C. have yet been obtained on the Monterey Peninsula, but at least 13 earlier dates, extending to about 6100 B.C., are available for the Moss Landing area.

The initial look at the database reveals “early,” “middle,” and “late” clusters of dates on the Monterey Peninsula. Do these correspond with the “Early,” “Middle,” and “Late” model commonly used by Central California archaeologists?

What Are the Data Trying To Tell Us?

The traditional Early/Middle/Late model relies heavily on artifacts for the definition of its cultural periods. This is illustrated by the table of cultural periods presented by Jones et al. (1996:42), which includes as primary indicators obsidian hydration (of artifacts and debitage), bead types, projectile points, and ground stone. However, the Monterey Peninsula is unusually short on formal artifacts. To see just how many different artifacts we are missing, consult the essays of Bennyhoff and Fredrickson (Hughes 1994), and particularly their Figs. 6.1 through 6.3.

Perhaps a model which relies less on artifacts, which are locally scarce, and more on dated site components and anthropological data would better characterize the area’s prehistory.

Actually, such a model has already been proposed. We proposed this in the early 1980s (e.g., Breschini 1981, 1983; Breschini and Haversat 1982, 1985a, 1985b; Haversat and Breschini 1984). The general tenets of this model, involving prehistoric population movements, are summarized in Fig. 18. This model was also explored independently by Moratto (1984: Fig. 6.16, 529-574) (see Fig. 19). In actuality, both iterations of this closely related model were developed in the 1970s, and embraced, in part, Gerow's (1968) University Village report as well as linguistic and other data published as early as the first decades of the 20th century.

This model interprets the culture history of Central California in terms of population movements, and is based on archaeological data, linguistics, and physical anthropology, rather than just changing populations of artifacts. As such, it provides a different, but equally legitimate, view of the prehistory of the Monterey Peninsula.

Moratto perhaps summarizes this model most succinctly:

Data... indicate that widespread but relatively sparse populations of hunter-gatherers lived in the Bay and Coast regions before 2000 B.C. The locations of their settlements, in hill country as well as on bay and ocean shores, are marked by earth or sand deposits with significantly less shell than is found in later middens. Shellfish were collected, but this was not a major subsistence activity. Large projectile points and millstones show that both hunting and vegetal processing were important. Semisedentism, a foraging subsistence strategy, and technologic traits assign these early peoples to the Archaic Stage. On the Central Coast, the origins of the Sur Pattern [read "early" period] are seen in these early Archaic manifestations. This pattern apparently extended as well into the San Francisco Bay region. In both regions,

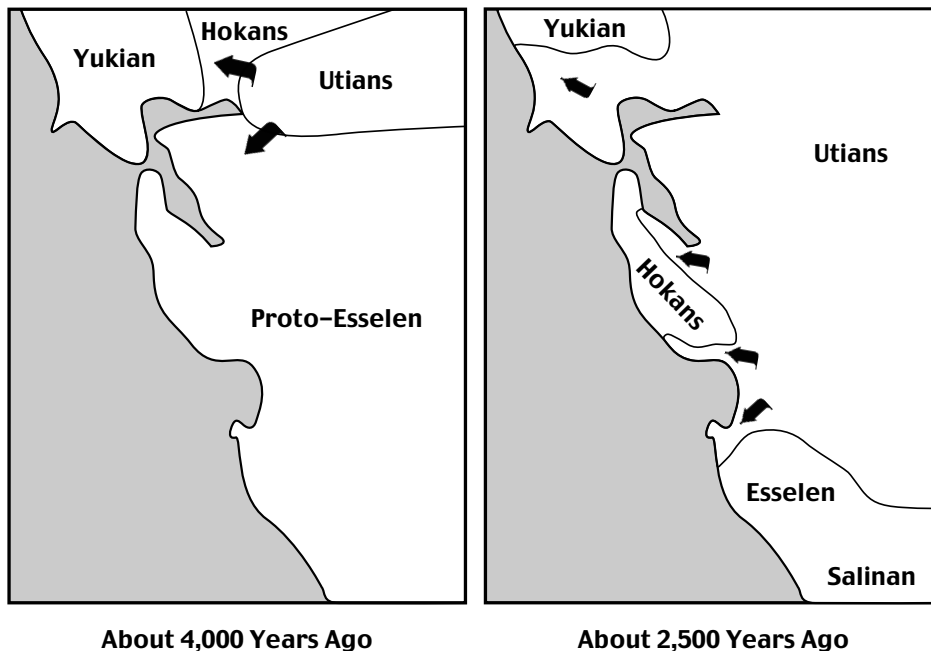


Fig. 18. The Utian radiation in west-central California. Redrawn and slightly modified from Breschini (1981; 1983; Figs. 10 and 11).

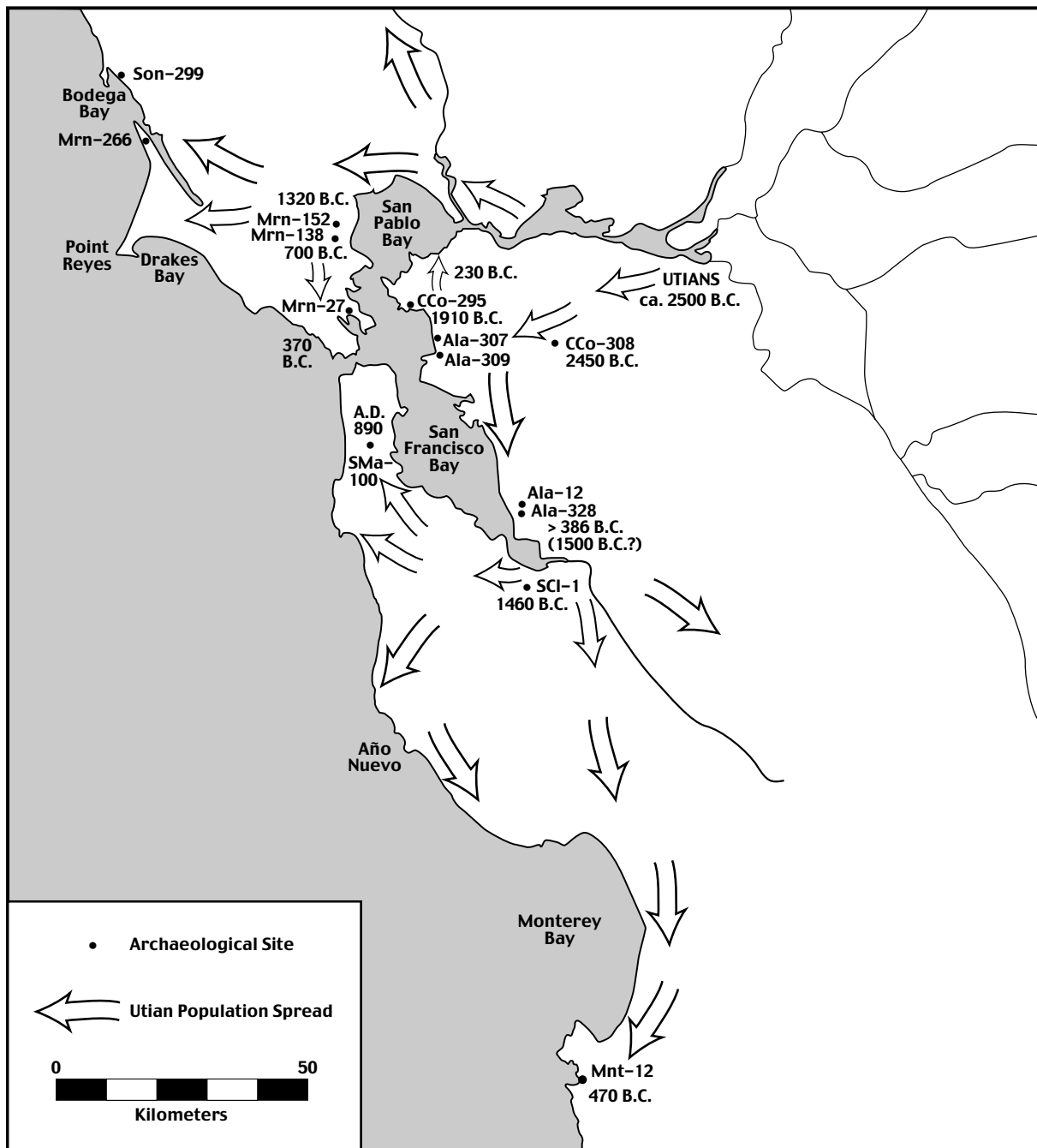


Fig. 19. The Utian radiation in west-central California. Arrows show the directions of Utian spread from the lower Sacramento Valley into the San Francisco Bay and Monterey Bay areas. Redrawn from Moratto (1984:280).

the Sur Pattern probably was associated with speakers of Hokan languages [Moratto 1984:277].

Based on geographic distribution of 14C-dated Berkeley Pattern components [Fig. 19], it would appear that Utian populations first occupied eastern Contra Costa County at circa 2500-2000 B.C., then expanded westward to San Francisco Bay. By circa 1900 B.C., at least one Utian group had settled on the east bayshore (at Ala-307). Thereafter, Utian populations identifiable as ancestral Costanoans spread southward. By circa 1500 B.C., they occupied lands around the southern end of San Francisco Bay, whence they expanded northward onto the Peninsula, westward to the coast, and southward into the Santa Clara Valley. Costanoan dominions at circa 500 B.C. extended as far south as Mnt-12 on the Monterey Peninsula and included essentially all of the territory that they would hold until historic times [Moratto 1984:279].

The reasons for, and the mechanisms of, the Utian expansion were complex. Breschini noted in 1983 that:

The reasons behind the Penutian movements into territories previously occupied by Hokan speakers, and the mechanisms by which these movements could have occurred, have been largely ignored by most researchers. In general, however, it can be suggested that the Penutian speakers engaged in a more specialized economic mode, and as a result had a higher population and a higher degree of social and political integration. The differences between the Hokan and Penutian groups may have been along the general lines suggested by Binford (1980) for foragers vs. collectors, or by Bettinger and Baumhoff (1982) for travellers vs. processors [Breschini 1983:126].

...the initial movement of Penutian speakers into this area appears to have followed a regular and predictable pattern. For example, ...the Penutian advance into Hokan territory is assumed to have taken place only where there was a specific combination of three conditions: relatively level areas of oak grassland, in reasonable proximity to either the ocean or San Francisco Bay, and sizable areas of marshland.

On the basis of this assumption, the route of the expanding Penutian speakers can be predicted, and specifically tested for archaeologically [Breschini 1983:139].

One interesting note here is that large portions of the interior of the San Francisco Peninsula and adjacent Santa Cruz Mountains did not contain the apparently favorable combination of oak grasslands, and either bay/ocean, or marsh areas. It is therefore likely that these areas were bypassed by the initial Penutian expansion, and were only later fully absorbed into the Penutian speaking groups. As a corollary of the...model, then, it is predicted that further research in the Santa Cruz Mountains will find that the interior sites characteristic of the Penutian groups first appear at a later date than in the surrounding coastal or valley areas [Breschini 1983:140-141].

