CHAPTER 8

Punctuated Culture Change in the San Francisco Bay Area

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THE SAN FRANCISCO BAY AREA SUPPORTED A DENSE hunter-gatherer population over thousands of years, a population that has left a rich and varied archaeological record. When Spanish settlements were established in 1776, the Bay Area was a place of incredible language diversity. Seven languages were spoken—Southern Pomo, Wappo, Patwin, Coast Miwok, Bay Miwok, Karkin Costanoan, and San Francisco Bay Costanoan (Figures 8.1, 8.2). The diverse ecosystem of the bay and surrounding lands supported an average of three to five persons per square mile, but reached over six persons per square mile in the Los Altos–Palo Alto vicinity in the South Bay and 11 persons per square mile in the Petaluma River basin in the North Bay (Milliken 1995a:19–21).

At Spanish contact, the Bay Area people were organized into local tribelets that defended fixed territories under independent leaders (Kroeber 1932). Typically, individual Bay Area tribelets included 200 to 400 people distributed among three to five semipermanent villages, within territories approximately 10 to 12 miles in diameter (Milliken 1995a). Bean and Lawton (1973) describe aspects of contact period regional organization as follows:

> Within the aboriginal social-religious institutions . . . smoothly articulated intergroup relationships were regulated by . . . secret societies or cults, confirming and demonstrating who had economic and political privileges, always supported in a ritual and cosmological referent of some sort. These institutions were responsible for distributing energy within the various subsystems, so that temporal or spatially related inequities in food and other economic goods could both be alleviated or maintained, depending on the particular needs of the corporate group. (Bean and Lawton 1973)

The distribution of artifacts in protohistoric sites—clamshell disk beads, distinctive *Haliotis* pendants, flanged steatite pipes, chevron-etched bone whistles and tubes, elaborately finished stone "flower pot" mortars, and needle-sharp coiled basketry awls—reflects the relative complexity of the native world at the Spanish arrival.

In 1984 both Moratto and the Chartkoffs dated the appearance of complex hunter-gatherer societies in the Bay Area to about 4,000 years ago, and both argued that complexity increased from that time forward. Both authors looked to population growth as a stimulus for resource intensification, increased cooperation, and social stratification (Chartkoff and Chartkoff 1984:227–237; Moratto 1984:276, 281–283). Moratto (1984) differed from the Chartkoffs (1984) by incorporating "language group migration" into his explanatory model. He posited that proto-Utians (ancestors of all Costanoan and Miwok-speaking groups) entered the East Bay about 4,500 years ago and then expanded throughout the Bay Area at the expense of forager groups who spoke Hokan languages. Subsequent development took place, he suggested, through internal change within the Utian population, with final Augustine Period development driven by indirect influence from Wintuan populations expanding into the North Bay (Moratto 1984:283). Chartkoff and Chartkoff (1984:205) rejected the importance of language group migration as an explanation, and instead asserted that new kinship systems were the innovation that freed people to increase status differentiation and develop rational regional institutions (Chartkoff and Chartkoff 1984:149–150).

The San Francisco Bay Area archaeological record as of the early 1980s has been summarized by Moratto (1984:227–237, 252–283). As ground disturbance has continued in the Bay Area since then, so too has archaeological fieldwork. Large-area survey, common in rural California, seldom takes place in the urban Bay Area. Instead, sites are usually encountered prior to or during

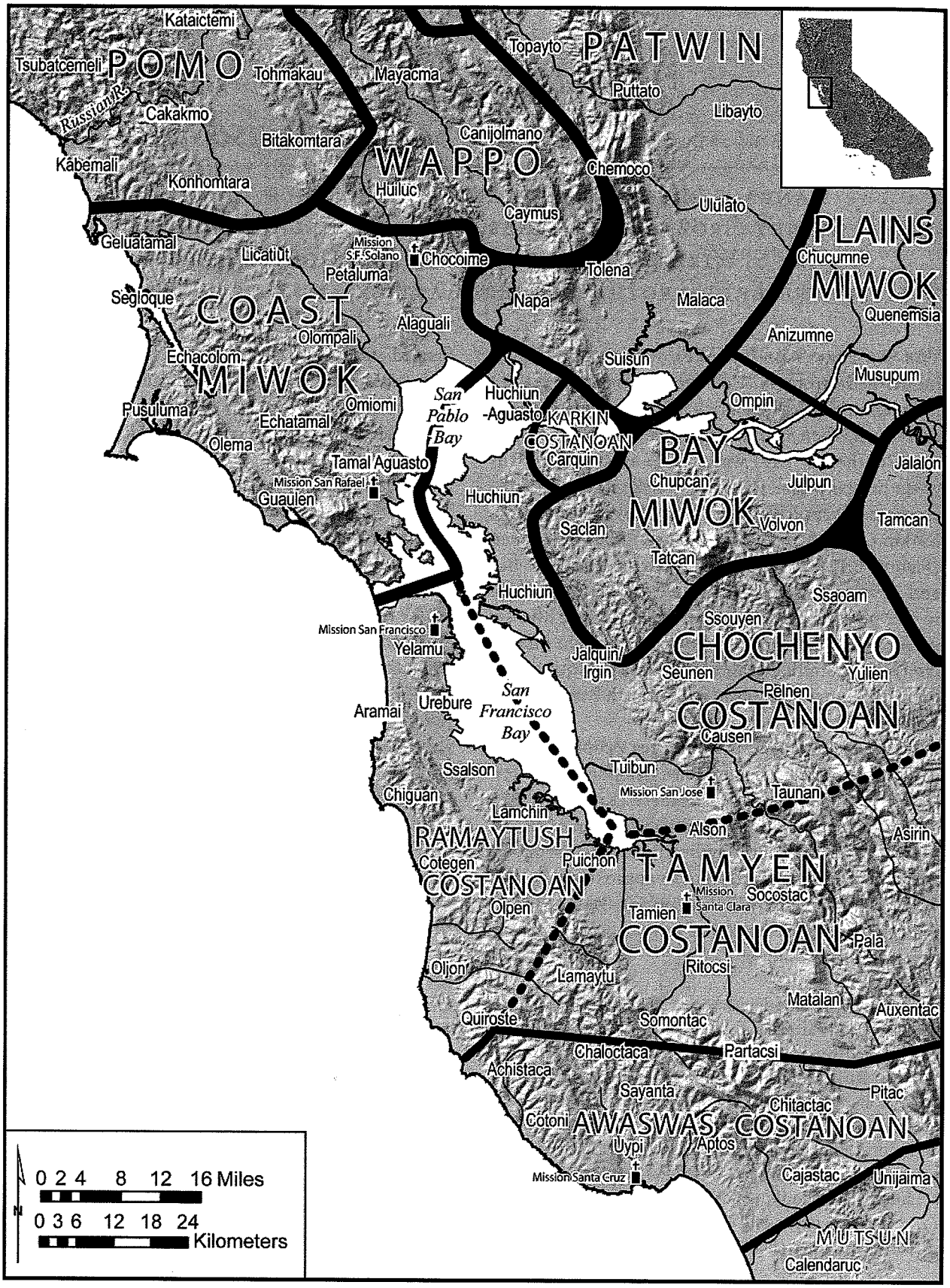


Figure 8.1. San Francisco Bay Area language groups and local, multivillage tribal communities.

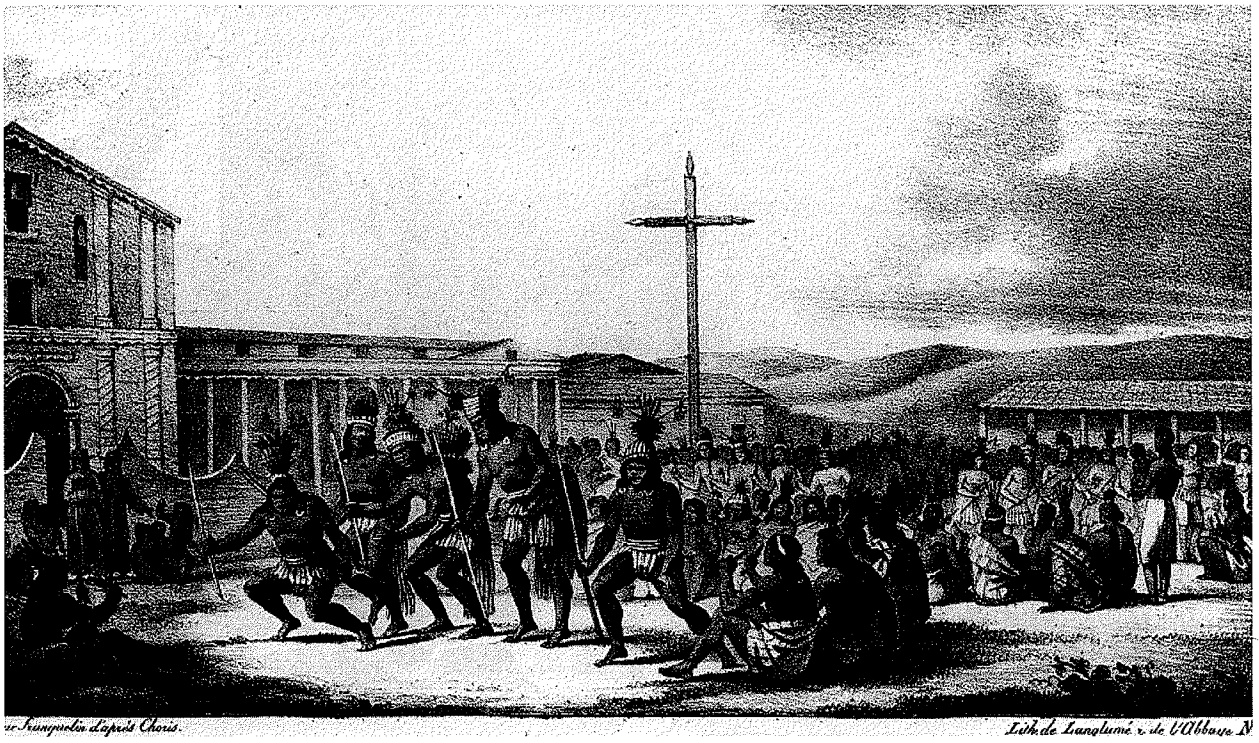


Figure 8.2. Dancers and audience in the plaza of Mission Delores (San Francisco) in October 1816, by L. Choris. (Courtesy of the Bancroft Library, University of California-Berkeley.)

land alteration for new home and industrial park development, urban redevelopment, highway construction, or linear underground utility installation. Figure 8.3 shows the locations of 200 prehistoric Bay Area sites with dated components critical to the interpretation of San Francisco Bay Area prehistory. Of the 200 sites, 93 (46 percent) were first studied prior to January 1, 1983, while the other 107 (54 percent) have been reported since that date. Santa Clara and San Francisco Counties have seen the greatest relative amount of post-1982 study, while Marin and Contra Costa Counties have seen relatively little (Table 8.1).

The initial sections of this chapter update topical themes—chronological and taxonomic issues, settlement systems, subsistence patterns, mortuary patterns, and physical anthropology. The final section takes a sequential approach. It describes cycles of change in Bay Area prehistory—population growth, economic intensification, symbolic integration, conflict, then crash—along a trajectory of generally increasing cultural complexity.

CHRONOLOGICAL AND TAXONOMIC ISSUES

A Hybrid Cultural Taxonomy

The San Francisco Bay Area is the meeting ground of two different systems for organizing the archaeological record into coherent units of observation and comparison.

- The Early-Middle-Late Period nomenclature of Beardsley (1954), dubbed the Central California Taxonomic System (CCTS) by Gerow (1968), is used by South Bay archaeologists (Bellifemine 1997; Cartier et al. 1993; Hylkema 2002) and some Central Bay archaeologists (Broughton 1999; Lightfoot and Luby 2002).
- The *Archaic-Emergent* temporal structure of Fredrickson (1973, 1994a), with specific cultural configurations identified by economic patterns, stylistic aspects, and temporally constricted regional phases, is used by North Bay archaeologists (Stewart 2003; White et al. 2002) and some Central Bay archaeologists (Meyer and Rosenthal 1997).
- A hybrid system, marking large blocks of time with the Early-Middle-Late Period structure and differentiating units of culture with Fredrickson's pattern, aspect, and phase concepts, is used by some Central Bay archaeologists (cf. Banks and Orlins 1985:28–51; Wiberg 1996a:123–128, 1997:9–17).

The third alternative, the hybrid system using the Early-Middle-Late Period *temporal sequence* (with all earlier post-Pleistocene times lumped as the Early Holocene) and the pattern-aspect-phase *cultural sequence*, is used in this chapter (Figure 8.4). The hybrid

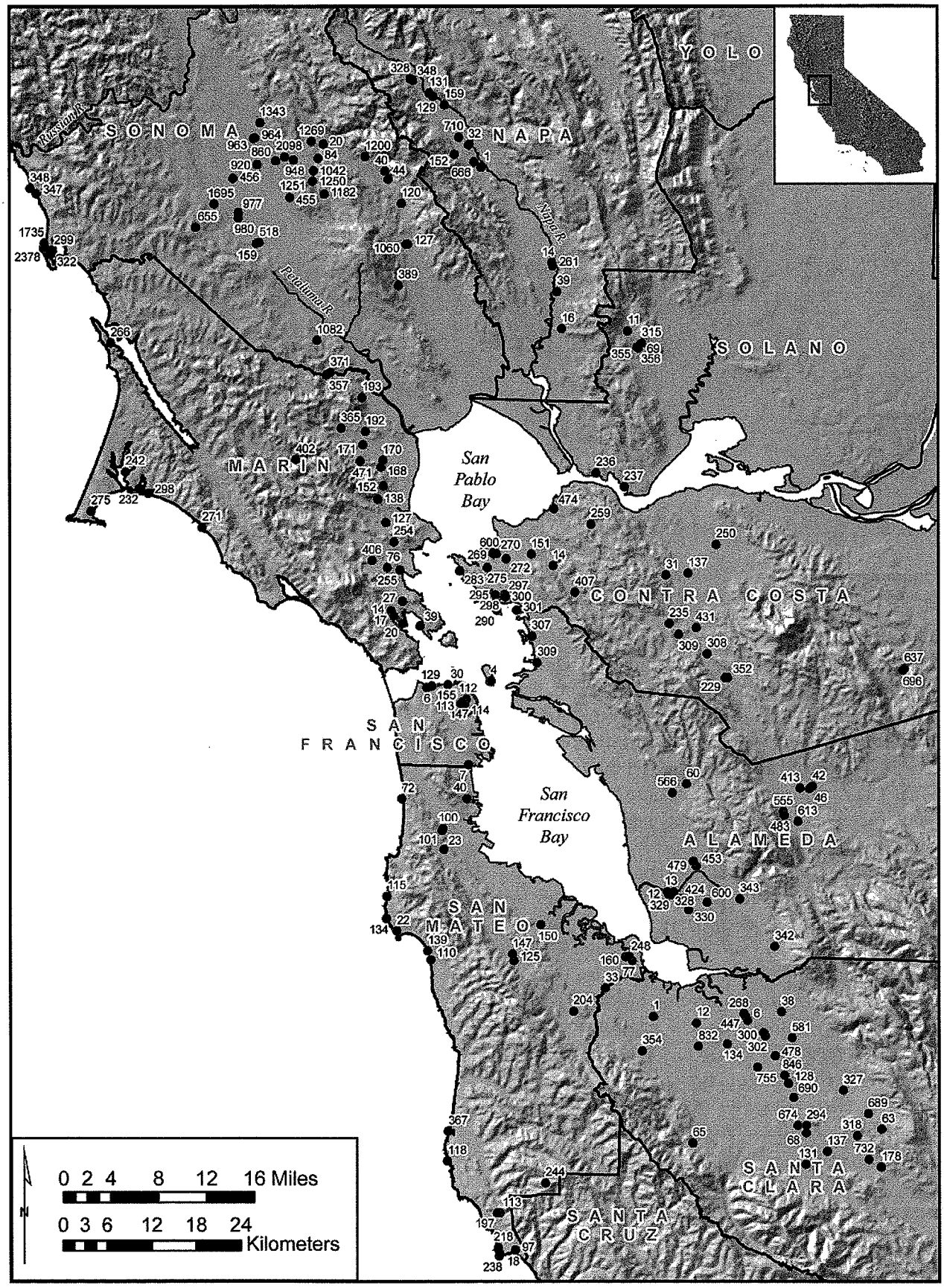


Figure 8.3. Archaeological sites and locations of the San Francisco Bay Area.

Table 8.1. Counts of Sites Mapped on Figure 8.3 by County, Differentiating Pre- and Post-January 1, 1983, Reports and Noting Density of Reported Sites

County	Sites Mapped on Figure 8.3	Pre-Jan. 1983 Reports	Post-Jan. 1983 Reports	Bay Area Land (square miles)	Square Miles per Mapped Site
Alameda	21	12 (57%)	11 (43%)	780	37
Contra Costa	28	21 (75%)	7 (25%)	580	21
Marin	28	21 (75%)	7 (25%)	588	21
Napa	14	6 (43%)	8 (57%)	500	36
San Francisco	10	2 (20%)	8 (80%)	91	9
San Mateo	26	9 (35%)	17 (65%)	531	20
Santa Clara	30	6 (20%)	24 (80%)	760	25
Solano	7	3 (43%)	4 (57%)	170	24
Sonoma	36	13 (36%)	23 (64%)	740	20
Total	200	93 (46%)	107 (54%)	4,740	24

taxonomic system has the advantage of allowing the identification of regional aspects within larger cultural patterns, as well as allowing subdivision of cultural patterns into short sequential phases of 200- to 300-year duration, when data are available. In deference to North Bay nomenclature, however, Archaic-Emergent equivalents to the Early, Middle, and Late Periods are selectively added below in parentheses.

Patterns, Phases, Aspects, and Localities

Definitions for the concepts of pattern, phase, and aspect are explained here as we use them in this chapter, following Fredrickson (1973, 1994a). The term *locality* is explained both as Fredrickson (1973, 1994a) used it and in the different way we use it in this chapter.

Patterns are units of culture marked by distinct underlying economic modes, technological adaptations, and ceremonial practices (Fredrickson 1994a:39–47). Separate patterns could co-occur in restricted geographical areas. For instance, during the Early Period (Middle Archaic) the range of Mendocino Pattern mobile foragers overlapped the territories of Lower Berkeley Pattern sedentary villagers in the northernmost portions of the San Francisco Bay Area.

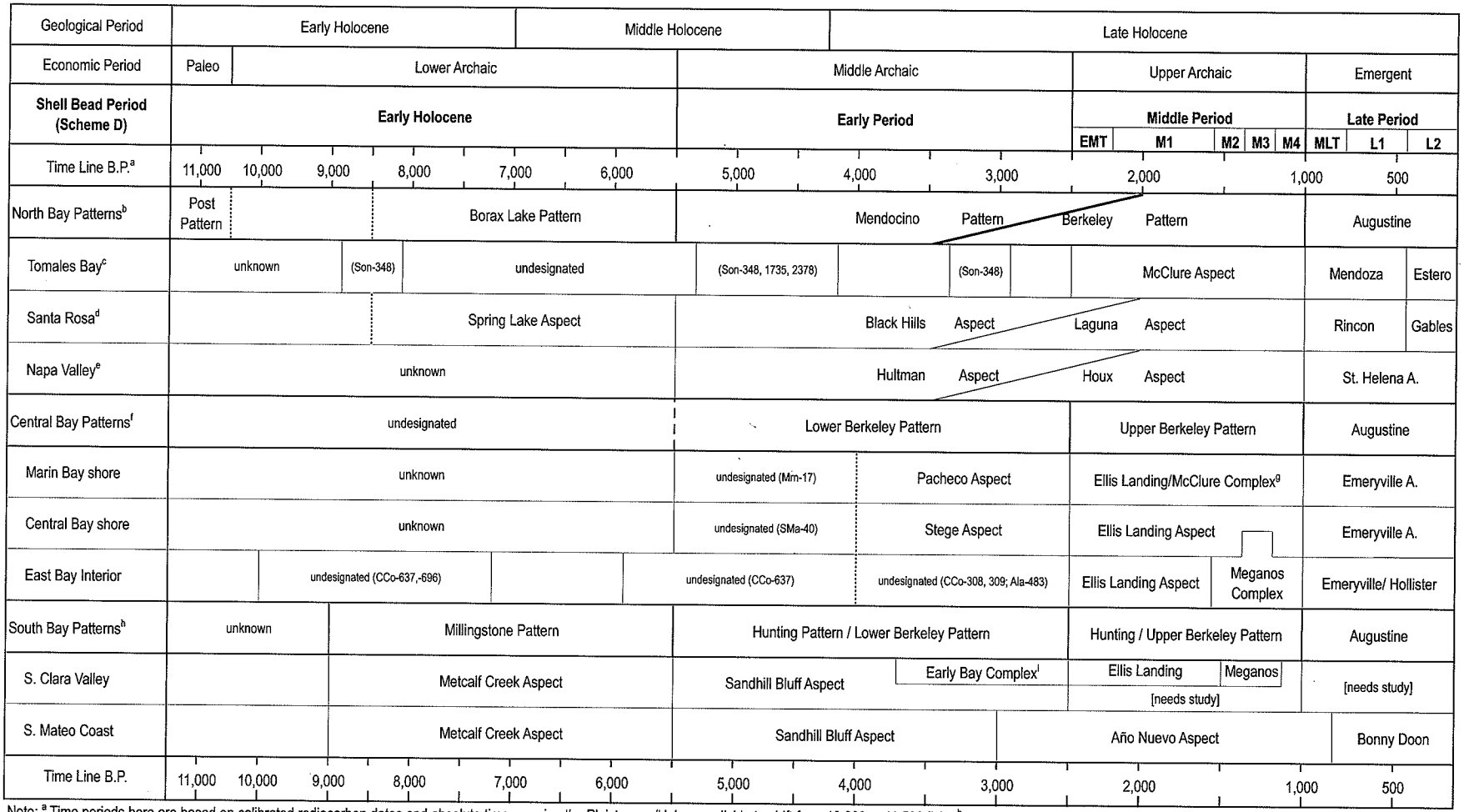
Phases, following terminology developed by Willey and Phillips (1958), are the smallest units of related site components "spatially limited to the order of magnitude of a locality or region and chronologically limited to a relatively brief interval of time" (Fredrickson 1994a:34). Phases in most parts of California, and most areas of the world, tend to be anywhere from 500 to many thousands of years long. But Bennyhoff (1994c:74) isolated sequences of short cultural phases of 200- to 300-year duration for many parts of the Late Holocene San Francisco Bay Area. Names of the local phases, such as Castro and River Glenn, derive from type sites (Bennyhoff 1986; Fredrickson 1973, 1994a). We consider documentation of such named phases crucial for future comparative research, but beyond the scope of the current overview (for phase seriation of artifacts, see Moore [1982]).

Aspect is the term Fredrickson coined to identify a local variation of one of his major economic patterns. "A sequence of phases within a single district is referred to herein as an *aspect.* Both phases (during a single time interval) and aspects (usually covering several time intervals) are district representatives of a pattern, a generalized cultural configuration usually encompassing one or more regions" (Fredrickson 1994a:35). Under the hybrid taxonomic system, Beardsley's (1954) Bay Area Stege, Ellis Landing, and Fernandez facies are considered to be San Francisco Bay Aspects of the more widely distributed Lower Berkeley, Upper Berkeley, and Augustine Patterns. Also under the hybrid system, the long phases of the South Bay chronology, such as Metcalf Creek and Sandhill Bluff, become aspects of a pertinent pattern (Figure 8.4).

Locality, according to Fredrickson (1973), is a "geographical space which exhibits complete cultural homogeneity at any given time." For purposes of inquiry, research, and comparison, the Bay Area has been divided into 18 localities in this chapter. Fredrickson's locality could change shape over time. In contrast, the localities of this chapter, such as "the San Mateo Coast," the "Santa Rosa Plain," and "the Livermore Valley," are fixed geographic areas, approximately 16 miles in diameter. We can be fairly certain that before the Spanish arrival, contemporaneous archaeological sites within each locality would have been created by people who interacted directly with one another, whether or not they shared a specific culture.

Shell Bead Horizons and Dating Scheme D

The cultural patterns, aspects, and phases of the Bay Area are anchored in time by Dating Scheme D, a pan-



Note: [a] Time periods here are based on calibrated radiocarbon dates and absolute time, causing the Pleistocene/Holocene divide to shift from 10,000 to 11,500 B.P.; [b] North Bay patterns follow White et al. (2002), who has modified Fredrickson (1973); [c] Tomales Bay aspects follow Beardsley (1954) with components at Duncans Landing noted (Kennedy 2005); [d] Santa Rosa aspects follow Fredrickson (1989); [e] Napa Valley aspects follow Fredrickson (1984:515); [f] Central Bay aspects follow Bennyhoff (1994c:74); [g] Marin bayshore Upper Berkeley Pattern components suggest a complex of Ellis Landing and McClure Aspect elements (Goerke and Cowan 1983:63); [h] Patterns and aspects in the South Bay, encompassing San Jose, Santa Teresa, and Point Año Nuevo localities, are from Hylkema (2002); [i] Early Bay Complex is distinguished at University Village site (SMa-77) because it mixes central bay Stege Aspect (Ala-307) ornaments and tools with a flaked tool assemblage typical of the south bay Sandhill Bluffs Aspect.

Figure 8.4. Concordance of archaeological time periods, patterns, and aspects in the San Francisco Bay Area.

central California sequence of directly dated *Olivella* shell bead horizons. Scheme D is the fourth radiocarbon-based sequence available for central California. The first such scheme, here called Scheme A, was introduced in 1958 by R. F. Heizer on the basis of 17 radiocarbon dates. In 1984, central California archaeologists, including the Chartkoffs and authors in the Moratto volume, relied on Dating Scheme A. It is a "long" chronology, placing the beginning of the Late Horizon (Late Period) at A.D. 300 to 500 (uncalibrated radiocarbon years).