Along these same lines, Moratto wrote:

It is notable that the extent of the early Utian radiation seems to match the distribution of marshlands. Most Utian settlements before circa 200 B.C. were situated on the margins of the best wetland environments in the Delta, Napa Valley, and San Joaquin Valley, as well as on the San Francisco Bay shore and central coast. A later emphasis on acorn

use coincides with the intensified occupation of foothill oak woodland zones throughout central California. The success of the Utians may have been a result of their economic specialization coupled with a relatively complex social organization and dense populations, as compared with the less numerous and relatively generalized hunter-gatherers whom they supplanted [Moratto 1984:557].

Some of the predictions and necessary consequences of this model are being confirmed. For example, Hylkema (1991) tested the hypothesis that the Santa Cruz Mountains maintained a forager-based (and presumably Hokan-speaking) economy. His concluding paragraph reads:

Middle and Late period sites within the study area reveal that Native Americans maintained a forager adaptive strategy which co-existed with a collector strategy that had developed in surrounding areas [Hylkema 1991:391].

Based on his studies of linguistics, Golla (2004) places the Miwok-Costanoan linguistic split at about 4000-4500 years ago; he suggests that the reconstructed plant and animal lexicon of the Proto-Utian links that group to the Sacramento-San Joaquin Delta where they were known archaeologically as the Windmill Pattern. Golla further equates the expansion of this group to the west with the western expansion of the Utian speech. Finally, Golla notes Moratto's suggestion concerning the emergence of the Berkeley Pattern as a fusion of older Hokan and intrusive Utian cultural elements in the Bay Area is the most plausible scenario.

The preceding discussion presents a model which can be used to interpret parts of Central California and Monterey Peninsula prehistory. It is not designed to replace, but rather to supplement, strictly archaeological models. However, the general reception for cultural models that stray from the conventional

thinking (obsidian hydration, bead types, projectile points, ground stone, faunal remains, etc.) is chilly. The prevailing wisdom among many of our colleagues is "you can't dig up a language."

For example, Dietz et al. (1988) write:

Breschini and Haversat (1980), Breschini (1983), and Moratto (1984) have attempted to assign ethno-linguistic affiliation to archaeological patterns. As already discussed, the "patterns" are ill-defined. It follows, therefore, that *archaeological deposits* have been given ethnolinguistic affiliation by virtue of their respective radiocarbon dates (see Breschini 1983, Tables 10-13 and Moratto 1984, Table 6.3).

There is, however, no necessary relationship between language, ethnicity, physical type, and material culture. This has been demonstrated time and again, particularly in California... [Dietz et al. 1988:23].

Unfortunately, this was not true in 1988 and it is even less true today. There are strong hypothesized links between language, ethnicity, physical type, and material culture. This was demonstrated by Breschini's (1983) use of multiple discriminate function analysis on Central California skeletal populations (incidentally, these are the same techniques used by Rightmire to track the Bantu expansion in Africa, another example of documenting the relationship between language, culture, and physical type).

We will not reiterate here the arguments made in Breschini (1983) and Moratto (1984)—the data have already been presented and the arguments made—but new information is now available.

For example, Eshleman et al. (2003) write:

The significant levels of correlation between language and mtDNA haplogroup distribu-

tion among native North Americans suggests that prehistoric population movements, especially in western North America, were not negligible events [Eshleman, Malhi, and Smith 2003:13].

In an earlier study, Eshleman (2002), using mtDNA, has noted that:

Examining ancient DNA extracted from prehistoric human remains for evidence of genetic continuity can be used to support or disprove hypotheses regarding migrations and population replacements or expansions that are based on linguistic and archaeological data. Kaestle and Smith found a marked difference between mtDNA haplogroup frequency distributions in two ancient burial populations from the Western Great Basin, the Pyramid Lake and Stillwater Marsh sites, and modern populations in the Western Great Basin, indicating that a population replacement occurred in the region. This replacement is consistent with archaeological, ethnographic, and linguistic evidence of a Numic expansion into this region approximately 1,000 ybp [Eshleman 2002:65-66].

While that same study failed to find support for the Penutian replacement of Hokan-speakers in the lower Sacramento Valley, it did find mtDNA continuity between Windmill and Middle Period populations. It also found evidence of Proto-Uto-Aztecs (Takic-speakers) in the Central Valley between 4000 and 2000 years ago.

The precise details of the mtDNA studies are still being worked out—these studies are still in their infancy—but one thing is clear: there does appear to be a significant degree of correlation between aspects of language, physical type, and material culture.

So, if we can equate some aspects of language and culture, what do these models have to say about the Monterey Peninsula?

Both Moratto's (1984) and our model postulate an influx of Penutian-speakers into the Monterey Bay area about 500 B.C. During this influx they inter-mixed, to some degree, with the existing proto-Esseen or Hokan-speaking populations. This model places the population movement within, or near the end of a radiocarbon "gap" of some 800 years. Did some climatic or cultural event occur which reduced the local population, making an influx of Penutian-speakers possible?

Dietz (1987:314-315) and Dietz et al. (1988:412-413) find many areas of this model with which to disagree, but after many pages of discussion ultimately postulate the same influx of Penutian-speakers into the Monterey Bay area at about A.D. 500, a thousand years later than the Breschini/Haversat/Moratto models. (It appears at this point that we are discussing *when* events occurred, rather than *whether* they occurred.)

It is interesting to note that if the Dietz et al. (1988) chronology is adjusted by less than 200 years, their postulated date for an influx of Penutian-speakers would correspond with the abrupt change suggested by the radiocarbon database at about A.D. 660.

More recently, however, Jones (1998:31) cites Hildebrandt and Mikkelsen (1993), who suggest that none of the changes in assemblage or subsistence they see at the end of the Middle Period (i.e., about A.D. 500-800) are extreme enough to suggest population replacement. They propose, instead, a merger between Hokan and Utian speakers consistent with the views of Gerow (1968).

Although it is not so attributed, this is exactly what the Breschini/Haversat/Moratto models postulated well

over 20 years ago! Not population *replacement*, but a gradual *mixture* between Penutian or Utian-speakers moving south who, because of specific cultural and environmental adaptations, were able to gradually intermarry with and absorb the proto-Esselen or Hokan-speakers. Beginning in the eastern portions of the San Francisco Bay area (Figs. 18 and 19), and lasting as long as 2000 years, incoming populations eventually occupied significant parts of proto-Esselen or Hokan territory. Seen from the perspective of the Monterey Bay area, this movement occurred prior to the Middle Period and ended only when the southward expansion reached the limits of the specific combination of favorable environmental factors which had made it possible. The rugged coast associated with the Big Sur Mountains effectively ended the southward movement, and existing Esselen populations south of about the Little Sur River remained relatively unaffected (Breschini and Haversat 1994, 2004).

The degree of intermixture between the two groups should be detectable through mtDNA analyses. So far, there is not a large enough mtDNA sample from the Monterey Peninsula area to provide firm answers, but initial investigations support the idea that there was indeed intermixing between two groups. For example, Eshleman (2000) states:

[Haplogroup] A is relatively high in Chumash populations and appears in greater frequency along the west coast than it does in inland western populations. The presence of A in three individuals from burials in Monterey County are consistent with the higher frequencies of A along the west coast. As the CA-MNT-1482 and -1489 burials are alleged to represent Costanoan populations, a member of the Penutian superstock, these individuals may represent the product of mixing of a Penutian speaking group that introduced the language and older inhabitants of the coast that possessed the A haplogroup.

As an aside, it is interesting to note that the presence of Haplogroup A in skeletal populations in the Monterey Peninsula area supports the “early coastal migration” theory. This theory suggests that the initial population of western North America was via water craft along the coast, rather than via the “ice-free” corridor through Canada.

Comparison of Radiocarbon Data with the Early/Middle/Late Period Model

A good recent summary of cultural periods suggested for the Monterey Bay area was produced by Jones et al. (1996). Fig. 20 compares that model of cultural periods with the patterns suggested by the radiocarbon database. While the overall agreement is reasonably close, discrepancies show up when you start looking closely at the details.

In the following analyses we make use of the Monterey Peninsula area radiocarbon database, which now includes 8 dated *Olivella* beads. These are supplemented by an additional 118 radiocarbon dated *Olivella* beads from elsewhere in California. These are from the following sources:

Source	Number of Dates	Area
Groza (2002)	104	San Francisco Bay area
Mikkelsen et al. (2000)	2	San Luis Obispo County
Fitzgerald (1998)	1	San Luis Obispo County
Koerper (personal communication)	11	Orange County

Because the local sample is so small, we do not yet know the degree to which the dates from outside of the Monterey Peninsula apply to the culture history of the Monterey Peninsula. For example, Bennyhoff and Hughes (1987:128) place the Type E1 and E2 beads as markers for Phase 2 of the Late Period (post-A.D. 1500), while Type E3 is a marker for the Historic Period. Four radiocarbon dates on Type E1 and E2 from

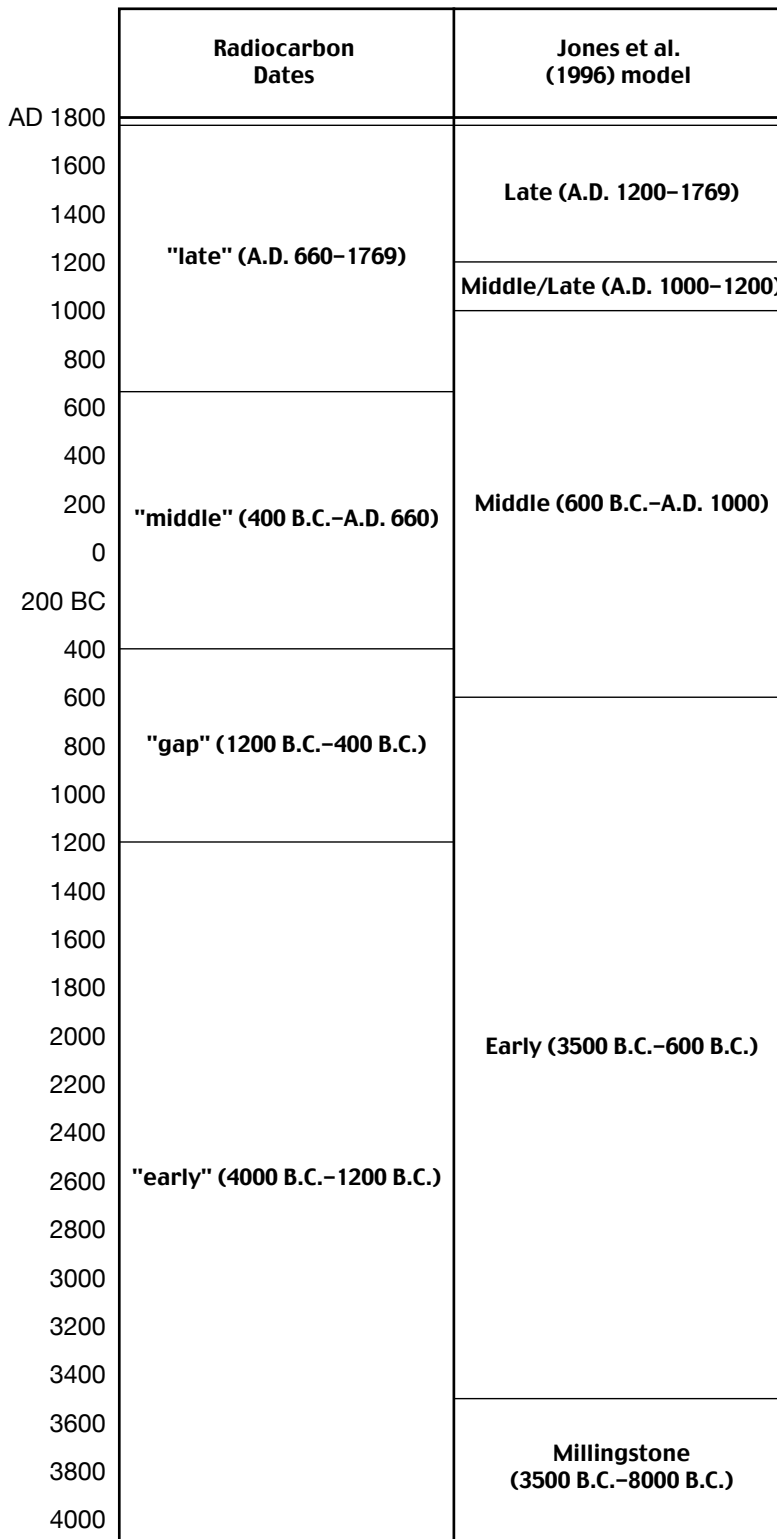


Fig. 20. Comparison of radiocarbon data with cultural periods suggested for the Monterey Bay area by Jones et al. (1996).