Dating Scheme B was introduced by Bennyhoff and Hughes in their 1987 *Olivella* shell bead monograph. It was based on 180 central California radiocarbon dates from charcoal, collagen, and shell; the dates were neither calibrated nor corrected for the marine reservoir effect. Scheme B moved the Middle/Late Period Transition (MLT) forward to A.D. 700 to 900. Elsasser (1978:41) proposed a compromise between Schemes A and B that was labeled Scheme C by Bennyhoff and Hughes (1987:147).

Dating Scheme D was developed by Groza (2002) in consultation with a consortium of archaeologists and in cooperation with the Indian community. It was initially based on 103 AMS radiocarbon dates on well-provenienced *Olivella* beads representing 10 of Bennyhoff's 11 bead horizons (Early/Middle Transition beads were not sampled). The new radiocarbon dates shift many shell bead horizons forward in time as much as 200 years. (See Chapter 17, Figure 17.2 for a representation of the Scheme D Late Holocene time periods in relation to the southern California temporal sequence.)

The notation used in this chapter for the Scheme D shell bead horizons is new. Bennyhoff and Hughes (1987) labeled 11 Scheme B shell bead horizons within the Early, Middle, and Late Periods as *phases,* the same term Bennyhoff (1986) elsewhere applied to regionally restricted cultural units. We use the term *bead horizon* instead of *phase* for the short time periods marked by trade of particular bead types across wide areas of central California, in order to clearly separate units of time and units of culture. In our nomenclature, the Early Period/Middle Period Transition bead horizon (marked by split-beveled *Olivella* beads) can be noted as the EMT. Bead horizons of the subsequent Middle Period are labeled M1, M2, M3, and M4; each has its own signature shell bead array. The MLT (Middle Period/Late Period Transition) and Late Period bead horizons L1 and L2 follow. (No shorthand is used for the Early Period, since it has yet to be divided into shorter bead horizons.) We reiterate that the bead horizons are units of *time,* with no cultural implications other than the fact that they are defined by widely traded shell bead types.

Summary: A Complex Taxonomy for a Complex Prehistory

The large number of separate prehistoric Bay Area cultural aspects are shown in Figure 8.4. The figure is a nightmare of detail to novices and archaeologists with "lumper" predilections, yet it represents real and significant variation in time and space. Aspect-defining artifacts for three localities in or near the San Francisco Bay Area are illustrated in Figures 8.5 (Santa Rosa Locality), 8.6 (San Mateo Coast Locality), and 8.7 (Los Vaqueros Locality, east edge of the Central Bay Area). See pages 119–123.

SETTLEMENT SYSTEMS

Since the 1980s Bay Area researchers have sought to interpret settlement systems within Binford's (1980) forager-collector model, which posits two extremes of hunter-gatherer behavior: mobile small bands versus storage-oriented central place villagers (cf. Polansky 1998). T. F. King (1974b) suggested synchronic variations along the forager-collector cline in the Bay Area during the Middle Period, with inhabitants of bay shore Marin County living in sedentary villages nestled in rich heterogeneous environments, in contrast with inhabitants of the Fremont Plain, who moved seasonally between marsh edge villages and camps in upland oak groves.

Years earlier, Beardsley (1955:138–139) contrasted the *central-based wandering model,* in which a community "spends part of each year wandering and the rest at a settlement or central base to which it may or may not consistently return in subsequent years" with the *semipermanent sedentary model,* in which a community "can be identified with a village that establishes itself in successive locations, occupying each for several years." More recently, Banks and Orlins (1981) presented a version of the central-based wandering model on the basis of historic evidence for San Francisco Peninsula tribelets at the time of the Spanish arrival. Tribelet populations on that landscape were divided among three to five specific villages, some or all of which relocated more than once a year. Because the system was used by territorially restricted groups in a densely populated landscape, it should not be confused with a mobile forager strategy. Banks and Orlins (1981) called it a *periodically mobile home base* model.

North Bay

In the North Bay, a concept of concurrent landscape use by settled collectors and wide-ranging mobile foragers was introduced by Wickstrom (1986) for part of the Late Holocene in the Santa Rosa Locality. Jones and Hayes (1989:16–18; 1993) refined the Santa Rosa Locality land-use sequence. They classified site components into site types (task-specific locations, residential camps, and semipermanent villages), then stratified them by time (primarily using obsidian hydration) and environmental zones (Jones and Hayes 1989:229). The pattern that emerged suggested Paleo-Indian forager use of lacustrine zones, followed by Lower Archaic (Early Holocene) and Middle Archaic (Middle Holocene and Early Period) forager residential camps along marshes and on grasslands, succeeded by Upper Archaic (Middle Period, i.e., after 500 cal B.C.) "concurrent use" by people using forager residential camps and people using semipermanent collector villages, finally leading to Emergent (Late Period, i.e., post cal A.D. 1000) semipermanent collector villages in oak woodlands, with residential camps along marshes.

Fredrickson (1989a) offered an analysis of changing North Bay settlement and chronology similar to that of Jones and Hayes (1989), but specific to the Laguna de Santa Rosa area along the west side of the Santa Rosa Plain. He proposed that overlapping use of the Laguna area by foragers (Black Hills Phase of the Mendocino Pattern) and collectors (Laguna Phase of the Berkeley Pattern) occurred between 1500 cal B.C. and cal A.D. 1. Later, Jones and Hayes (1993) redated the period of forager-collector overlap to cal A.D. 500 to 1000.

South Bay

In the 1970s King and Hickman (1973) proposed that Late Period settlement in the Gilroy-Hollister area (south of the San Francisco Bay Area) utilized valley-edge logistical centers, with special task locations in the higher uplands and along marsh edges. In the 1980s prehistorians tested the applicability of the model to the San Jose Locality at the south end of San Francisco Bay and the inland Santa Teresa Locality between San Jose and Gilroy (see Elsasser 1986). Bergthold (1982) showed that the large residential villages of the northern Santa Clara Valley were typically out in the center of the valley along perennial streams, but she lacked the temporal evidence necessary for documenting change or continuity of settlement pattern over time. Cartier et al. (1993:54) revisited Bergthold's model with new temporal evidence, suggesting that some settlement shifts occurred in the Santa Teresa Locality about 2,000 years ago and arguing for a population drop in the San Jose Locality at the end of the Middle Period.

Early mobile forager land use gave way to semisedentary collector land use in the South Bay by the outset of the Middle Period (Upper Archaic) at about 500 cal B.C., according to a recent synthesis by Hylkema (2002:233, 250). By cal A.D. 700 that collector pattern was trending toward the more complex social organization that would lead to the rich midden central sites of the Late Period. Meanwhile the forager system persisted through the Middle Period on the nearby San Mateo coast to the west; it did not change to the collector mode until the Late Period, after cal A.D. 1200. When coastal area people did shift to a collector economy (with mortar and pestle predominance at central sites), they developed a specialized transhumance pattern between upland meadows and coastal terrace—summer hunting for juvenile deer in the uplands, then winter otter and harbor seal hunting on the coast (Hylkema 2002:255).

Central Bay

Central Bay settlement pattern studies have been time stratified and locality based. Banks and Orlins (1981) used the "periodically mobile home base" model that we mentioned above to explain how so many Middle Period residential sites could have been generated in the Richmond Locality of the East Bay. They documented 28 residential sites within a 10 kilometer circle, each containing at least two meters of cultural deposit, and inferred that they were generated by people who utilized only two or three of the sites as semipermanent villages at any one time. The problem for archaeologists, they pointed out, is that sites used as residences during one generation may have been used as special activity locations by other generations, making locality-wide settlement patterns nearly impossible to interpret.

Parkman (1994:45) built a model of "the semisedentary and seasonal nature of the settlement of the southern Alameda County bay shore, an area that is characterized by a broad plain separating the bay shore and bay hills." He pointed out an increase in deer (found in the hills) relative to elk at bay shore sites during the Late Period (citing Hildebrandt et al. 1984; Watts 1984) and argued that Middle Period elk hunters were not as logistically oriented as the Late Period people, who brought deer and processed vegetal foods

back from inland foothills to bay shore residential villages during the spring and fall.

Wilson (1999) presented a more complex settlement pattern analysis for the Fremont Plain, modeling differing land use over five time periods—Early, EMT, Middle, MLT, and Late—broken into components using obsidian hydration, radiocarbon dates, and seriated artifacts from eight residential/cemetery sites. He posited light initial residential occupation at the end of the Early Period at ALA-343, six kilometers inland from the bay marshes. He inferred that the bay marsh edge was first settled at the Patterson Mound (ALA-328) at the end of the Early Period, around 600 cal B.C. (Wilson 1999:5). He viewed the Middle Period as a time of competition between two unrelated groups, a marsh-oriented people at ALA-328 and an inland people at ALA-343 who "began challenging ALA-328 for area dominance" (Wilson 1999:6). He inferred that the Late Period was a time of peace and locality-wide integration, on the basis of an increase in identified site components along the bay shore marsh and farther inland. Wilson's study could be strengthened by tracking possible settlement shifts through the four phases of the Middle Period. Nevertheless, the study provides a rare, time-sensitive analysis of site distributions and discusses sites in terms of human communities.

Late Period population and settlement increase around San Francisco Bay has generally been accepted (see Elsasser 1978:43), but some scholars have argued that it actually decreased (Beardsley 1954:84–86; Banks and Orlins 1981; Jones 1992:12–15; Hildebrandt and Jones 1992:378; Holson et al. 2000:24–28). Lightfoot and Luby (2002) examined settlement patterns within a 15 by 15 kilometer area of the Richmond Locality. Most of the sites in their sample were bay shore sites with Middle Period components. Late Period components, on the other hand, were fewer in number and more evenly distributed between bay shore locations and locations three to five kilometers inland. "Some sites that served as mounded villages in the Middle Period were apparently deserted and then later re-used as special-purpose places in the Late Period where individuals continued to be buried and where occasional gatherings and ceremonies took place" (Lightfoot and Luby 2002:277). They concluded that the Middle Period was a golden age of shell mound communities and that population dropped during the Late Period, concurrent with the shift of central sites away from the bay shore (Lightfoot and Luby 2002:276–277).

In order to see if a general shift inland occurred everywhere around the bay, we collated evidence for bay shore and inland habitation at four localities. Our results support a view of decreased bay shore strand occupation in the Richmond Locality. But the decrease occurred after Bead Horizon M1 within the Middle Period rather than at the beginning of the Late Period (Table 8.2). Elsewhere, increased Late Period bay shore occupation is indicated in the San Rafael and Fremont Localities, while Middle to Late Period stability is suggested in the San Jose Locality. All in all, data on settlement shifts are inconclusive due to (1) small sample sizes, (2) geographic bias in past archaeological testing programs, and (3) varying geomorphic processes of site burial.

SUBSISTENCE PATTERNS

Late-twentieth-century research interest in subsistence behavior—from least effort modeling to patch utilization theory to optimal foraging theory—has generated new studies and new insights about Bay Area prehistory. In this section we review selected studies on mammal, shellfish, and plant harvest.

Mammal Harvesting Patterns

Late Holocene faunal exploitation in the South Bay over the past 4,000 years has been characterized as a deer economy by Hildebrandt et al. (1984), utilizing the principles of optimal foraging theory (see Broughton 1999:5–12 for theoretical considerations). Since 1990 numerous faunal studies have been undertaken using intensification theory. Hildebrandt and Jones (1992) studied 11 bay shore sites to document a shift from large-bodied pinniped, especially northern fur seal, dominance in the Early Period (2500 to 500 cal B.C.), to terrestrial large mammal dominance in their Middle Period (500 cal B.C. to cal A.D. 1 [actually the EMT]), to an increase in sea otter and harbor seal in their Late Period (post cal A.D. 1, encompassing most of the Middle and Late Periods). Hylkema (2002:254) noted a shift from large sea mammal exploitation to sea otter exploitation along the San Mateo coast at a later date, the onset of the Late Period.

The concept of the broad-spectrum coharvesting exploitative strategy—short-term local shifts from one resource to another as a flexible adaptive response to resource explosions and crashes—was offered by Simons (1992:73–103) as a description of the central California mode of animal harvest for the entire late Holocene. He documented an increase in the harvest of sea otters, relative to large artiodactyls, on the bay shore during the Middle Period, followed by a rebound of deer exploitation during the Late Period.