the San Francisco Bay area range from A.D. 1638-1691, and a fifth date comes in at A.D. 533 (Groza 2002). A recently obtained date on a Type E2a from the Monterey Peninsula was A.D. 1630, well within the Bennyhoff and Hughes' range (Fig. 23b) and quite close to the four Bay Area specimens. However, single examples of K1 and L2 beads from the Monterey Peninsula area date 60-100 years earlier than the range for similar samples from the Bay Area.

"Late" Radiocarbon Dates

Perhaps the largest discrepancy is on the most recent end of the scale. The "late" radiocarbon dates span a period of about 1100 years, while the Late Period spans less than 600 years. As such, the "late" dates span a seemingly unbroken interval which includes the Late Period, the Middle/Late Transition, and just over 20% of the Middle Period of the Jones et al. model.

The characteristics of the latter model for this time period include a variety of bead types, projectile point styles, and ground stone artifacts. The most temporally diagnostic of these are the shell beads and Desert Side-notched points. Specific data is discussed below:

- One of these bead types, *Olivella* type G is listed as a characteristic of the Middle Period. This is only partially true. The Monterey Peninsula area radiocarbon database includes five dates on type G1 beads (see Fig. 24), two each from CA-MNT-234 at Moss Landing and CA-MNT-1701 at Rancho San Carlos, and one in the National Forest west of Ft. Hunter Liggett (CA-MNT-307). The range is A.D. 785-1320, all within the "late" series of radiocarbon dates. An additional date, on multiple G1 beads from CA-SCL-690, at A.D. 1000, also fits within this range. However, this range does not fit well with the Jones et al. model; it spans portions of their Middle, all of their Middle/Late Transition, and portions of their Late Periods. In actuality, the G1 type appears to be a marker for portions of the "late" time period,

as suggested by the radiocarbon database, rather than the Late Period. It is found in significant quantities, for example, in the upper ("late") levels of CA-MNT-234 and at three Rancho San Carlos sites (Figs. 17 and 21).

- Other *Olivella* bead types which appear characteristic of the "late" series of radiocarbon dates are the E & H series, the K1 and M1/M2 (Fig. 24). However, the M1 & M2 series includes Jones et al.'s Middle/Late Transition, and Late Period.
- Desert Side-notched points appear characteristic of both the "late" series of radiocarbon dates and the Late Period. However, the temporal range of this point type has not been accurately established for the Monterey Peninsula. It does not span the full range of the "late" dates, and probably does not span the full range of the Late Period.
- *Olivella* type D beads, reported by Jones et al. to be characteristic of the Middle/Late Transition appear to be lacking on the Monterey Peninsula (this style is not represented in our database of 6,964 shell beads).

"Middle" Radiocarbon Dates

There is significantly better agreement between the "middle" series of radiocarbon dates and Jones et al.'s Middle Period. The primary difference is that their Middle Period begins 200 years earlier and ends about 350 years later than suggested by the radiocarbon database.

- *Olivella* type G2, G3, and G6 (Fig. 25) beads appear to be better markers for the Middle Period defined by Jones et al. than the "middle" series of radiocarbon dates. Significant quantities of these bead types appear in sites with strong "middle" components (including two of the Moss Landing sites and CA-MNT-101). They also appear in a clearly "middle" component at CA-MNT-108 that was not radiocarbon dated. The current range for these types, based on radiocarbon dates

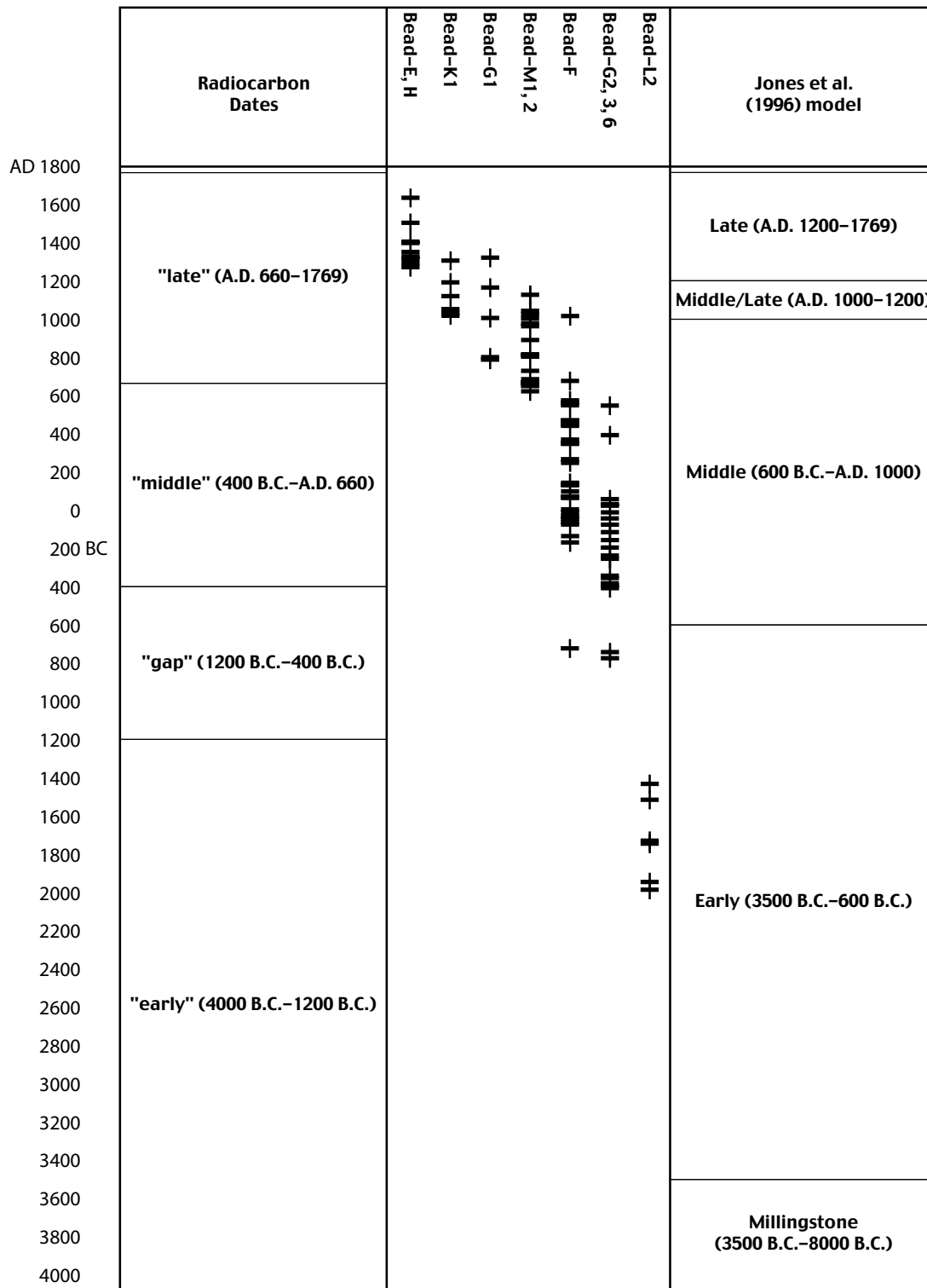


Fig. 21. Comparison of radiocarbon data and dated *Olivella* bead types with cultural periods suggested for the Monterey Bay area by Jones et al. (1996).

obtained by Groza and Mikkelsen et al., is 390 B.C.-A.D. 969.

- *Olivella* type F beads (Fig. 25) also appear to correspond with the Middle Period model. However, this bead type has not yet been found in significant quantities on the Monterey Peninsula (our database of 6,964 shell beads includes only 12 examples).

"Gap" in the Radiocarbon Dates

The radiocarbon database suggests a gap between about 1,200 and 400 B.C. Only two dates are found within this time span. No such gaps are identified in the Jones et al. model.

While we do not know the meaning of this gap, it appears that the settlement and subsistence pattern which had been in use on the Monterey Peninsula for over 2000 years broke down in some manner at about 1200 B.C. Sites which had been occupied for a substantial length of time were apparently abandoned. We do not know where the populations were during this time period, as we have only two radiocarbon dates. This appears too small a number of radiocarbon dates to be accounted for by sampling error or archaeological bias, and we believe that the data are trying to tell us something important about the culture history of the Monterey Peninsula.

The two sites which supplied radiocarbon dates for this time period are located on the outer coast of the Monterey Peninsula (Fig. 4); both sites also had been occupied during the "early" period.

"Early" Radiocarbon Dates

The radiocarbon and Early/Middle/Late models both agree that the *Olivella* L2 bead (Fig. 23) is characteristic of the earliest period identified for the Monterey Peninsula area. A Millingstone component may be located at one or more sites in the Moss Landing area,

but no such component has yet been identified for the Monterey Peninsula.

Was There a Middle/Late Transition in the Monterey Peninsula Area?

One of the benefits of establishing an accurate database is we can more closely examine previous ideas concerning the prehistory of the Monterey Peninsula. For example, there are questions concerning the Middle/Late Transition, and the degree to which it applies to this area.

Jones (1998:86) writes:

The alternative endorsed here is that the major changes in settlement/subsistence in the Monterey Peninsula area that took place during early centuries of the present millennium [sic] were caused by climatic flux (i.e., severe droughts) associated with the Medieval Warm Period. This scenario was originally proposed on the basis of findings from Big Sur that showed correlation between unusual sea temperatures during the Medieval Warm Period and a disruption in settlement. As it turns out, evidence for disruption is equally abundant in the Monterey Peninsula/Elkhorn Slough area. Middle Period sites such as CA-MNT-229 and CA-MNT-101 show evidence for abandonment during the Middle/Late Transition, while Late Period sites are a single component—originally established during or immediately following the Transition. There is very little evidence for continuity in settlement between ca. A.D. 800 and 1500.

Fig. 22 illustrates the radiocarbon dates from CA-MNT-1701, located at Rancho San Carlos in the Carmel Valley. There is continuity in settlement at this site from A.D. 785 to A.D. 1410, based on 24 single-piece radiocarbon samples obtained using mussel (12), abalone (7), charcoal (2), and *Olivella* shell beads (3).

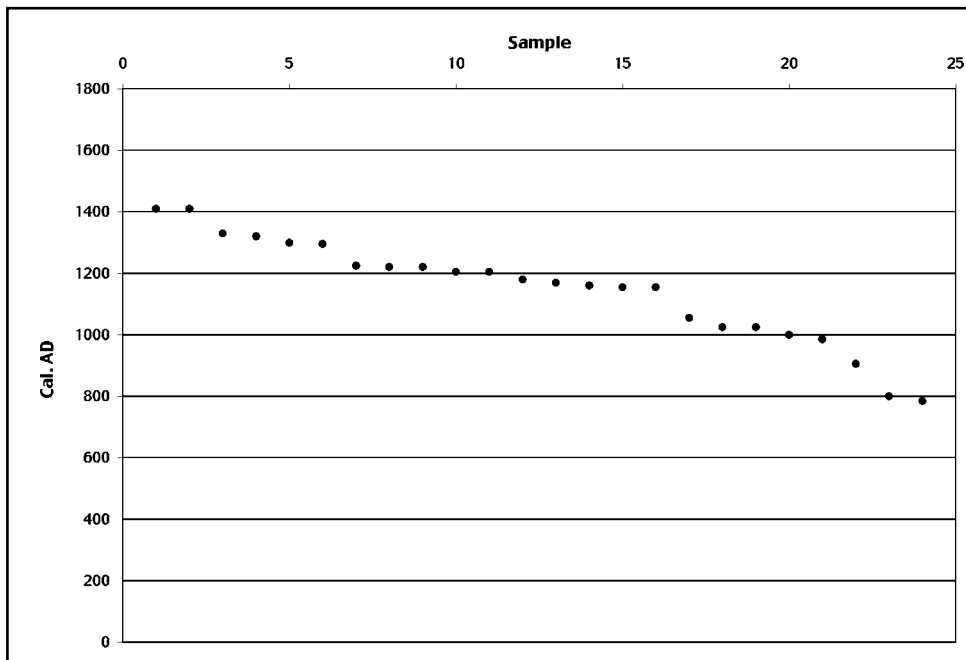


Fig. 22. Radiocarbon dates from CA-MNT-1701, at Rancho San Carlos. This series of dates was largely obtained from a single unit (21 of 24 samples), and illustrates the value of intense radiocarbon dating. It also illustrates continuity across the Middle/Late Transition and/or Medieval Warm Period (A.D. 1000-1400).

Several other sites also show evidence for continuity in settlement (Fig. 17).

Based on this continuity, it is possible that changes which occurred in the Big Sur area are not the same as those which occurred on the Monterey Peninsula. For one thing, the Monterey Peninsula experienced the transition from Hokan-speakers to Penutian-speakers, while the Big Sur area did not. Also, the physiographic settings are significantly different. And, at least one site in the Big Sur area (CA-MNT-376; see Jones 1994) appears to cross the A.D. 660 “line” which, so far, acts as a dividing line on the Monterey Peninsula.

Jones also mentions the two large Middle Period sites, CA-MNT-229 (at Moss Landing) and CA-MNT-101 (near Fisherman’s Wharf in Monterey), as showing signs of abandonment during the Middle/Late Transition. Actually, these sites (and two others at Moss Landing) were abandoned significantly

earlier, just before the A.D. 660 date indicated by the radiocarbon model. The Moss Landing sites have a substantial “late” occupation, but CA-MNT-101 was apparently not occupied to any significant degree during “late” times.

What are the implications of this information for a Middle/Late Transition on the Monterey Peninsula? While there is a substantial break at A.D. 660 between “middle” and “late” sites, this does not correspond to the dates accepted for the Middle/Late Transition (generally A.D. 1000-1200). On the other hand, there appears to be continuity of many sites during the A.D. 1000-1200 period (note the number of sites with dates spanning this period in Fig. 17). Note also Figs. 10 (CA-MNT-437), 11 (CA-MNT-820), and 15 (CA-MNT-1612 complex).

What we have during the “late” period is an increased complexity of site types on the Monterey Peninsula.



Fig. 23. Temporally-sensitive shell artifacts from the Monterey Peninsula area which have been radiocarbon dated. A. *Mytilus* fishbooks from CA-MNT-113C (170 B.C.-A.D. 95). Scale is in centimeters (artifacts are approximately 2.5 times actual size). B. *Olivella* Type E2a bead from CA-MNT-125 (A.D. 1630). C. *Olivella* Type L2a bead from CA-MNT-1612 (1530 B.C.). Scale is in centimeters (artifacts are approximately 3.5 times actual size).

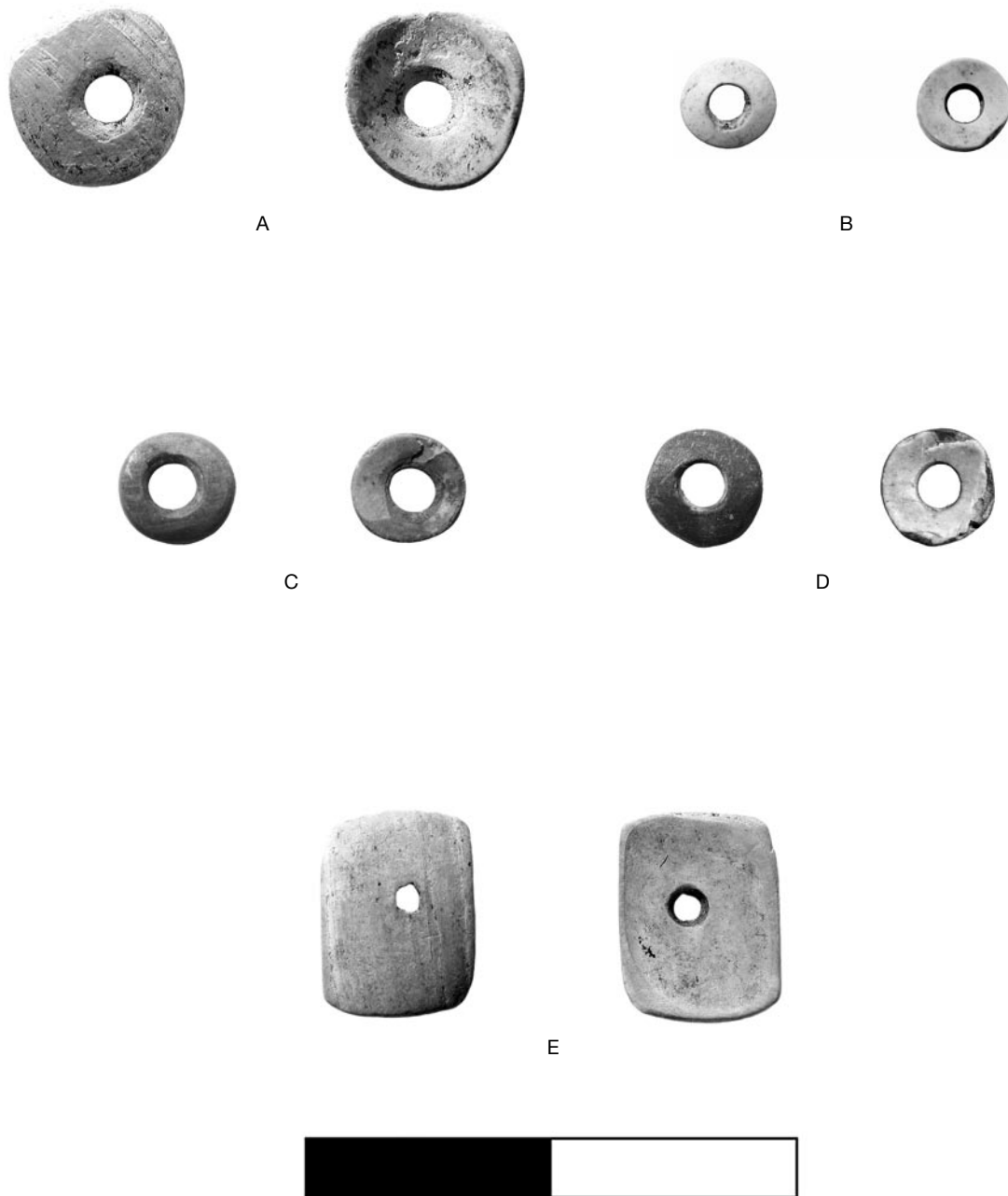


Fig. 24. Temporally-sensitive shell artifacts from the Monterey Peninsula area: Late Period. A. *Olivella* Type J bead from CA-MNT-834. B. *Olivella* Type K1 bead from CA-MNT-1486/H. C, D. *Olivella* Type G1 beads from CA-MNT-1486/H. E. *Olivella* Type M1a bead from CA-MNT-1486/H. Scale is in centimeters (artifacts are approximately 3.5 times actual size).