Table 8.2. Counts of Site Components (Stratified by Distance from the Bay Shore) at Four Example Localities, Together with Total Count of All Documented Components at the 200 Sites Mapped on Figure 8.3

Locality	*Bead Horizon Phase*									
Distance from Bay	Early 3,000 yrs	EMT 300 yrs	M1 600 yrs	M2 200 yrs	M3 200 yrs	M4 250 yrs	MLT 200 yrs	L1 300 yrs	L2 250 yrs	Total
San Rafael Locality (25 sites)										
0–2 km	2	1	6	1	1	4	4	7	6	32
2–10 km	1	1	0	0	0	1	0	0	2	5
10–16 km	0	0	0	0	0	0	0	0	0	0
% for locality	8	5	16	3	3	14	11	19	22	*100*
Richmond Locality (29 sites)										
0–2 km	5	9	10	7	4	3	3	4	6	51
2–10 km	0	0	1	4	4	3	1	3	3	19
10–16 km	0	0	0	0	0	0	0	0	0	0
% for locality	7	13	16	16	11	9	6	10	13	*100*
Fremont Locality (16 sites)										
0–2 km	0	2	3	3	2	2	2	5	4	23
2–10 km	0	0	1	0	3	1	2	0	1	8
10–16 km	0	0	0	0	0	0	0	0	0	0
% for locality	0	6	13	10	16	10	13	16	16	*100*
San Jose Locality (20 sites)										
0–2 km	1	0	1	0	2	1	3	4	2	14
2–10 km	2	3	4	4	6	4	1	3	1	28
10–16 km	1	0	1	0	0	0	1	2	0	5
% for locality	9	6	13	9	17	11	11	19	6	*100*
Total Bay Area (200 sites)										
Components	61	56	86	60	67	64	67	105	101	667
% of Total	9	8	13	9	10	10	10	16	15	*100*

Hylkema (1991:377; 2002:257) suggested that otters were harvested for their pelts rather than their meat, based on the relative completeness of sea otter skeletal remains at Late Period site SMA-115 on the coast just south of San Francisco. Broughton (1994b) argued that foraging efficiency declined through the Late Holocene on the basis of increasing ratios of otter to deer in 18 temporally discrete Middle and Late Period site components from three localities around the bay. He interpreted the increase of sea otter bone as evidence of deer population decline that may have been partially related to human-deer competition for acorns. When sorted by time, Broughton's components reveal that the shift to otter predominance took place suddenly at the M1/M2 divide, about cal A.D. 425 to 475, when a new cultural pattern, the Meganos Aspect, was spreading into the East Bay. The suddenness of the otter bone increase leads us to suggest a cultural interpretation, that the new group may have desired sea otter pelts for cloaks or vests.

A buffer zone patch exploitation model was offered by Broughton (1999) to explain an artiodactyl rebound at the Emeryville shell mound (ALA-309) following many years of relative increase in small mammal remains at the site. Broughton dated the beginning of the rebound at cal A.D. 1, and he noted a gradual increase in the deer-to-small mammal ratio up to cal A.D. 1250. He posited the existence of buffer zones between the habitation areas of neighboring tribal communities, zones where deer could thrive and be available for people willing to travel great distances to hunt them and carry them back to their core tribal areas (Broughton 1999:64–65). Broughton's conclusion is based on the study of a trench sample from a single site. Valente (1998b:212), in a single site study at MRN-254, found the opposite type of fau-

nal assemblage change, from a Middle Period cervid economy to a more diversified Late Period economy that included waterfowl, deer, and carnivores. Future studies of change and continuity in faunal exploitation patterns will have to rely on comparative study of multiple sites within localities, in order to overcome the problems of limited and anomalous component samples.

Differences in faunal assemblages over the past 2,500 years are attributable to geography and habitat, not intensification over time, concludes a recent comparative study by Simons (2004:408–422). He compared the faunal assemblages of the inland Santa Clara Valley, the East Bay, and western Solano County. He found that intensive cottontail rabbit harvesting was important throughout the Middle and Late Periods everywhere but in Solano County. He noted that fractions of deer, elk, and pronghorn varied with geography but not time, a pattern that supports his 1992 broad-spectrum coharvesting model.

Intensification of Shellfish Harvesting

A shift from oyster harvesting to mussel harvesting and then clam digging was noted on the central and northern bay shore very early (Gifford 1916). Bennyhoff (in Elsasser 1978:39; in Moratto 1984:262) seriated the shifts to the Middle Period, oyster giving way to mussel at the M1/M2 break (about cal A.D. 430), and mussel giving way to clam at the M3/M4 break (about cal A.D. 800). Moratto (1984:259) favored sedimentation as the explanation for the shifts. Jones (1992:4) reopened the possibility that the shifts reflected oyster overexploitation. Broughton (1999:71) too argued that oysters and mussels were overharvested, forcing people to dig clams out of the mud. Story et al. (1966:48) suggested that an oyster bed near San Mateo had been smothered by sedimentation at about cal A.D. 250–350, just prior to Bennyhoff's suggested oyster-mussel shift. Gottsfield (in Pastron et al. 2004:79–80) documented a sudden shift from mussel exploitation to clam exploitation at the Mission Bay site cluster (SFR-112, 113, 114, 147, 155) on the northern San Francisco Peninsula at approximately cal A.D. 100–160. A possible correlation between this foraging shift, the bay sedimentation event, and a cultural disruption at the M1/M2 boundary (the Meganos intrusion discussed below) deserves future study.

In the South Bay, clams were never an important dietary element; mussel and oyster harvesting persisted through the Late Period (Bickel 1976:37; Cartier 1996; Rosenthal 2001). Roop et al. (1982) and later Cartier et al. (1993:168–171) have noted large amounts of coastal shellfish (relative to bay shellfish) in sites of the Santa Teresa Locality, more than 16 kilometers south of the bay, in contrast to the preponderance of bay shore shellfish in sites of the bay shore San Jose Locality.

A sudden intensification of tiny horn snail (*Cerithidea* spp.) harvest, relative to the oyster and mussel harvest, occurred along the South Bay shore at the outset of the Late Period. Hylkema (2002:252) suggested that increasing populations began to gather horn snails during off-months when mussels were inedible. An alternative social intensification model might suggest that surplus labor was being spent in the Late Period to gather the snails as luxury food items, regardless of high collection costs.

Plant Harvesting Intensification

The accepted paradigm of plant harvesting—that acorns were not added to small seeds as important carbohydrates until 4,000 years ago—has been called into question in the past 10 years with the aid of macrobotanical recovery from midden and features. Wohlgemuth (2004:144–145) synthesized recent macrobotanical studies to present a comparative view of plant harvesting intensification in central California. Acorn use is well documented in the Early Holocene (Lower Archaic), but small seed use is not. Millingslabs and handstones, the original paradigm infers, were used to process small hard seeds and nuts, whereas mortars and pestles were used to make flour from acorns (Fredrickson 1973; Moratto 1984:264; see also Basgall 1987). We now know that mortars were in use at least 5,700 years ago in the Bay Area (Rosenthal and Meyer 2004a:34–35; Wohlgemuth 2004:143).

Passive acorn leaching is evidenced during the Early Period (Middle Archaic), along with peak use of bulbs and some use of small seeds, in pits at SOL-391 near Fairfield. Pounding acorns for flour increased during the Middle Period (Upper Archaic). Use of small seeds, including green-phase seeds, increased greatly in the Late Period (Emergent Period) at the Fairfield site and at most other sampled localities in west-central California. At a few sites on the immediate shore of San Francisco Bay (ALA-309, 310, 604), however, sparse amounts of acorn and small seeds were recovered from Middle Period components, and neither acorn nor small seeds were recovered from Late Period components (Wohlgemuth 2004:114–120).

Wohlgemuth's (2004:70) bay shore data were strongly weighted to the EMT and M1 basal levels of

one site, ALA-309 (Emeryville). Popper and Martin (Wiberg 2002:9–11) report remarkably high amounts of goosefoot, along with acorn and several other seeds, at EMT site SCl-478 (Skyport Plaza), only four kilometers south of the bay shore in the San Jose Locality (see also Legare 1998 for MRN-254). Obviously a larger comparative sample is needed, as is a rigorous study of burned small seed preservation problems, in order to refine our understanding of plant food resource use in the past.

MORTUARY PATTERNS AND SYMBOLIC EXPRESSIONS

Evidence of ritual treatment of the dead is one of the few archaeological windows for viewing the emergence of social complexity in the past. Despite the fact that professional archaeologists avoid excavating burials in the Bay Area whenever possible, more burials have been scientifically removed over the 25 years since 1982 (approximately 3,750) than were removed over the previous 100 years (approximately 3,570), due to ongoing urban development. In this section we discuss the themes pertinent to social complexity—mortuary contents, mortuary structure, relative grave wealth, and interpretation of change in mortuary structure and wealth over time.

Status Goods and Surplus Labor

The full array of artifacts that prehistoric Californians placed in the graves of their deceased is too extensive to recount here (Beardsley 1954:80–101; Bickel 1976; Fredrickson 1974b; Moratto 1984:264–265, 275–276; Leventhal 1993). Ornamentally shaped stone mortars may be the most expensive items found as grave offerings. Fully shaped examples appear after cal A.D. 1200 (Bellifemine 1997; Leventhal 1993:222; Wilson 1993). Beardsley (1954:31) found that some ornamental mortars weighed 80 pounds and had been carried over 30 miles to their final disposition site. Transportation is the least of the costs for the creation of a fully shaped show or flower pot mortar, however. Leventhal and Seitz (1989:156–165) determined that it took 17.2 hours and 46,000 blows just to create a small five centimeter mortar cup on a granodiorite boulder. Leventhal (1993:225–226) writes, "The energy output . . . must have made these large, finely made objects highly desirable commodities, especially for wealthy families."

Shaped marine shell beads are another category of items placed with burials that were costly to manufacture or obtain. Thousands of beads went into the ground as mortuary offerings each year during most time periods. Raw material was obtainable only along the coast. Each shaped bead, cut from the hard wall of *Olivella, Haliotis,* or clamshell, represented almost an hour of production activity. C. King (1974b:84) argued that high-labor beads circulated in centralized political systems where it was important to control flows of subsistence goods from community food stores; less expensive decorative beads (of larger diameter, less careful edge finish, or made from softer materials such as steatite), on the other hand, circulated in economic systems where centralized control was not an issue (see Chapter 17 for discussions of recent studies on Santa Barbara Channel shell bead manufacture and trade and the implications for the Bay Area).

Beautifully manufactured blades of obsidian and chert or carefully shaped elongate elk femur artifacts distinguished occasional burials during some bead horizons of the Middle Period. Late Period mortuaries contain steatite pipes with elaborate flanges, elongated flanged stone pestles, stone plummets (charmstones), and a wide array of distinctive *Haliotis* ornaments. Destruction and burial of wealth items in Middle and Late Period mortuaries intentionally or unintentionally prevented the depreciation of wealth item values that would have accompanied their accumulation among the living. Wealth destruction also indicates that surplus time and specialized labor were available to replenish the supply.

Cemeteries versus Dispersed Graves

Four modes of mortuary location and organization have been described in the Bay Area. The first, and seemingly most common, is the noncemetery pattern, where people were buried in a dispersed informal way under house floors and at other places in or adjacent to a village. The other three are dedicated cemeteries where interments were placed in some formal structure: (1) cemeteries in rich midden adjacent to villages, (2) cemeteries away from villages in sterile or near-sterile sediments, and (3) possible dedicated cemetery mounds with formal burials and some dietary residue from feasting.

Both dispersed and compact mortuaries in rich midden sites were well documented prior to 1984 (T. King 1970, 1974b:38; Fredrickson 1974b:62–63). Since then, many off-village cemeteries have been documented in East Bay and Santa Clara Valley Middle Period and MLT sites. One example is the multicomponent Rubino site (SCL-674) in the Santa Clara Valley, regarding which Pastron (1999:iv) stated, "The intensity of occupation at the site was at no time

commensurate with the extensive number of burials interred there." The Mazzoni site (SCL-131), another nonvillage cemetery in the Santa Clara Valley, is remarkable for its lack of grave offerings. A cache of obsidian blades at the cemetery may "represent a conspicuous, highly valued commodity, offered, not cached . . . [in] homage to a sacred plot" (Pastron and Walsh 1989:86); obsidian hydration rims suggest the cache was buried during poorly documented Bead Horizon M4. In the East Bay, a number of nonmidden cemeteries, each representing one or two upper Middle Period bead horizons (M2, M3, M4), have now been recognized (Bennyhoff 1994c:66).

Leventhal (1993) proposed that bay shore mounds were dedicated burial and funerary sites. He argued that the Ryan Mound (ALA-329) in the Fremont Locality had been created by "large groups of people purposefully engaged in mound-building activities as part of the commemoration, ritual obligation and specialized treatment for mostly a distinctive class of people" (Leventhal 1993:259). The mound, occupied continually during Bead Horizons M4 through L2, contained little shell, but typically large amounts of waterfowl bone. Leventhal (1993:251–252) interpreted the dietary remains as the product of feasts and cemetery offerings left after groups gathered to honor the elite dead. Lightfoot (1997) summarized the more commonly accepted view that the bay shore mounds are multipurpose sites, used repeatedly as residential locales, ceremonial centers, and long-term repositories for the dead.

Luby and Gruber (1999:101) incorporated part of Leventhal's thesis, that bay shore mounds were places where feasting occurred as part of mortuary ritual. Luby (1992) described a shift of mortuary patterning at the Patterson Mound (ALA-328) in the Fremont Locality, from an organized submound cemetery (presumably off-village) to a midden mound village with dispersed inhumation. That shift occurred over a short period of time, between the beginning and end of the EMT (500 to 200 cal B.C.). Luby (2004) recently interpreted the shift as a reflection of cultural change, from explicit social inequality to public expression of an egalitarian ideal.