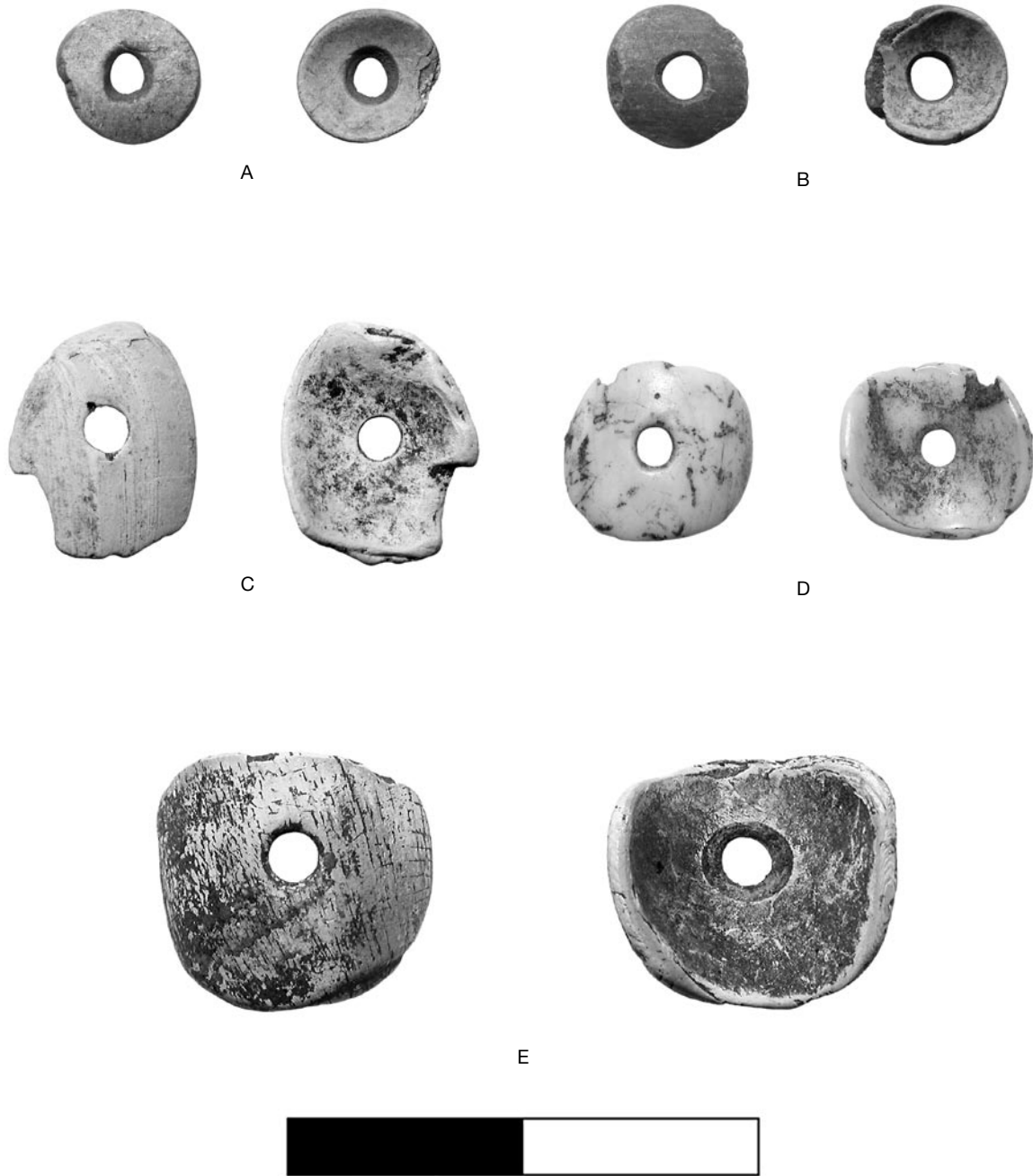


Fig. 25. Temporally-sensitive shell artifacts from the Monterey Peninsula area: Middle Period. A, B. *Olivella* Type G2 beads from CA-MNT-1485/H. C. *Olivella* Type G6 bead from CA-MNT-1485/H. D, E. *Olivella* Type F2 beads from CA-MNT-33a. Scale is in centimeters (artifacts are approximately 3.5 times actual size).

On the one hand we have a number of residential sites (including CA-MNT-834B, CA-MNT-1612, etc.) which are characterized by mussel shell (usually 75-90% by weight) and the normal constituents of a residential site. On the other hand we have, during the same time period, the “abalone pavements” which are greater than 90% abalone shell by weight (including portions of CA-MNT-17, CA-MNT-134, CA-MNT-170, and CA-MNT-1084). These generally exhibit few of the constituents associated with a residential site. However, the “abalone pavement” sites are not all the same, but rather exhibit a range of complexity. For example, CA-MNT-129 has a wider range of shellfish species, as well as larger quantities of fish and non-fish bone, and artifacts. The vertebrate remains from CA-MNT-129 included a minimum of 42 species: 18 species of fish, at least 1 species of amphibian and 2 species of reptile, 6 species of bird, and 14 species of mammal (see Breschini and Haversat 1991b). Abalone, however, constituted 94.1% of the shell by weight.

What we don't seem to have is evidence of a significant cultural break during the long “late” period beginning about A.D. 660. Undoubtedly there were changes and innovations, as the bow and arrow came in at some point during this time period and the bead styles changed (Fig. 21). The Medieval Warm Interval and the Little Ice Age both probably affected the populations, but not to the degree that numerous sites were suddenly abandoned.

At this point it appears that the changes described by Jones for the Big Sur coast may not extend to the Monterey Peninsula.

Discussion

There are significant differences between these radiocarbon dates and the primary interpretive model of cultural periods being applied to the Monterey Bay area.

One of the most striking differences is that the “late” radiocarbon dates correspond to all of the Late Period, all of the Middle/Late Transition, and over 20% of the Middle Period. Why is there such a discrepancy?

The primary characteristic of the radiocarbon model as it has been developed to this point is that the radiocarbon dates themselves have been allowed to suggest the temporal periods. While these periods are an interpretation of the data, the concentrations and gaps are based on a high quality database and have a stronger empirical basis than earlier formulations. For example, the radiocarbon dates show a clear break at about A.D. 660. The sites just younger than A.D. 660 appear to be completely differentiated from the sites just older than A.D. 660. There is also a distinct gap between 1200 B.C. and 400 B.C.

For some reason, the traditional Early/Middle/Late model being developed in Central California is a poor fit for the Monterey Peninsula, particularly after about A.D. 600.

When the traditional Early/Middle/Late model is applied to the Monterey Peninsula, the “late” radiocarbon components and, to a lesser degree the late bead series, are divided among two or even three cultural periods. It is possible that this reflects the origins of this model in the lower Sacramento Valley (beginning with Lillard, Heizer, and Fenenga 1939) and its modification in the greater San Francisco Bay area (e.g., the taxonomic framework proposed for Central California archaeology by Bennyhoff and Fredrickson; see Hughes 1994 and the more recent radiocarbon analyses by Groza 2002).

Summary

What are the radiocarbon dates from the Monterey Peninsula area trying to tell us?

While there is no break in settlement on the Monterey Peninsula at the time period specified for the Middle/Late Transition, there is a substantial break earlier, at about A.D. 660. For lack of a better term this can be described as the boundary between the “middle” and “late” radiocarbon periods.

On the recent side of this break are sites clearly acknowledged as Late Period, for example CA-MNT-3, CA-MNT-834B, and the Rancho San Carlos complex. On the older side of this break are sites clearly acknowledged to be Middle Period, including CA-MNT-101, CA-MNT-113B/C, and at least two of the Moss Landing sites (CA-MNT-229 and CA-MNT-234). The “middle” period begins at about 400 B.C.

At this point there do not appear to be any meaningful breaks within the “middle” or “late” periods—at least as defined by the radiocarbon dates. However, other models could be constructed, emphasizing other data, which may provide entirely different results.

An “early” period on the Monterey Peninsula spans the time from just after 4000 B.C. to about 1200 B.C. There are fewer long series of radiocarbon dates within this time period, so adding subdivisions at this point would be dangerous.

However, an apparently single-component site in Pacific Grove (CA-MNT-831) has contributed four radiocarbon dates between 3760 and 2430 B.C. (Breschini and Haversat 2002b). (Incidentally, this was a monitoring project, but we still managed to obtain some useful information.) CA-MNT-112, immediately to the north, has produced a corresponding date of 2435 B.C., along with several “late” dates. There was less shell in the CA-MNT-831 deposit than in most other local sites, but a very interesting ground stone assemblage; only six of the 170 artifacts were of shell, bone, and flaked stone. It is possible that additional research in this particular site would help clarify

whether there are subdivisions within the “early” period.

These, then, are the cultural periods identified on the Monterey Peninsula by the radiocarbon dates. They differ from the Early/Middle/Late model which originated largely to the north and east.

So where do we go from here?

Rather than imposing cultural models from elsewhere in Central California on the Monterey Peninsula, we need to examine the local data to see where the areas of agreement and disagreement may lie.

If we go back to the beginning—the radiocarbon dataset with no interpretation (Figs. 17 and 20)—we have a firm starting point from which to begin addressing the problems of cultural periods on the Monterey Peninsula. Then the other variables—beads, points, faunal assemblages, etc., can be introduced into the equation within a solid chronological framework.

Who knows, perhaps the cultural sequence for the Monterey Peninsula will be found to apply to other areas of Central California as well!

Correlation of Temporally-Sensitive Artifacts with the Radiocarbon Data

Because many archaeologists are accustomed to working with artifacts, we have examined some representative, and well-dated, sites to see the degree to which various artifacts correlate with the periods revealed by the radiocarbon data.

“Late” Period (A.D. 660-Contact)

For the “late” period we have selected three sites which we believe are representative. These are: CA-MNT-3, an inland site located about 16 km east of downtown Monterey; CA-MNT-834B, on the shores

of Carmel Bay in the Pebble Beach area; and two of the Rancho San Carlos sites, CA-MNT-1485/H and CA-MNT-1486/H, situated south of the Carmel Valley some 19 km southeast of downtown Monterey (Fig. 4).

CA-MNT-3 was excavated by Jones (1998), who obtained a sample of about 9.9 cubic meters, with just over 75% being processed with 1/8 inch mesh (dry field sort) and the rest with 1/4 inch mesh (dry field sort). Column samples were also obtained using fine mesh. Eleven radiocarbon dates span the range A.D. 1010-1525.

Only four shell beads were recovered. The limited number could be in part because field sorting was used. Of these, only one, an *Olivella* K1, is temporally sensitive. As shown by Fig. 21, this bead associates with both the “late” radiocarbon period and the Late Period.

Two projectile points were found, but one was non-diagnostic and the other, a Contracting-stem type, is thought to span approximately 3500 B.C. through A.D. 1200, or perhaps into historic times (Jones 1998:49).

The ground stone assemblage included only three pestles. A single bone artifact, a whale rib pry, also was recovered. Only three pieces of obsidian were recovered; these were all from the Napa source, and hydration readings ranged from 1.0 to 2.6 microns. These readings suggest occupation during the last thousand or so years, consistent with the radiocarbon dates.

It is interesting to note that no Desert Side-notched points were found. It is possible, as discussed by Breschini and Haversat (1995b, 2000b) that this site was occupied prior to the introduction of this point style.

CA-MNT-834B is situated on the shores of Carmel Bay. Two excavations have been conducted at this site: a small test excavation (Jackson 1996) and a larger data recovery project (Breschini and Haversat, in progress).

Our project employed both 1/4 and 1/8 inch mesh, with about 13.8 cubic meters being screened through the 1/4 inch and 4.8 cubic meters screened through the 1/8 inch mesh. The reason the 1/4 inch mesh was used was the upcoming destruction of the site, and we modified our field techniques to permit rapid recovery of a larger sample. However, no field sorting was attempted; all materials remaining in the screens, except bulk rock, were returned to the laboratory for water washing. The site was shallow, with an average depth between 55 and 60 cm.

Ten radiocarbon dates (all on *Haliotis* shell) range from A.D. 1200 to 1650.

Our excavations produced approximately 220 artifacts, of which 134 (61%) were shell beads, ornaments, fishhooks, etc. Other artifacts included whale bone pry fragments (11), misc. polished or incised bone (7), chert cores, scrapers and flakes (7), chert and obsidian bifaces and fragments (11), and ground and battered stone (50), including one pestle fragment and one mortar fragment. (Obsidian sourcing and hydration have not been completed.)

The five temporally sensitive *Olivella* beads types recovered from CA-MNT-834B are listed in Table 5.

The presence of these bead types agrees with the occupation suggested by the radiocarbon dates. These ranges are all within the “late” period as defined by radiocarbon dates on the Monterey Peninsula.

The *Mytilus* fishhooks (3) are thought to be a Middle and Late period marker, but the only dates on these artifacts of which we are aware are from the Middle

Period. Three specimens from CA-MNT-113C, in Pacific Grove, averaged from 170 B.C. to A.D. 95. Based on the presence of four *Mytilus* fishhook fragments at CA-MNT-834B, a single-component “late” site, it is likely that direct dating will eventually confirm the existence of these fishhooks during the Late Period.

As was the case at CA-MNT-3, no Desert Side-notched points were found at CA-MNT-834B.

CA-MNT-1485/H and CA-MNT-1486/H are situated immediately adjacent to one another at Rancho San Carlos and can be treated as a single site. These sites were tested in 1991 and reported by Breschini and Haversat (1992). Additional investigations were conducted since the 1992 report, resulting in additional dates from CA-MNT-1486/H.

The excavation volume at CA-MNT-1485/H was 7.20 cubic meters, and at CA-MNT-1486/H it was 11.60 cubic meters. All soils were screened using 1/8 inch mesh, and all sorting was done in the laboratory following water washing.

Radiocarbon dating from these sites has produced quite similar results (see Table 6).

Compared with most coastal sites, and even CA-MNT-3, the Rancho San Carlos sites produced a larger number and a significantly wider range of artifacts. In all, 443 items were recovered during the 1991 excavations, including 219 shell beads, ornaments, fishhooks, etc., 57 bone artifacts, 113 flaked stone artifacts, and

Type	Number	Radiocarbon dated range
M1a	3	A.D. 1024-1331
G1	1	A.D. 785-1320
K1	21	A.D. 1180-1485
E3	2	A.D. 1562-1666

Table 5. *Olivella* Bead Types Recovered from CA-MNT-834B and their Estimated Temporal Ranges.

54 stone artifacts. Mortars and pestles were well represented in the collection.

The majority of the temporally-sensitive shell beads (55 of 71, or 77.5%) represent the “late” period. These include *Olivella* types E1 (3) and E2 (2), G1 (28), K1 (13), and M1/M2 (9).

A small number of beads (7 of 71, or 9.9%) represent both the “middle” and “late” radiocarbon periods, but fall conformably within the Middle/Late Transition and Middle Period. These include *Olivella* types F3 (1), G2 (4), and G6 (2).

The remaining beads (9 of 71, or 12.7%), including *Olivella* types B2 (3), B5 (1), C2 (1), G5 (1), K2 (1), and K3 (2) cannot yet be accurately assigned to either period based on radiocarbon dates (Groza 2002).

The other artifacts from these sites produce similar temporal results. Notable artifacts include two steatite earspools and a single non-perforated charmstone. These artifact types are extremely rare in Monterey County, and can probably be assigned to the “late” period.

Obsidian was not common; CA-MNT-1485/H produced three Napa readings of 1.7, 3.5, and 7.1 microns, and one Casa Diablo reading of 5.9 microns. CA-MNT-1486/H produced three Napa readings of 2.0, 2.5, and 2.5, and two Casa Diablo readings of 2.0 and 3.7. Several of these readings are outside of the range expected based on other criteria.

In all of these artifacts, only one specimen was identified as a Desert Side-notched point.

Summary

The three sites discussed above are placed within the “late” period based on radiocarbon dates. All three are also associated with the “late” period based on

Table 6. Radiocarbon Dates from CA-MNT-1485/H and CA-MNT-1486/H.

Site	Range (cal.)	Average	Samples	Single-piece
CA-MNT-1485/H	A.D. 877-1523	A.D. 1135	9	3
CA-MNT-1486/H	A.D. 899-1455	A.D. 1180	16	13

their artifact assemblages, but one (the Rancho San Carlos sites) also contains a small percentage of items normally associated with both the Middle Period and the “middle” period.

It is possible that additional radiocarbon dates would extend the range of these two sites farther back in time, beyond the A.D. 660 “line” which separates the “late” from the “middle” periods.

At present, we have 25 dates from these two sites, 16 of which are on single pieces of material. This is a reasonably good sample, probably better than most sites being tested in California today. But we do have additional information which can be applied: the other sites within the Rancho San Carlos complex have contributed an additional 40 dates, but the temporal range has only been pushed back by 82 years, to A.D. 805. Even with 65 radiocarbon dates, 52 of which are on single pieces of material, there is no radiocarbon evidence of a “middle” component.

We are left, then, to seek alternate scenarios by which the 10% of “middle” period artifacts reached Rancho San Carlos. Heirloomed would be the obvious choice.

Along these same lines, we have obsidian hydration readings from CA-MNT-1485/H and two adjacent sites of 6.9, 7.0, and 7.1 (Napa), which should equate to somewhere over 7000 years B.P. (Dietz 1987:312; Wilson 2004:12). We have no explanation at this point other than “old quarry surfaces” which remained on the finished tool. However, these ancient surfaces are found on fully one-third (3 of 9) of the Napa obsidian from these three sites.

The obsidian hydration range for the “late” period should be closer to ≤ 2.7 for Napa and ≤ 3.2 for Casa Diablo. These micron ranges, and the ones to follow, are based on conversions of the radiocarbon period dates using the rim age equivalents table provided by Dietz (1987:312).

Finally, we come to the Desert Side-notched point. We have presented information from three significant excavations, each of which examined a reasonably-large quantity of “late” midden, and only one Desert Side-notched point was found. This is simply too small a number to be explained away by sampling error, bias, or other simple explanations. It is thus likely, as we have previously suggested (Breschini and Haversat 1995b, 2000b), that the Desert Side-notched point was not in common usage in the Monterey Peninsula area during most of the temporal span of these three sites. This would place its introduction into the Monterey Peninsula area significantly later than is generally thought for the central coast. The Desert Side-notched point does not appear to span the “late” period, nor even major portions of the Late Period. It probably came into common usage in this area as late as the protohistoric period.

Based on the above information, we have evidence of change during the long “late” period defined by radiocarbon dates. *Olivella* bead types, for example, appear to have progressed from G1 to M2 to M1 to K1 to E and J, although the exact dates are still being worked out. The F3 also may be characteristic of this period, although the F2 appears generally earlier.

The Medieval Warm Interval and the Little Ice Age both probably affected the populations during this time period (Moratto 2004). Archaeological models could be formulated which break this period into subdivisions based on changes in, for example, projectile point styles or bead types, or minor changes in subsistence and settlement. However, we believe that significant data support the existence of a single long “period” spanning approximately A.D. 660 to Contact in the Monterey Peninsula area. (We do see some evidence of possible subsistence and settlement changes about A.D. 1400, but the details have not yet been worked out.)

“Middle” Period (400 B.C.-A.D. 660)

The “middle” period is poorly sampled on the Monterey Peninsula. In part this is because there are limited numbers of sites from this time period. Also, some of the tested sites include more than one time period, and did not provide as clean a sample. While “late” sites are often single-component sites, or are situated on “early” components, “middle” sites often have minor “late” and “early” components associated with them.

For the “middle” period we have selected two sites which we believe are representative. Both are on the Monterey Peninsula. These are: CA-MNT-101, a large site overlooking the Monterey harbor; and CA-MNT-113B and CA-MNT-113C (formerly designated CA-MNT-114 and CA-MNT-115, respectively), located on the northern shore of the Monterey Peninsula in Pacific Grove. We have also included information on a third site, the portion of CA-MNT-108 in and around the Custom House at the base of Fisherman’s Wharf (Fig. 6).

CA-MNT-101. The first major subsurface investigations at CA-MNT-101 were conducted by Pritchard in 1967. A mimeographed report (Pritchard 1968) was circulated, but the quality of the copies made from it

were poor. The sections dealing with prehistory have been slightly revised and published (Pritchard 1984).

Pritchard encountered seven burials (three adults and four infants) during his investigations. Approximately 28.5 cubic meters of soil were removed from the prehistoric portion of the deposit (Dietz 1987:57).

Artifacts included, whole or fragmentary, 8 mortars, 17 pestles, 15 manos, 1 metate, 4 pitted stones, 86 projectile points, 41 shell fishhooks, 41 shell beads, 20 bone awls, and a number of other specimens. The limited numbers of some smaller artifacts can be attributed to the data recovery techniques then being used (1/4 inch mesh, dry field screening). The temporally-sensitive *Olivella* beads included Types F, and G2/G6, all considered reliable “Middle” Period markers.

Pritchard obtained no radiocarbon dates, but noted a possible change in subsistence-settlement at CA-MNT-101. The lowermost levels (below 140 cm) contained a majority of the milling stones, while the upper levels (above 140 cm) contained heavy concentrations of shell. This led him to speculate that the lower levels of the deposit had considerable antiquity, probably on the order of 2000-3000 B.P. He also determined that CA-MNT-101 had probably been abandoned by the time the early explorers arrived in the Monterey Bay (1602, 1769). Based on the data presented by Pritchard, Dietz (1987:68) speculated that CA-MNT-101 was a two component site, the lower component representing a forager residential base, and the upper component a collector field camp and/or location.

During 1985, Dietz conducted additional testing at CA-MNT-101. His investigations were primarily along the edge of the mound, an area not examined by Pritchard, who concentrated on the top of the deposit. A total of 52.21 cubic meters of soil were removed from 50 excavation units of various dimensions (Dietz 1987:299). A number of these units were designed to test El Castillo, the early gun emplacement, or other

nearby archaeological sites. Most of the units into the prehistoric deposit were excavated using 1/8 inch mesh with dry field screening.

No burials were encountered during the Dietz investigations at CA-MNT-101, but six fragments of human bone were noted.

Artifacts included, whole or fragmentary, 4 mortars, 2 pestles, 17 manos, 21 projectile points, 17 shell fishhooks, 130 shell beads, 12 bone awls, and a number of other specimens. The temporally-sensitive *Olivella* beads included types G6 (11), L2b (1), and M1a (1). The L2 is an Early or Early/Middle Transition type, while the M1, as discussed above, associates with the "late" period.

Bead manufacturing was documented by 126 pieces of bead manufacturing waste and 695 whole *Olivella* shells.

Dietz obtained nine radiocarbon dates from CA-MNT-101, we believe on single pieces of abalone shell; seven were very consistent, ranging from A.D. 33-612. One sample was younger (A.D. 1191) and one older (2161 B.C.). The obsidian dates suggested a slightly older date for the primary component, and also showed the younger and older components. Pritchard's results suggest that the most recent stratum may be situated on the top of the deposit, rather than along the sides tested by Dietz. This would account for the limited evidence of a late component which resulted from Dietz's research.

One additional radiocarbon date was obtained from CA-MNT-101 by the authors. This was obtained from a disturbed context during monitoring of a road widening project below Lighthouse Curve, and so represents a portion of the site not tested by previous researchers. The date matches the early date obtained by Dietz very closely.

The range for obsidian hydration readings is 1.9-5.0 (Napa, 16 specimens), and 1.5-6.1 (Casa Diablo, 34 specimens). About two-thirds of the specimens fall within the range 2.8-3.9 microns (Napa) and 3.3-4.8 microns (Casa Diablo).

CA-MNT-113B and CA-MNT-113C produced nine calibrated radiocarbon dates centered between about 166 B.C. and A.D. 414. The first six of these were obtained by Dietz and Jackson (1981:675), who used the designations CA-MNT-114 and CA-MNT-115, respectively. They suggested that these two areas were used as a single locus of activity, which we agree is likely.

CA-MNT-113B produced 6 projectile point fragments, 4 flake tools, 6 cores, 1 chopper, 1 burin, 4 ground stone tools, 3 *Olivella* beads, 1 *Olivella* shell fragment, 1 *Haliotis* chipped disc, 1 *Haliotis* shell spoon, and 1 fragment of a *Mytilus* fishhook. The only temporally-sensitive bead was an *Olivella* Type G2/G6.