Statistical Analysis of Mortuaries

Only three mortuary studies have been carried out since 1984 that take a quantitative approach to the structure of a Bay Area cemetery. Cartier et al. (1993) developed a statistical method to quantify social inequality on the basis of the range of wealth within a given mortuary component. This methodology attempted to score the value of each type of item found in grave lots; uncommon and exotic items and those representing large investments of production time were given high scores. The total score for a given grave was called the grave association (GA) score. Using GA score distributions, they highlighted distinctions along a cline from the poorest mortuary (SCL-128, Holiday Inn) to the richest mortuary (SCL-690, Tamien Station) in their study area. Wealth was most evenly distributed in the richest cemetery, Tamien Station (SCL-690, predominately an MLT site). Inequality was highest in the poorest site, the Holiday Inn site (SCL-128, mixed M2, M3, L1, L2 components).

Bellifemine (1997) utilized multivariate analysis to demonstrate a high degree of spatial organization in the largely L1 cemetery at SCL-38 (Yukisma site), a dark midden site where 244 individuals were recovered with 32,000 beads and other associated artifacts. She made the following observations about the cemetery:

> The central cluster is strongly associated with males and cremations, while four of the other clusters (two in the middle ring, two in the outer) have a balanced sex ratio. This last could indicate lineal groups, clans, or moieties, and later DNA analysis could verify this patterning. Furthermore, there are preferential areas for youths, elders, and infants in the intermediate and peripheral regions. . . . There is also a correlation between the artifact frequency sets and the spatial clustering. (Bellifemine 1997:260)

Mortars and pestles in the SCL-38 mortuary tended to co-occur in burials with beads, whereas utilitarian bone artifacts tended to co-occur with bone tubes and whistles (Bellifemine 1997:260). Four artifact types were restricted to the rich central cemetery area: charmstones, stone beads, type K *Olivella* beads, and type M *Olivella* beads. If this pattern holds at other sites, it could be used to refine the GA scoring system proposed by Cartier et al. (1993).

The third statistical approach to a Bay Area mortuary was that of Luby (1992, 2004), as part of his study of the submound and midden mortuaries of the Patterson Mound (ALA-328) during the EMT. Of 100 graves in the basal strata of the site that included both mortuaries, 30 were randomly selected and scored for burial attributes. Cluster analysis, specifically unweighted pair–group cluster analysis, was applied to the sample, illuminating two distinct groups of similar burials: (1) a statistical cluster containing a small but diverse array of accompaniments, primary inhuma-

tion, and cremation, that included most of the sterile sediment submound burials, and (2) a statistical cluster of dispersed interments in the midden just above the submound burials, with very few accompaniments and no cremations. Based on this study, Luby (2004) argued for the decline in publicly expressed social inequality at the beginning of the Middle Period.

The Meaning of Mortuary Wealth

By 1984 most scholars agreed that formal cemeteries with differential grave wealth, reflecting the emergence of status ascription and hierarchical social control, appeared late in Bay Area prehistory. But disagreement existed regarding the precise time of that emergence. T. F. King (1974b:38) argued for status ascription's first appearance at the beginning of the Middle Period (Upper Archaic), while Fredrickson (1974b:62–63) did not see it until the beginning of the Late Period (Emergent). Recent studies indicate that cemetery wealth differentiation did not develop steadily over time and space. Milliken and Bennyhoff (1993) illustrated an increase in mortuary wealth and wealth differentiation, expressed by shell bead numbers and concentration, from the Early Period to the Middle Period, followed by a marked increase during the MLT, then a steady decline through Bead Horizons L1 and L2 of the Late Period (Hylkema 2002:258–261; Wiberg 1996a:376–380). They offered two alternative explanations for the Late Period drop in mortuary bead counts and concentration: (1) bead inflation as certain bead types became accessible to most families in a culture (cf. King 1990:95, 118 for the Santa Barbara Channel) or (2) a shift from show-off behavior (conspicuous destruction of wealth through funerary offering by a limited numbers of rich families) to conspicuous gifting behavior (redistribution of beads by rich families to poorer families at funerary or mourning ceremonies).

A mortuary pattern that seems on the surface to suggest social equality may mask more subtle aspects of social control, writes Luby (2004). A simple and undifferentiated mortuary pattern, such as the terminal EMT midden inhumations at ALA-328, may mask the presence of a strong aggrandizer leadership if that leadership accepts an egalitarian ideal. A decrease in mortuary inequality over time may reflect emergence of a corporate mode of inequality, where collective ritual, kinship affiliation, public mound construction, and suppressed display of economic differences are emphasized (Luby 2004:18).

With the new concepts of conspicuous gifting and egalitarian ideal in mind, we are reminded of Fredrickson's (1974b:65) argument that the people who brought the Late Period Augustine Pattern into the Walnut Creek Locality had an incipient social ranking system. Status and prestige were obtained and controlled through membership in a new regional ceremonial system that was marked in graves by unique status markers, especially "banjo" *Haliotis* ornaments (Fredrickson 1974b:65–66, see also Chartkoff and Chartkoff 1984:237; Leventhal 1993:230–236).

We conclude the review of mortuary studies with a caution that there may have been periods, as yet undocumented, when access to symbols of wealth and power was impeded. Mortuaries lacking grave associations are difficult to place in time. In large, multicomponent bay shore mounds, such as the Emeryville shell mound, any short time periods of burial without any grave associations would be impossible to recognize. Inability to recognize and study the temporal patterning of wealthy-poor mortuary assemblages may be inhibiting us from recognizing evidence of punctuated change in the past.

PHYSICAL ANTHROPOLOGY

Physical anthropology research in the Bay Area prior to the 1980s focused on biological distance between populations (Breschini 1983:52–55). More recent bioarchaeological studies have explored additional research issues, including skeletal evidence for dietary stress and signs of interpersonal violence and warfare.

Physical Types and Genetic Populations

As proposed by Gerow (1968), a single physical type prevailed among all central California peoples throughout the Late Holocene, with the exception of the divergent Windmiller people of the delta. The central California type was characterized by a broad-headed (mesocephalic) cranium in combination with relatively small postcranial morphology (Wallace and Lathrop 1975). The Early Period Windmiller people, on the other hand, were longheaded (dolichocephalic) and taller. Gerow (1993) later suggested that the Windmiller people were migrants into California with affiliation to archaic populations of the eastern United States and lowland eastern Mexico. Whatever their origin, the Delta people became smaller and wider-faced over time. By the Late Period they were morphologically similar to other central California peoples, including Bay Area groups (Gerow 1968:96–98).

Breschini (1983:56–61) distinguished a Penutian (Wintuan and Miwok) cranial type from a Hokan (Shasta and Salinan) type using discriminate analysis

on small samples from geographically discrete areas. He argued that Bay Area Costanoan speakers exhibited metric cranial characteristics intermediate between Hokan and Penutian extremes, concluding that the Costanoan speakers are a genetic mix of the two. This conclusion is controversial in light of ongoing debate among linguists regarding the reality of either the Hokan or Penutian language stocks (Chapter 6 in this volume). The differences Breschini found may track the effects of genetic drift rather than migration events (Cartier 1993:90; Suchey 1975). It is also important to recognize that Breschini's interpretations were based on an extremely small sample of metric data.

Despite concerns about overinterpretation, osteologists have continued to measure skeletal attributes that may illustrate population differentiation and mixing. In an intriguing study in the Green Valley area of the Napa Locality, Wiberg (1992:236) contrasts the 2600 to 500 cal B.C. cemetery population at SOL-315 with the cal A.D. 600 to 1900 population at adjacent site SOL-355: "Osteometric data indicate earlier site inhabitants were more narrow-headed and postcranially smaller than later [ones]" suggesting to Wiberg a shift from Yukian or Hokan people to Penutian people at 500 cal B.C.

Stark shifts in physical type have also been noted in the East Bay. Early Period Livermore Valley people were significantly larger than subsequent Middle Period and Late Period people (Wiberg 1996a:377–379). On the Fremont Plain, Hall et al. (1988) reported that the individuals of the Meganos extended burial population at ALA-343 (M3 Bead Horizon) were larger and higher-vaulted than typical Bay Area people, but somewhat smaller than Windmiller populations. That pattern supports Bennyhoff's (1994d:83) hypothesis that the Meganos culture carriers were intermarried Berkeley and Windmiller Pattern people. Given all these findings, a new regional comparative study of cranial and postcranial attributes, by bead horizon and locality, seems warranted.

Osteology and Health

Bay Area mortuary populations have not been studied for evidence of progressive dietary stress over time to the extent that Santa Barbara Channel and Sacramento Valley populations have. Relevant data are scattered in site reports and local overviews (cf. Holson et al. 2000:524–535; Jurmain 1993; Roop et al. 1982). In a synchronic comparative study of Livermore Valley skeletal populations, Wiberg (1996a:267–284, 383) found evidence for increased upper respiratory tract infections among Late Period women, perhaps reflecting work activity in aggregated groups and exposure to fire smoke. Almost twice as many women as men exhibited carious dental lesions (during all time periods), and Late Period women showed increased cribra orbitalia, a skeletal pathology thought to result from iron-deficiency anemia (Wiberg 1996a:383). In a recent study Bartelink (2006) used stable isotope data from human bone collagen to document significant regional differences in diet and health between three different prehistoric Bay Area populations.

Evidence for Warfare

Osteological evidence for warfare and other expressions of interpersonal violence occur in four forms: (1) healed bone fractures and puncture wounds, (2) direct evidence of violent death (e.g., embedded projectile points), (3) postmortem modification of skeletal material, and (4) the haphazard disposal of the dead on burned house floors or in nonformal burial pits. Hylkema (2002:260) discussed evidence for violent death at many East and South Bay sites. Strother (2003) presented a detailed summary of evidence for violent death at nine East and South Bay sites with components dating to the Middle and Late Periods.

Well-documented evidence of violence has been reported at the EMT/M1 Skyport Plaza site (SCL-478) in northern San Jose, where Wiberg (2002) documented extended burials that "appear to be linked with evidence of violence and special mortuary treatment, i.e. partial dismemberment (trophy taking) and interment in multiple graves." Pesnichak and Evans (2005:14), reporting on a subsequent excavation in a different part of SCL-478, noted victims of violent death lying on house floors, perhaps with burned roofs; they concluded that the distribution of the skeletons and their demographic mix clearly showed that the inhabitants of SCL-478 had been attacked. At the Rubino site (SCL-674), polished forearm elements were recovered that exhibited cut marks along the shaft; it was another EMT/M1 mortuary (Grady et al. 1999).

The burial population of the Late Period Hillsdale site (SCL-294) in the Santa Teresa Locality of San Jose exhibited higher rates of healed fractures and penetration wounds, 17 percent of the total population, than reported anywhere else in North America; healed wounds were 50 percent higher in females than males (Richards 1988:120-122). Elsewhere, at several Middle Period and Late Period sites in the Fremont and San Jose Localities, Jurmain (1990) reported numerous examples of forearm trauma (usually on the left arm),

interpreted as the result of parry fractures. Additionally, multicomponent Early, Middle, and Late Period sites CCO-474 in the Richmond Locality and ALA-613 in the Livermore Locality yielded a catalog list of evidence for violent interactions, including scalping, sharp-force trauma to the neck, embedded projectile points, parry fractures, and modified human bone artifacts (Strother et al. 2005; Estes et al. 2002).

Taken as a whole, reports seem to support Chartkoff and Chartkoff's (1984:236) prediction of increased violence over time, corresponding with increased resource stress and territoriality. However, some Bay Area mortuary assemblages show little or no evidence of violent death. For instance, the mortuary population of 131 skeletons at the Kenwood II site (SCL-689) in the Santa Teresa Locality south of San Jose exhibited no signs of interpersonal violence (Clark and Reynolds 2003:8). A comprehensive study is needed, quantifying amounts of violence on a horizon-by-horizon and locality-by-locality basis, in order to reconstruct and explain changing patterns of intergroup conflict.

THE BAY AREA CULTURAL SEQUENCE IN BRIEF

This section describes a series of cultural changes in the San Francisco Bay Area over the past 10,000 years. We skip discussion of occupation during the 11,500 to 8000 cal B.C. time frame, when Clovis big-game hunters, then initial Holocene gatherers, presumably lived in the area. Evidence for those periods has not yet been discovered, presumably because it has been washed away by stream action, buried under more recent alluvium, or submerged on the continental shelf (Rosenthal and Meyer 2004a:1). We do have enough evidence to document an in-place forager economic pattern beginning at 8000 cal B.C., followed by a series of five cycles of change that began at approximately 3500 cal B.C., all described in subsections below.

The Early Holocene (Lower Archaic), cal 8000–3500 B.C.
An opaque portrait of a generalized mobile forager pattern, characterized by the millingslab and handstone and by a variety of large wide-stemmed and leaf-shaped projectile points, emerges around the edges of the San Francisco Bay Area during the Early Holocene Period (including part of the geological Middle Holocene). The earliest Bay Area date for a millingstone component is 7920 cal B.C., obtained in the mid-1990s from a discrete charcoal concentration beneath an inverted millingslab at CCO-696 at Los Vaqueros Reservoir in the hills east of Mount Diablo (Meyer and Rosenthal 1997). The date came from the deepest component at CCO-696 (390–415 centimeters), which also contained a wide-stemmed projectile point of Napa Valley obsidian with a mean hydration band of 6.9 microns. Archaeobotanical remains from CCO-696 suggested an economy focused on acorns and wild cucumbers (Wohlgemuth 1997).

The earliest documented grave in west-central California was recovered in the 1990s at CCO-637 (within a few hundred meters of CCO-696 at Los Vaqueros Reservoir), where a single radiocarbon date of 6570 cal B.C. was returned from a loosely flexed burial (Meyer and Rosenthal 1998). A 325-centimeter-deep component at CCO-696 yielded a tightly flexed burial that returned a date of 5490 cal B.C. The millingstone assemblage at Los Vaqueros reservoir has yet to be assigned a phase or aspect name (Figure 8.4).

In the South Bay, SCL-178, the Metcalf Creek site, gives its name to the Metcalf Creek Aspect (or Phase), the millingstone pattern cultural expression in the Santa Clara Valley and adjacent coast. Findings from Metcalf are discussed in more detail in Chapter 9. Another Metcalf Creek Aspect millingstone site, SCL-65 (the Saratoga site), produced two flexed burials beneath cairns of millingstones dating between 5400 and 4900 cal B.C. (Fitzgerald 1993). Local Franciscan chert dominates the Early Holocene Santa Clara Valley components (Hylkema 2002:235).

The earliest radiocarbon dates in the North Bay come from the Duncan's Landing site (SON-348/H), a rock shelter that has produced a basal date of ca. 7000 cal B.C. (see Chapter 4 in this volume; Kennedy et al. 2005). The deposit was predominately mussel shell, with limited quantities of fish, bird, and pinniped, with limited numbers of obsidian flake tools and no milling equipment (Schwaderer 1992). A wide-stemmed projectile point from the site produced a hydration reading of 7.5 microns (Borax Lake obsidian), suggesting manufacture about 8,000 years ago. Farther inland, the Spring Lake site (SON-20) in a small valley just east of Santa Rosa has yielded stone millingslabs as well as large wide-stemmed projectile points and other flaked stone tools, a large proportion made from Borax Lake obsidian from distant Lake County. SON-20 is the type site of the Spring Lake Aspect of the Borax Lake Pattern, again thought to represent a mobile forager economic pattern (Fredrickson 1989a:22-23).

The Early Period (Middle Archaic), 3500 to 500 cal B.C.
New ground stone technology and the first cut shell beads in mortuaries signal sedentism, regional sym-

bolic integration, and increased regional trade in the Bay Area, beginning at 3500 cal B.C. The earliest cut bead horizon—the *Olivella* grooved rectangle (Vellanoweth 2001), bracketed 3400 to 2500 cal B.C.; in the Bay Area it is represented so far by a single bead from the San Bruno Mound (Clark 1998:127, 156). Double-perforated *Haliotis* rectangle beads are first documented in the Bay Area in the 5,590-year-old Sunnyvale Red Burial (SCL-832), which also contained red ocher and exhibited preinterment burning (Cartier 2002). The earliest known *Olivella* rectangle beads with drilled perforations date to 4,800 years ago in a burial that contained red ocher and also exhibited preinterment burning from CCO-637 at Los Vaqueros reservoir (Rosenthal and Meyer 2000). Rectangular *Haliotis* and *Olivella* beads are the markers of the Early Period bead horizon; they continued in use at least until 2,800 years ago (Ingram 1998; Wallace and Lathrop 1975:19 for ALA-307; Gerow 1968 for SMA-77).

The mortar and pestle are first documented in the Bay Area shortly after 4000 cal B.C. Pestles utilized with wooden mortars have been dated to 3800 cal B.C. in the Los Vaqueros reservoir area (CCO-637; Meyer and Rosenthal 1997). By 1500 cal B.C. cobble mortars and pestles were used to the exclusion of millingslabs and handstones at the West Berkeley site on the east shore of San Francisco Bay (Wallace and Lathrop 1975:19) and in deeply buried components at CCO-308 in the San Ramon Valley (Fredrickson 1966) and ALA-483 in the Livermore Valley (Wiberg 1996a:373). Millingstone and mortar assemblages may or may not have been contemporary at two East Bay sites with poor component differentiation (CCO-474 [Estes et al. 2002]; ALA-613).

In the central Bay Area, the Lower Berkeley Pattern, marked by mortars and pestles and a burial complex with ornamental grave associations, represents a movement from forager to semisedentary land use at shell mounds like West Berkeley (ALA-307), Ellis Landing (CCO-295), and Pacheco (MRN-152). Elliptical house floors with postholes, dating to 1500 cal B.C., were discovered in 2005 at the Rossmoor site (CCO-309) in the Walnut Creek Locality; they clearly suggest sedentism or semisedentism in the interior East Bay (Price et al. 2006).

At the north end of San Francisco Bay, variations of mobile band (forager) economies persisted for much of the Early Period (Middle Archaic). The generalized Early Holocene Borax Lake Forager Pattern (rich in obsidian flaked stone) gave way to more localized forager lifeways of the Mendocino Pattern, the chert-using Black Hills aspect of the Santa Rosa Locality, and the obsidian-using Hultman Aspect in the Upper Napa Valley. The collector-oriented Lower Berkeley Pattern, with its cobble mortars and flexed burials in residential midden sites, spread into the Napa Valley at about 1500 cal B.C. and to the Santa Rosa Locality by 1000 cal B.C. (Bennyhoff 1994b:52). For much of the Early Period, the lowland sedentary collectors lived side by side with the upland mobile foragers who occasionally visited lowland marshes.

Lower Middle Period (Initial Upper Archaic), 500 cal B.C. to cal A.D. 430

A major disruption in symbolic integration systems is clear in the record by about 500 cal B.C., the end of the Early Period (although disruption may have begun a few hundred years earlier). The ubiquitous rectangular shell beads, in use for 3,000 years, disappeared from not only the Bay Area but the Central Valley and southern California as well. Split-beveled and tiny saucer *Olivella* beads, the first examples of a whole new suite of decorative and presumed religious objects, appeared during the EMT (Elsasser 1978:39). However, EMT mortuaries around the Bay contained few accompaniments, and spire-lopped *Olivella* beads were more common than the cut beads (Luby 2004). The first rich black midden sites are noted in the Napa Valley in EMT sites (Bennyhoff 1994b:52). New sites were occupied at Bodega Bay (Kennedy 2005). Cobble mortars and Excelsier leaf-shaped projectile points appeared on the Santa Rosa Plain (Figure 8.5).

Bead Horizon M1 of the Middle Period (Upper Archaic, 200 cal B.C. to cal A.D. 430), developing out of the EMT, marks a cultural climax on San Francisco Bay. *Olivella* saucer beads became common and new circular *Haliotis* ornaments appeared. New bone tools and ornaments also appeared, among them barbless fish spears, elk femur spatulae, tubes, and whistles (Elsasser 1978:39). Basketry awls (split cannon bones) with shouldered tips, indicating coiled basketry manufacture, appeared in the Central and North Bay (Bennyhoff 1986:70; Bieling 1998:218).

Mortars and pestles continued to be the sole grinding tools during Bead Horizon M1 in the Central Bay, while mixed mortars and millingslabs continued in use around the peripheries. Net sinkers, a typical Early Period marker all around the bay, disappeared at most sites but continued in use well into the Middle Period at SFR-112 (Pastron and Walsh 1988a:90). The pure millingslab/handstone-oriented forager economy,

however, continued along the Pacific coast of San Mateo County (Hylkema 2002:261).

Upper Middle Period (Late Upper Archaic), cal A.D. 430 to 1050

A dramatic cultural disruption occurred in central California at about cal A.D. 430. The *Olivella* saucer bead trade network suddenly collapsed, 53 of 103 known M1 sites were abandoned, sea otter bones spiked in the remaining sites, and the Meganos extended burial mortuary pattern began to spread in the interior East Bay (Bennyhoff 1994a, 1994d). These changes co-occurred with the inception of a series of *Olivella* saddle bead horizons—M2, M3, and M4—that would mark central California bead trade until cal A.D. 1000 (Groza 2002). "A Castro phase inhabitant, decked out in Saucer beads and black *Haliotis* ornaments, would have seen a Sherwood phase inhabitant, wearing ear spools, saddle bead appliqué, and red *Haliotis* rectangles, as different, even if few past archaeologists did," wrote Bennyhoff (1986:69), contrasting people of specific lower Middle Period (M1 Bead Horizon) and upper Middle Period (M3 Bead Horizon) cultural phases of his Alameda district.

The first sign of the Meganos complex, characterized by dorsal extended burials, appeared at ALA-413, the Santa Rita village site in the Livermore Valley. There, a 30-year-old man was buried at the end of Bead Horizon M1 with approximately 30,000 *Olivella* saucer beads (the largest documented California bead lot), quartz crystals, and bead appliquéd bone spatulae (Wiberg 1988). Unlike the deeper flexed interments at the site, this individual was buried in dorsally extended Meganos style. One associated saucer bead provided a median AMS intercept of cal A.D. 388 ($\Delta R = 225 \pm 35$; Groza 2002:158). Within a few years the saucer beads disappeared as burial accompaniments, replaced by rough-edged full saddle *Olivella* beads with remarkably small perforations, markers of Bead Horizon M2a. Six full saddle *Olivella* beads have been directly dated so far, from flexed burials at ALA-329 and CCO-269 along the bay shore, and from extended burials at ALA-413 and CCO-151 farther inland. All six have calibrated median intercepts in the narrow cal A.D. 420–450 time range (Groza 2002).

Bead Horizon M2b is marked by mixed *Olivella* saddle beads with tiny 1.0- to 1.5-millimeter perforations that date to cal A.D. 430–600. The Meganos mortuary style continued to spread westward during M2b. A number of new items appeared in Central Bay sites during the M2a and M2b horizons, including beautifully fashioned show blades, fishtail charmstones, new *Haliotis* ornament forms, and mica ornaments (Elsasser 1978:39:Fig. 3). The earliest evidence for inland manufacture of *Olivella* wall beads is found on the Santa Rosa Plain (Tamez 1978).

The climax of upper Middle Period stylistic refinement occurred during Bead Horizon M3 (cal A.D. 600 to 800). It is marked by small, delicate square saddle *Olivella* beads in burials, occasionally with small, poorly shaped *Olivella* saucer beads, often in off-village single component cemeteries. Single-barbed bone fish spears, ear spools, and large mortars first appear during M3. Wohlgemuth (2004:146) notes an increase in seed recovery from middens dated to this time. The Meganos mortuary complex spread during M3 from the interior almost to the Bay at the Fremont BART site (ALA-343), and into the Santa Clara Valley at Wade Ranch (SCL-302). It did not, however, reach the West Bay or the North Bay.

Bead Horizon M4 (cal A.D. 800 to 1050) may be a period of postclimax culture in parts of the Bay Area. It is marked by a devolution of the *Olivella* saddle bead template into a variety of wide and tall bisymmetrical forms, and by the appearance of distinctive *Haliotis* ornament styles (unperforated rectangles and horizontally perforated half ovals). Grave accompaniments are completely lacking at the Santa Teresa Locality Mazzoni site (SCL-131) in the South Bay, and few other mortuaries can even be dated to this time period.

Initial Late Period (Lower Emergent), cal A.D. 1050 to 1550

The lifeways in place at the Spanish entry emerged during the time of the Late Period shell bead horizons. Culture moved up a notch in complexity, from that of collectors who buried their dead with diverse, numerous, but fairly simple ornaments to collectors who invested large amounts of time in the creation of finely wrought wealth objects. The Late Period was called the Emergent Period by Fredrickson (1973, 1994c:100–101), in recognition of the appearance of a new level of sedentism, status ascription, and ceremonial integration in lowland central California. Scheme A dated the beginning of the Late Period to cal A.D. 300, but it is now clear that the Middle/Late Transition (MLT) bead horizon, marking the beginning of the Late Period, began at cal A.D. 1000. During the MLT, fully shaped show mortars, new *Olivella* bead types, and a new array of multiperforated and bar-scored *Haliotis* ornaments appeared at such sites as CCO-308

(Fredrickson 1973), ALA-42 (Wiberg 1997), and SCL-690 (Hylkema 2006). These items are initial markers of the Augustine Pattern. The classic Augustine Pattern markers appeared in Bead Horizon L1 (after cal A.D. 1250); among them were the arrow, the flanged pipe, the *Olivella* callus cup bead, and the banjo effigy ornament (Bennyhoff 1994c).