CA-MNT-113C produced 8 projectile points or point fragments, 14 flake tools, 6 cores, 1 chopper, 2 mortar fragments, 25 battered cobbles, 21 *Olivella* beads, 12 *Olivella* shells or shell fragments, 2 chipped *Haliotis* discs, 1 unfinished *Haliotis* pendant, 4 *Mytilus* fishhook fragments, and 3 awl fragments. The only temporally-sensitive beads were two *Olivella* Type G2/G6.

Based on an additional test which we conducted at CA-MNT-113C in 1999, this site appears to have been a Middle Period occupation area which was probably used on a seasonal basis. Principal activities included shellfish gathering and processing, along with hunting and fishing. Processing of vegetal foods is inferred from the mortars and manos. With three specimens in a 90 cm unit, the relative frequency of *Mytilus* shell fishhooks is the highest we have encountered in the Monterey Bay area (Breschini and Haversat 2000c). This level of recovery can be attributed in part to the

use of 1/8 inch mesh and wet screening with laboratory sorting. These three fishhooks were all dated, and ranged from 170 B.C. to A.D. 95. (Fig. 23a).

Dietz and Jackson (1981:692) note that 87% of all obsidian debitage recovered during their project, which involved 19 sites, came from the upper levels of CA-MNT-113B and CA-MNT-113C. They suggest that exotic (trade) materials will generally be found at residential bases, and that these two sites may represent seasonal residential bases used by collectors. No obsidian hydration readings are available for these sites.

CA-MNT-108 is a large, multi-component site. An Early Period component at the base of Fisherman's Wharf was investigated in the late 1980s (Breschini and Haversat 1989; see the following section). Subsequent investigations around the Custom House, about 100 meters to the south, revealed the presence of separate Middle and Late components (Breschini and Haversat 1993).

We employed 1/8 inch mesh and wet screening with laboratory sorting throughout this project, which is probably why we were able to recover large quantities of shell beads.

No radiocarbon dates were obtained on the Middle Period deposit because it had been disturbed; the primary unit consisted of soils which had been pushed over a bank to help fill an area of beach. The different layers created by the earth movement stood out clearly throughout the unit, until clean beach sand was encountered at a depth of 361 cm below the surface. The beads were in inverse order, with the oldest types being nearest the surface.

The 296 shell and stone beads and ornaments included 67 which are temporally sensitive. These were *Olivella* Types F1 (2), F2 (3), G2 (3), G6 (52), and L2 (7). No *Mytilus* fishhook fragments were recovered.

Bead manufacturing was documented by 281 pieces of bead manufacturing waste and 3,353 whole *Olivella* shells.

The range for obsidian hydration readings is 3.3-5.2 (Napa, 5 specimens), and 2.1-5.4 (Casa Diablo, 50 specimens). About two-thirds of the specimens fall within the range 2.8-3.9 (Napa) and 3.3-4.8 (Casa Diablo).

Summary

The first two sites discussed above were placed within the "middle" period based on radiocarbon dates. The third site was placed within this period based on a large assemblage of *Olivella* beads which, at other sites, have been shown to represent the "middle" period (thus avoiding a strong case of circular reasoning).

The artifacts which appear to be most characteristic of the "middle" period include *Olivella* Types F2 and G2/G6. Type F1 is thought to be an Early/Middle Transition style, and L2, an Early Period style which extends into the Early/Middle Transition, but neither of these attributions is yet documented by radiocarbon dating.

Also characteristic of the "middle" period are quantities of the curved *Mytilus* fishhook. These artifacts appear to occur in smaller quantities in the "late" period. The only dates on these fishhooks we know of are from our project at CA-MNT-113C, where three specimens average about 100 B.C.

The obsidian hydration range for the "middle" period should be close to 2.8-3.9 for Napa and 3.3-4.8 for Casa Diablo, but only about two-thirds of the specimens from these sites fit within these ranges.

"Early" Period (1200 B.C.-ca. 4000 B.C.)

Several "early" period sites have been tested on the Monterey Peninsula, but some of the better samples appear to be from CA-MNT-108, CA-MNT-170, and CA-MNT-391. CA-MNT-108 is located at Fisher-man's Wharf, CA-MNT-170 is located at the southern tip of the peninsula, and CA-MNT-391 is located in the Cannery Row area.

CA-MNT-108 was mentioned above as a "middle" period site, but there was a substantial "early" component as well (Breschini and Haversat 1989). The two components were generally horizontally stratified, but there appears to have been some intermixing.

The discussion which follows deals only with radiocarbon dates and temporally-sensitive artifacts. The other results of the excavations are too detailed to adequately summarize in a few paragraphs.

Four single-shell *Haliotis* samples produced a range from 2462-1209 B.C. In our 1989 report we extrapolated a longer occupation based on the depth of the site and the placement of these four *Haliotis* samples, suggesting occupation from about 3000-500 B.C. If accurate, this would span most of the "gap" between 1200-400 B.C. At this point, we must conclude that we do not have good evidence for occupation during this time period. A mixed *Mytilus* shell date was obtained at 933 B.C., which could represent occupation during part of the gap, but it could also represent mixture with some "late" *Mytilus* shells. This is perhaps another example of the dangers of using only *Haliotis* shells (see Example 3, above), and of using too few samples. Our impression at this point is that additional dating using single pieces of *Mytilus* shell would expand the age of this site considerably beyond that documented by the four *Haliotis* samples. Certainly the obsidian hydration

readings suggest a considerably earlier date than is so far documented by the four radiocarbon dates.

The temporally-sensitive *Olivella* beads included Type L2 (10), an "early" period marker, but also included 16 beads (F2, G2/G6) which are "middle" period markers.

Other artifacts thought to characterize the "early" period are bone fishing gorges. As we have seen, the "middle" and "late" periods are characterized by curved *Mytilus* fishhooks.

Bead manufacturing was documented during the "early" period as well, with 341 pieces of bead manufacturing waste and 135 whole *Olivella* shells. Shell beads were probably the method used to pay for the obsidian which was brought in from distant sources (Breschini and Haversat 1989:82-83).

The range for obsidian hydration readings is 4.9-5.5 (Napa, 4 specimens), and 2.5-7.1 (Casa Diablo, 18 specimens). All of the Napa specimens fall within the range 4.5-7.5, but only half of the Casa Diablo specimens fall within the range 5.6-8.0 (micron readings suggested by Dietz's rim age equivalents table). As Casa Diablo is the dominant obsidian on the site, this clearly suggests a more recent component and is in agreement with the *Olivella* beads.

CA-MNT-170A is a two-component site, with the often-seen "early" and "late" components. In this case they are horizontally-stratified, with the "late" gathering site on the coastal bluff and the "early" village farther inland, where it probably would have been more sheltered in the trees. These "early" and "late" components are also seen at CA-MNT-17, CA-MNT-148, CA-MNT-438, CA-MNT-834A, and several of the Pacific Grove sites tested by Dietz and Jackson (1981).

We tested CA-MNT-170A in 1980, and characterized the two dated site components as the Monterey and Sur Patterns because we recovered virtually no artifacts. This designation was picked up by Moratto (1984), and as a result is still included in any regional syntheses even though it has long since been eclipsed by our more recent research. What we described as the Monterey Pattern has subsequently been re-characterized as the Late Period Coastal Shellfish Processing Site, Abalone Processing subtype (Breschini and Haversat 1991b). What we described as the Sur Pattern is essentially the same as the sites described herein as “early” or Early Period.

Dietz (1991) conducted the data recovery excavations, and obtained a large sample of both components (60.4 cubic meters, using both 1/8 inch mesh and 1/4 mesh dry field screening).

The four radiocarbon dates on the “late” gathering site spanned a narrow range from A.D. 1410-1498. This range is narrower than is often found; CA-MNT-1084 (see Fig. 4), for example, produced five radiocarbon dates within a range of A.D. 974-1277, CA-MNT-129 produced four radiocarbon dates within a range of A.D. 991-1407, and CA-MNT-17A produced eleven radiocarbon dates within a range of A.D. 1159-1806.

The radiocarbon dates on the “early” component range from 3962-1485 B.C. (this is currently the oldest dated site on the Monterey Peninsula).

All of the radiocarbon dates from CA-MNT-170A have been obtained using abalone shell. Would additional data be provided if mussel shells were dated?

Temporally-diagnostic artifacts included ‘early’ period *Olivella* Types L2 (4) and L3 (1) beads, but no “middle” period types.

The five *Olivella* Type L beads are a very small sample for 60+ cubic meters of deposit, even using

1/4 inch mesh and dry field screening—Type L beads are almost always large enough to be found in 1/4 inch mesh.

The obsidian hydration readings produced equivocal results. There are virtually no readings which can be attributed to the “early” component at CA-MNT-170A. The Napa readings (2.2-4.5 microns) barely reach the “early” component, but instead represent the “late,” “middle,” and the gap. The same is true for the Casa Diablo readings (2.3-5.6 microns). What we may be seeing is a lack of obsidian trade reaching CA-MNT-170A throughout most of the “early” period. CA-MNT-108, probably the most important early residential site in the Monterey Peninsula area (Breschini and Haversat 1989), has significantly older obsidian readings in spite of younger radiocarbon dates. This is illustrated in Table 7.

Was CA-MNT-170A an outpost of some kind which did not receive obsidian, shell beads, or other important items from the “trade center”? The obsidian and beads which were in common usage at CA-MNT-108 were apparently not reaching CA-MNT-170A for much of its long span of occupation.

CA-MNT-391, in the Cannery Row area of Monterey, has produced the largest sample yet obtained from a site on the Monterey Peninsula. Because the site was to be destroyed for a parking lot, volunteers were organized to supplement the data recovery effort, and on Memorial Day weekend, 1984, a hundred or more archaeologists answered the call. In all, some 300 cubic meters of soil were excavated and screened (Cartier 1993a).

In all, 22 radiocarbon dates have been obtained from the site, but only eight are on single pieces of shell. The range of these samples, all obtained using *Haliotis*, is 3292-1422 B.C. Other *Haliotis* dates suggest a “middle” occupation, but these, as has been

noted elsewhere, are questionable samples and cannot be relied upon.

We have pointed out the dangers of relying on a single shell species, particularly *Haliotis*, for all of one's dates, and indeed, four *Mytilus* samples have been obtained from CA-MNT-391. These samples, which we obtained during early investigations, are in the 3100-1500 B.C. range, but they were obtained using multiple pieces of shell and are now not considered very reliable.

There is no support in the shell bead inventory for a "middle" occupation. In all, 529 *Olivella* Type L beads, characteristic of the "early" period were recovered, but no beads clearly associated with "middle" or "late" periods were found. Is this because 1/4 inch mesh and dry field sorting were used for most of the data recovery? It is hard to believe that other bead styles, such as the G2/G6, if present, would have been missed; these beads are almost always larger than 1/4 inch mesh.

Bead manufacturing was also documented at CA-MNT-391.