The first arrow-sized projectile point types in the Bay Area were the Stockton serrated series, a unique central California type (Bennyhoff 1994b:54; Hylkema 2002:49; Justice 2002:352). Surprisingly, they did not appear until after cal A.D. 1250. Biface and debitage production dropped significantly at Napa Valley Glass Mountain quarries with the appearance of the bow and arrow (Gilreath and Wohlgemuth 2004:14). At the same time, Napa Valley obsidian manufacturing debris increased dramatically in the interior East Bay. "Technological organization is defined by acquisition of large Napa Valley flakes that were treated as cores to produce small points, preforms, and miscellaneous simple flake tools," wrote Bieling (1997:76). In the San Jose and Point Año Nuevo Localities of the South Bay, however, debitage and casual tools continued to be derived from local Franciscan chert, and finished projectile points of Napa Valley obsidian continued to be imported from the north (Bellifemine 1997:124–136; Clark and Reynolds 2003:8; Hylkema 2002:250). Jackson and Ericson (1994) argue that Late Period North Bay obsidian exchange was regulated by social elites.

More evidence of increasing social stratification is provided by mortuary evidence. Partial cremation, often associated with the wealthiest grave offerings, appeared, or in some places reappeared. Although numbers of shell beads with burials actually dropped (Milliken and Bennyhoff 1993:392), the overall array of uncommon wealth items increased in high-status burials and cremations (Fredrickson 1994b:62). Fredrickson (1974b:66) and Bennyhoff (1994b:70, 72) suggested that the mortuary pattern, including signature *Haliotis* "banjo" effigy ornaments, reflected a new regional ceremonial system that was the precursor of the ethnographic Kuksu cult, a ceremonial system that unified the many language groups around the Bay during Bead Horizon L1.

Terminal Late Period: Protohistoric Ambiguities

The signature *Olivella* sequin and cup beads of the central California L1 Bead Horizon abruptly disappeared at around cal A.D. 1500 to 1550. Clamshell disk beads, markers of the L2 Bead Horizon, began to spread across the North Bay at that time, but were not initially traded south of Carquinez Strait. From cal A.D. 1500 to cal A.D. 1600 or 1650, the only shell beads in South Bay and Central Bay mortuaries were *Olivella* lipped and spire-lopped beads, and they occurred in far smaller numbers than the bead offerings of the L1 Horizon (Milliken and Bennyhoff 1993:392). While site distributions did not change remarkably, L2 components often seem to be thin signatures on the surface of rich L1 middens.

The North Bay was the seat of innovation during the L2 Horizon in the Bay Area. The toggle harpoon, hopper mortar, plain corner-notched arrow-sized projectile point, clamshell disk beads, magnesite tube beads, and secondary cremation all appeared in the north first. The toggle harpoon, known earlier in northwest California, replaced the multibarbed fish spear. The hopper mortar appeared on the Santa Rosa Plain and the Napa Valley for the first time, but did not spread to the Central or South Bay (Bennyhoff 1994b:54; Wickstrom 1986). Simple corner-notched points replaced Stockton serrated points in the North Bay and began to appear in the Central Bay, while Desert side-notched points spread into the South Bay from the Central Coast (see Hylkema 2002; Jackson 1986, 1989a; Jurmain 1983).

Clam beads were not manufactured in volume on the coast. Some manufacture did occur at Point Reyes (King and Upson 1970:131), but at Bodega Bay, known ethnographically as a collecting point for clamshells, only one bead blank and several drills were recovered during controlled-volume sampling at five separate sites (Kennedy 2005). Evidence of a thriving clam disk manufacturing industry does appear on the Santa Rosa Plain some 30 kilometers inland (Keswick 1990; Wickstrom 1986), as well as at NAP-539, 80 kilometers inland in the Berryessa Valley (Hartzell 1991), and YOL-69 (Wiberg 2005), 115 kilometers inland in the lower Sacramento Valley. The earliest date for clam disks south of Carquinez Strait, cal A.D. 1670, was obtained from a charcoal lens at CCO-309 (V. M. Fredrickson 1968).

Why did shell bead types, mortuary wealth distributions, and some technological artifact types change after cal A.D. 1500? Had population shot past carrying capacity due to success of regional organization during the L1 Horizon, spawning conflict and wealth contraction? Were populations on the move, forcing or marrying their way into neighboring lands? Did European-introduced epidemics spread across the continent following Spanish explorations in Mexico, causing population crashes and cultural disturbances (Erlandson

and Bartoy 1995; Preston 1996)? Whatever the cause, indications are that another upward cycle of regional integration was commencing when it was interrupted by Spanish settlement in the Bay Area in 1776.

CONCLUSION: WHAT DROVE CHANGE IN BAY AREA PREHISTORY?

In conclusion, some brief comments are offered regarded two common explanatory themes for past change in Bay Area prehistory: linguistic group migration and population pressure. Gerow (1968:98) and Breschini (1983:64–70, 98–101) posit an east-to-west spread of the mortar-based collector economy into the Bay Area during the Early Period, carried by proto-Penutian speaking peoples from the delta. Moratto (1984:207, 280, 550–557) agrees, but suggests that the invading Penutian groups were proto-Utians (ancestral Miwok-Costanoans), already differentiated from other Penutian groups. Bennyhoff (1994c:83) argues, alternatively, that the proto-Utians had come into the central San Francisco Bay Area somewhat earlier and developed the Early Period Berkeley Pattern in place (Bennyhoff 1986:67, 1994b:66). Fredrickson (1989a) concurs with Bennyhoff, positing a Lower Berkeley Pattern spread from the Central Bay into the North Bay after 1500 cal B.C. and tying it to a proto-Miwok separation from proto-Costanoan (Ohlone). An alternative argument can be made for a later arrival of the Utians, with a proto-Costanoan entry into the Bay Area during the Early Period, and the Miwokans remaining on the Sierran side of Sacramento Valley until a later date.

It was the general consensus in 1984 that Miwokan speakers expanded eastward from the North Bay into the Sacramento Valley at the EMT (500 to 200 cal B.C.), forcing the Windmiller Pattern people south into the San Joaquin Valley (Bennyhoff 1994c:66; Fredrickson 1984:511; Moratto 1984:210; Wiberg 1993:265). Under the alternative model, the Miwokans actually moved westward into the North Bay during or just prior to the EMT.

The Meganos extended burial practice in the East Bay, also found in the Stockton vicinity, seems to have its antecedent in the Early Period Windmiller Pattern of the Sacramento–San Joaquin Delta. The language of the people who carried the Windmiller and Meganos cultures has been suggested as an extinct subgroup of Utian (Moratto 1984:201–211) or as proto-Yokutsan (James Bennyhoff, personal communication to Randall Milliken, 1980). Whatever their language, their cultural pattern was pushed from the East Bay to the San Joaquin Valley at the end of the Middle Period, probably by speakers of proto-San Francisco Bay Costanoan. But what change stimulated such an expansion-retraction?

No change was more dramatic than the appearance of the Augustine Pattern, beginning in the MLT and consolidating in the L1 Bead Horizon. Bennyhoff (1994c:66–67) argues that it arose through stimulation from Patwin speakers newly arrived into the Sacramento Valley from Oregon, bringing with them the bow, the flanged pipe, preinterment grave pit burning, and other new traits. It is a challenge to linguistic group–based explanation that the key traits of the Augustine Pattern were shared by Plains Miwoks, Patwins, Bay Miwoks, San Francisco Bay Costanoans, Coast Miwoks, Wappos, and southern Pomos at the time of Spanish settlement. Perhaps the Augustine Pattern, with its inferred shared regional religious and ceremonial organization, was developed as a means of overcoming insularity, not in the core area of one language group but in an area where many neighboring language groups were in contact.

Finally we turn to the question of population pressure, often offered as an explanation for the rise of cultural complexity in the past. Under hunting and gathering conditions, human populations have an "intrinsic rate of natural growth" in the general range of 1 percent to 3 percent per year, which allows them to double in size within a century, unless the growth rate is somehow checked (Richardson et al. 2001:396–397). Bay Area population pressure must have been incessant in all times in the past, with the exception of the initial centuries of colonization during the Terminal Pleistocene. We presume that Bay Area populations cyclically approached and overran their carrying capacity, crashed (probably through warfare, since humans have only one important predator), and quickly rebounded. Only technological or social innovations allowed the carrying capacity to be raised, and such innovations, we suggest, did not always occur.

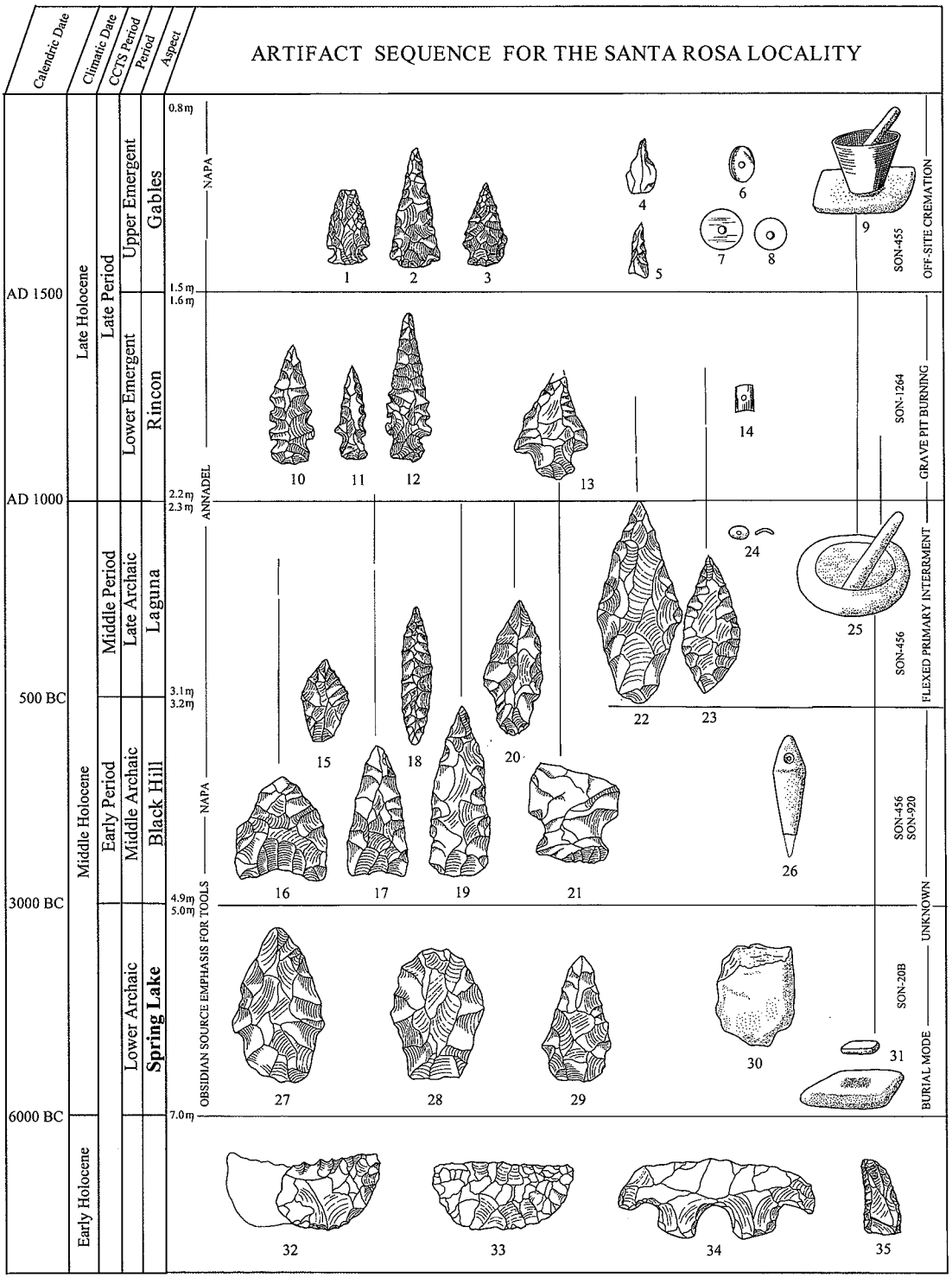


Figure 8.5. Artifact sequence for the Santa Rosa Locality. Key: (1–3) obsidian corner-notched arrow points; (4–5) chert bead drills; (6) *Olivella* lipped bead; (7–8) clamshell disk beads; (9) hopper mortar and pestle; (10–12) obsidian serrated, corner-notched projectile points; (13) side-notched spear point or hafted knife; (14) *Olivella* rectangular bead; (15) obsidian small, diamond-shaped projectile point; (16–17) obsidian (or chert) concave-based projectile points; (18) obsidian (or chert) narrow, leaf-shaped projectile point; (19-20) chert stemmed projectile points; (21) chert side-notched spear point or hafted knife (chert earlier, obsidian later); (22–23) obsidian shouldered, lanceolate projectile points; (24) *Olivella* saddle-shaped bead; (25) bowl mortar and pestle; (26) blue schist charmstone (biconically drilled); (27–28) obsidian wide-stemmed projectile points; (29) obsidian small-stemmed projectile point; (30) basalt unifacial cobble tool; (31) millingslab and handstone; (32) obsidian (Napa) butterfly form crescent; (33) chert lunate form crescent; (34) chert zoomorphic form crescent; (35) high-quality chert unifacial tool. (Only projectile points drawn to relative scale. Drawings by Nelson Thompson.)