Another question arises on dating. Six radiocarbon dates were obtained from Unit 7N/8W, from the 20-30, 40-50, 60-70, 80-90, 100-110, and 120-130 cm levels. We believe that obtaining samples from evenly spaced levels, such as this, is a good dating strategy. Unfortunately, the report describes the samples only

as "Shell-*Haliotis*," without specifying the number of pieces. As such, these samples are considered unreliable. However, when multiple pieces of shell are mixed together, they return an average date for those pieces. The two lowermost samples returned dates of 3525 and 2393 B.C., one of which is slightly older than the eight reliable dates, and one of which is within their range. The other four samples, however, returned dates between 863 and 100 B.C., within the "middle" and the gap as defined by our radiocarbon database. What is being averaged from these specific proveniences at CA-MNT-391 to produce dates between 863 and 100 B.C.? No matter how you approach this question, there has to be some younger material somewhere to return dates in this range. What is this material? What are its actual ages?

The shell beads do not provide any help, but what do the obsidian hydration readings say? Based on Dietz's rim age equivalent chart, most of the readings at CA-MNT-391 do not represent an "early" deposit; rather, they span the "middle" and part of the "late" periods. To some degree, this is the same pattern seen at CA-MNT-170A, discussed above. At that site there was a clear "late" deposit, consisting almost entirely of abalone shells, but no such deposit was observed at CA-MNT-391. Is this a second example where one of the secondary "early" sites contains minimal amounts of obsidian? Given the presence of 529 *Olivella* Type L beads, there is certainly no evidence that CA-MNT-391 was cut off from the bead trade.

Site	Radiocarbon dates	Obsidian Hydration (average)	
		Napa	Casa Diablo
CA-MNT-170A	3962-1485 B.C.	3.08	3.41
CA-MNT-391	3292-1422 B.C.	3.55	3.34
CA-MNT-108 (early)	2462-1209 B.C.	5.13	5.23
CA-MNT-108 (middle)	---	4.02	4.37

Table 7. Obsidian and Radiocarbon Dates from the "Early" Components at CA-MNT-170A, CA-MNT-391, and CA-MNT-108.

There is clearly something going on here which we do not yet understand.

Summary

From these discussions, it appears that the “early” period is not as clearly understood as it could be. The radiocarbon dates on the sites described above were virtually all obtained using *Haliotis* shells. It is likely that more samples, including single-shell *Mytilus* samples and individual *Olivella* shell beads, would help extend and clarify the dating at these sites.

CA-MNT-391 has the most extensive string of radiocarbon dates for the “early” period (Fig. 17). It appears likely, but has not yet been documented, that this site was regularly, although probably not continually, occupied for at least 2000 years. A nearby site, CA-MNT-103, on the other hand, has been shown to have been occupied during only one relatively brief portion of the “early” period. It is possible that habitation occurred intermittently throughout the Cannery Row area during all of the “early” period, but that some locations were occupied relatively intensely while other locations were left unoccupied for long periods.

The *Olivella* Type L bead appears to be a reliable marker for this period. Only one such bead has been dated from the Monterey Peninsula area; that bead, a Type L2a from CA-MNT-1612, returned a date of 1530 B.C. (Fig. 23c).

CA-MNT-108 has by far the oldest obsidian in the Monterey Peninsula area (omitting the possible “old quarry surfaces” at Rancho San Carlos). In the Monterey Bay, the average age of the Casa Diablo and Napa obsidian at CA-MNT-108 is equaled only by CA-SCR-177, in Scotts Valley (Cartier 1993b). Other “early” sites in the Monterey Peninsula area had obsidian which was considerably more recent. Based on this, it would be risky at this point to try to equate specific rim readings with specific time periods. If

CA-MNT-170A or CA-MNT-391 were dated using only obsidian rim readings, the results would clearly be misleading.

Finally, CA-MNT-170A and CA-MNT-391 have both produced obsidian readings suggesting a more recent component. However, neither of these sites has produced assemblages of *Olivella* shell beads or radiocarbon dates confirming the obsidian dates. All of the reliable radiocarbon dates were obtained from *Haliotis* shell. Would dating *Mytilus* shells reveal later components? Was there some activity being practiced at these sites during the radiocarbon “gap” or later which employed obsidian but which did not produce abalone or other shellfish remains for us to date?

There clearly are many questions which remain to be answered.

Directions for Future Research

Temples? Pyramids? Sorry, try Egypt or Central America.

Huge quantities of artifacts? Sorry, try the San Francisco Bay or the lower Sacramento Valley.

Pristine, undisturbed sites? Better look elsewhere for those too.

Most archaeological sites on the Monterey Peninsula don’t have as elaborate an artifact assemblage as sites in adjacent areas, and they’re generally disturbed as well. Archaeologists who are looking only for large, pristine assemblages probably should look elsewhere.

What we have are sites which have, in many cases, suffered from years of bioturbation followed by a century of urbanization. If you want to study the past on the Monterey Peninsula, that’s probably what you will end up with. This has required us to focus on research methods which produce meaningful data from

the remaining cultural matrix. Archaeologists who are unwilling or unable to deal with such contexts will probably contribute very little.

But there are some directions for future research which we believe will be productive.

As has been discussed throughout this paper, radiocarbon dating is one of the more productive directions for research. It can provide chronological data for strictly archaeological models as well as other types of studies.

For example, a disturbed site which is determined through radiocarbon dating to contain a single-component can provide a reliable sample of artifacts, debitage, faunal materials, etc. relating to that component. If the temporal variable can be controlled through accurate dating, other data automatically become more useful.

The examples in the first section of this paper show some of the mistakes that should be avoided in radiocarbon dating. Beyond this, there are some steps we can take to make the dating even more accurate.

- Additional tests should be undertaken on multiple materials from single proveniences to further clarify the Delta-R question. It is likely that the problem is more complex than we currently believe, and that micro-environments play a significant part. It is also likely that Delta-R values changed differentially through time! Careful sample selection and analyses, and full reporting of materials and dating techniques by all archaeologists working in this area will be needed to successfully address this question.
- Radiocarbon dating of *Olivella* beads may provide a good method for dating materials which co-occur with *Olivella* beads, for example in grave lots. However, *Olivella* beads were probably manufactured in a limited number of places and traded for significant distances. Establishing

the Delta-R for the sources of these beads will be more productive than the Delta-R of the coastline nearest to where the beads were found. Can we do isotopic sourcing of *Olivella* shells to determine their origins?

- We should constantly reevaluate our interpretations based on new assessments of the accuracy of the underlying radiocarbon dates. For example, the original interpretations of CA-MNT-229 (Dietz et al. 1988) had to be redone when it was realized that seven radiocarbon dates with ages greater than 6000 B.P. had been erroneously dismissed because they did not agree with other chronometric data (Jones and Jones 1992:159). We have had to reassess Cartier's (1993a) radiocarbon determinations for CA-MNT-391 because we cannot get adequate information on some of the samples, particularly those from Unit 7N/8W. This is unfortunate, as these dates, if accurate, would show that the site is an additional 1,200 years younger and 250 years older than the range established by the eight single-shell dates that appear reliable.
- There is a radiocarbon "gap" between 1200-400 B.C. Why are we not finding evidence from this time period? Did the settlement/subsistence pattern change so much that we are not recognizing and dating these sites? Is it because of an unrecognized sampling error, such as the many cases of sampling error detailed in the first half of this paper? Should we have dated more *Mytilus* shell at CA-MNT-108 back in 1989? It is hard to believe that there was a huge population drop, but that possibility will have to be explored. Was it because of the Hokan/Penutian interaction? The influence of the Penutian-speakers may have had an effect prior to the date suggested for their entry to the Monterey Bay.

One additional step that should be implemented immediately is the standardized reporting of radiocarbon results. Even within recent synthetic monographs

(e.g., Erlandson and Jones 2002) there is no consistent method among the various articles for reporting results. For example, one article reports conventional age and calibrated dates at 1 sigma while another reports measured age, ages when corrected for $^{13}\text{C}/^{12}\text{C}$, and calibrated dates at 2 sigma—but both omit the actual ^{13}C measurement. Information which is critical for the long-term applicability of a date is what the sample included (material, number of pieces), provenience, measured age and range, and ^{13}C (if available). With this basic information we should be able to recalibrate the date whenever the calibration datasets are improved.

In conclusion, it appears that there is a great deal of information which can be used to make up for the limited numbers of artifacts in many of the sites on the Monterey Peninsula. In addition to strictly archaeological models, more anthropologically-derived models may offer new insights. In either case, accurate radiocarbon dating is one of the primary keys to better understanding the past.

Lest it be thought that we are advocating abandonment of the Early/Middle/Late model, our point is that there should be more, rather than fewer, models. Perhaps its time for archaeologists to expand their “horizons.”

We also need to conserve our remaining cultural resources so as to preserve as much data for future research as possible. Likewise, in monitoring and other projects which document site disturbance, we need to maximize our information return as mitigation for that disturbance and data loss. Monitoring projects which simply watch cultural soils being hauled to the Marina dump contribute nothing to science.

So, as Professor Frank Leonhardy charged us long ago, we now charge you: “Go forth and do science!”

End Note (June 29, 2005)

This article was submitted on June 1, 2004. Since then, we have obtained 53 additional dates from Monterey County and made a number of additional finds in the study area. Rather than try to update the article, we will summarize a few of the more pertinent findings in this end note.

First, the “gap” in the radiocarbon dates has been further refined with additional radiocarbon dates and, in one case, reanalysis of an existing date. The “gap” we described as extending from 1200-400 B.C., with only two dates in that span, can now be extended to 1200-200 B.C., with only three dates in that span, and one of these three dates is now questionable.

Recent reanalysis and additional dating at CA-MNT-148 suggest the date from that site is erroneous. This date, 2855 ± 80 (WSU-3927; 875 B.C.; two sigma cal. 1125-741 B.C.) was obtained in early 1989 from the lowermost abalone shell in a discrete stack of abalone shells resting on a working surface. Dating two additional abalone shells from immediately above the original shell produced dates of 3520 ± 50 (Beta-204630; 1688 B.C.; two sigma cal. 1884-1511 B.C.) and 3540 ± 70 (Beta-205525; 1724 B.C.; two sigma cal. 1946-1504 B.C.). These dates are well before the gap begins, suggesting the original WSU date is erroneous.

Further research has shown that this gap currently can be observed in the northern half of Monterey County, not just on the Monterey Peninsula. It has not been observed in the southern half of Monterey County or in Santa Cruz County.

We still have no additional conclusions on the origins of this gap, but it is becoming increasingly clear that it is real, rather than the result of bias or sampling error, and that it is limited largely to the northern or northwestern portions of Monterey County.

We have obtained additional dates on shell beads.

- An *Olivella* type L2b from CA-MNT-831 returned an age of 3900 ± 40 (Beta-203062; two sigma cal. 2344-1958 B.C.), extending the range for this type back to ca. 2144 B.C.
- A *Mytilus* type L2b bead from CA-MNT-831 returned an age of 3290 ± 40 (Beta-203061; two sigma cal. 1478-1154 B.C.).
- An *Olivella* type E2a bead from CA-MNT-125 returned an age of 480 ± 40 (Beta-205525; two sigma cal. A.D. 1497-1804). There are now six type E1 and E2 beads dated within a narrow intercept range of A.D. 1634-1694.

Finally, investigations at CA-MNT-831 have produced a radiocarbon date on the Peninsula of 6400 ± 80 (5190 B.C.; two sigma cal. 5360-4920 B.C.). This is 1200 years older than the next oldest date for the peninsula.

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