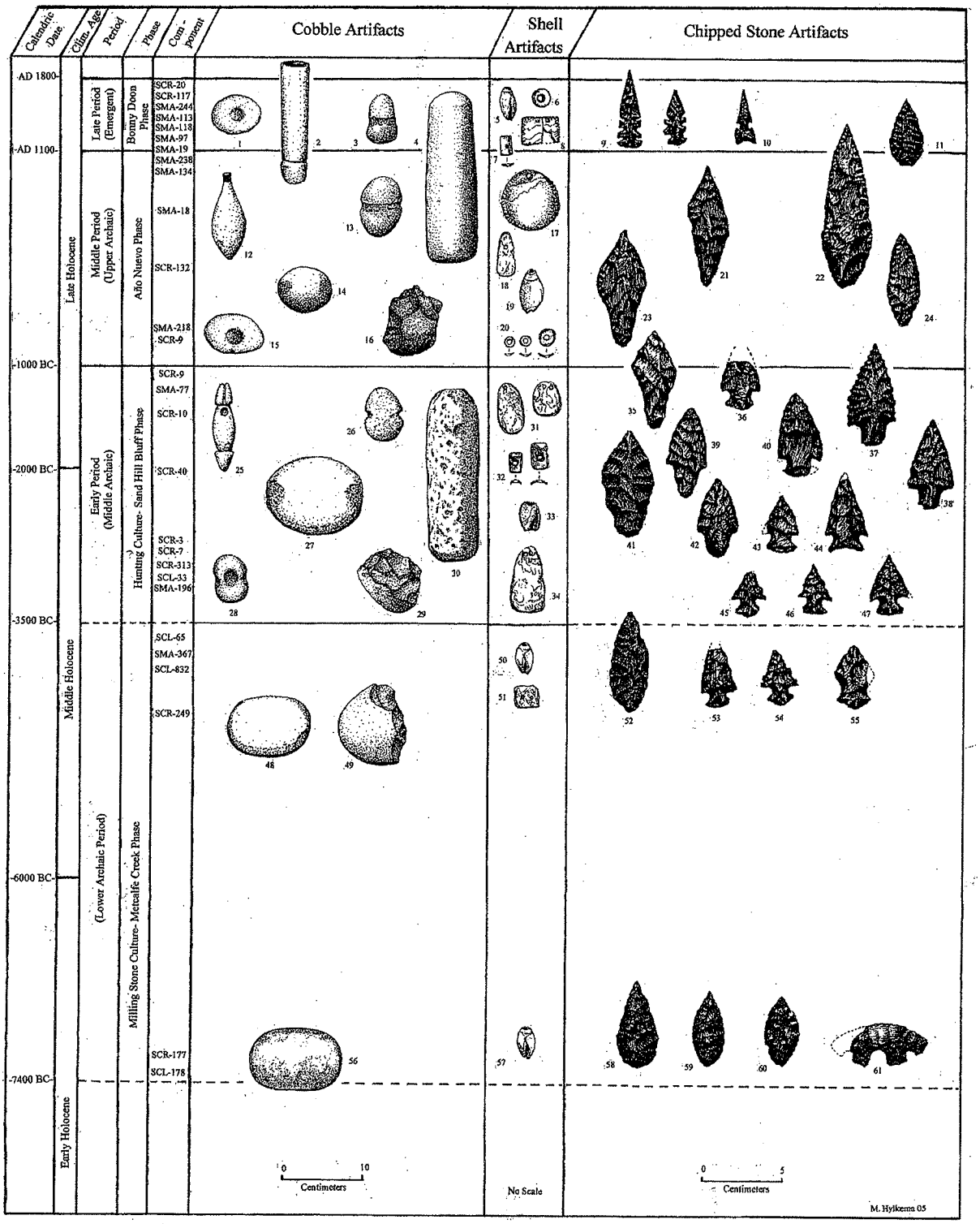


Figure 8.6. Artifact sequence for the San Mateo coast and Santa Cruz Localities.

Key: (1) sandstone bi-pitted cobble, SMA-134;
(2) chlorite schist tobacco pipe, SCR-117;
(3) Andesitic grooved sinker, SMA-238;
(4) sandstone pestle, SCR-20;
(5) *Olivella biplicata* type A1 series bead, SMA-244;
(6) steatite disk bead, SMA-244;
(7) *Olivella* M1a thin rectangle bead, SCR-20;
(8) *Haliotis* type RC5e ornament SMA-238;
(9) Napa obsidian Stockton-serrated points, SMA-244;
(10) Monterey chert desert side-notched point, SCR-20;
(11) Napa obsidian lanceolate point, SMA134;
(12) Andestic piled charmstone, SCR-132;
(13) sandstone grooved sinker, SCR-132;
(14) granitic shaped handstone, SCR-132;
(15) sandstone bi-pitted cobble, SCR-132;
(16) basaltic cobble chopper, SMA-218;
(17) *Haliotis* type CA3h ornament, SCR-10;
(18) *Haliotis* type OB3 ornament, SCR-9;
(19) *Olivella biplicata* type A1 series bead, SMA-18;
(20) *Olivella biplicata* type G series beads, SMA-218;
(21) Monterey chert Año Nuevo long-stemmed point, SCR-9;
(22) Napa obsidian lanceolate point, SMA-97;
(23) Monterey chert Año Nuevo long-stemmed point, SMA-218;
(24) Napa obsidian lanceolate point, SMA-18;
(25) serpentine perforate charmstone, SCR-93;
(26) sandstone edge-notched sinker, SMA-77;
(27) granitic handstone SCR-9;
(28) granitic bi-pitted cobble, SCR-7;
(29) quartzitic cobble chopper, SCR-7;
(30) sandstone pestle, SCR-40;
(31) *Haliotis* type SC3 and FA5 ornaments, SMA-77;
(32) *Olivella biplicata* L series rectangle beads, SMA-77;
(33) *Olivella biplicata* type B series barrel bead, SCR-38;
(34) *Haliotis* type OK5 ornament, SMA-77;
(35) Monterey chert Año Nuevo long-stemmed point, SMA-218;
(36) Monterey chert notched point, SCR-9;
(37) Franciscan chert Rossi square-stemmed point, SCR-9;
(38) Monterey chert Rossi square-stemmed point, SCR-7;
(39) Monterey chert shouldered contracting-stemmed point, SCR-40;
(40) chalcedony notched point, SCR-7;
(41) Monterey chert contracting-stemmed biface, SCR-7;
(42) Monterey chert shouldered contracting-stemmed point, SCR-7;
(43-47) Franciscan chert notched points SCR-7;
(48) sandstone handstone, SCL-65;
(49) quartzitic cobble chopper, SCR-177;
(50) *Olivella biplicata* A1 series bead, SCL-832;
(51) *Haliotis* type H2a bead, SCL-832;
(52) Monterey chert biface, SMA-196;
(53) Monterey chert notched point, SCR-249;
(54) Monterey chert notched point, SCR-313;
(55) Monterey chert notched point, SCL-65;
(56) sandstone handstone, SCL-178;
(57) *Olivella biplicata* type A1 series bead, SCL-178;
(58-60) Monterey chert lanceolate points, SCR-177;
(61) Monterey chert eccentric crescent, SCR-177.
(Some artifacts not drawn to scale. Artifacts depicted are represented at multiple sites. Drawings by Mark G. Hylkema.)

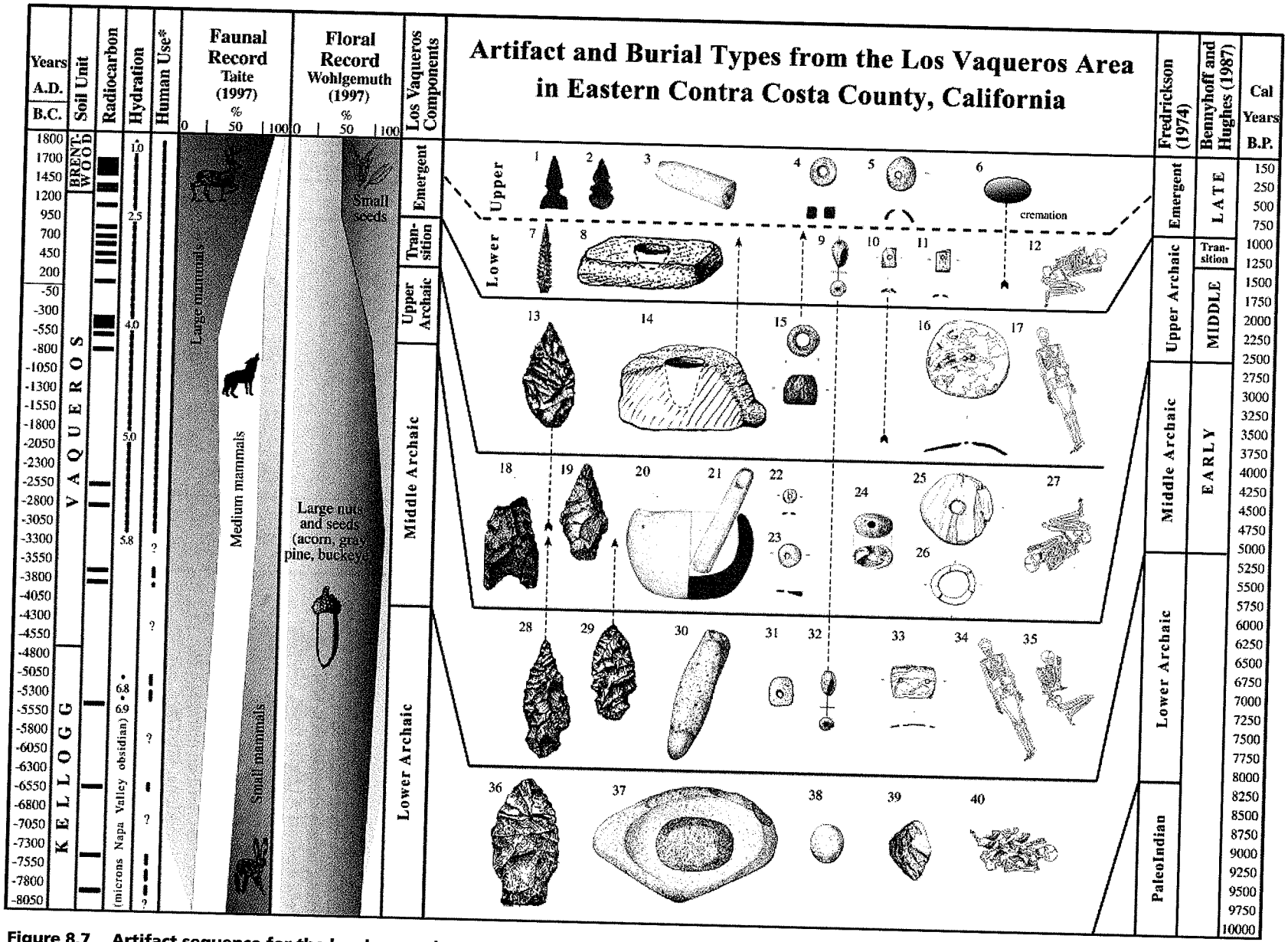


Figure 8.7. Artifact sequence for the border area between the Livermore Locality and the San Joaquin Valley.

Key: (1) Panoche side-notched and desert side-notched projectile points (mainly cryptocrystalline rock);
(2) Stockton side-notched and corner-notched projectile points made only of obsidian;
(3) small cylindrical pestles;
(4) clamshell disk beads;
(5) lipped *Olivella* beads, Type E;
(6) cremation of human remains;
(7) Stockton stemmed projectile points made only of obsidian;
(8) small block mortars;
(9) spire-lopped *Olivella* beads, Type A1b;
(10) thin rectangular *Olivella* beads, Type M1;
(11) thin rectangular *Olivella* beads, Type M2;
(12) tightly flexed burials with variable orientations;
(13) shouldered lanceolate projectile point made of obsidian;
(14) bedrock mortars (Upper Archaic Period cups larger than Emergent Period cups;
(15) steatite beads;
(16) *Haliotis* ornaments, Type CA4fm;
(17) ventrally extended burials primarily with northern orientations;
(18) concave-base projectile points made of chert and obsidian;
(19) contracting-stemmed projectile point made of chert;
(20) shaped and cobble bowl mortars;
(21) shaped and cobble pestles;
(22) saucer *Olivella* beads, Type G1 and G2;
(23) *Macoma* clam disk beads;
(24) split *Olivella* beads, Type C;
(25) *Haliotis* ornaments, Type C1C;
(26) *Haliotis* ornaments, Type C2C;
(27) tightly flexed burials, primarily with southwest orientation;
(28) side-notched projectile point made of chert (CCO-637, Burial 7, 3850 cal B.C.);
(29) side-notched projectile point made of chert (CCO-637, Burial 5, 3720 cal B.C.);
(30) cobble pestles with convex parabolic end wear;
(31) thick rectangular *Olivella* beads;
(32) spire-lopped *Olivella* beads, Type A1a;
(33) *Haliotis* ornament, Type uBA7;
(34) fully extended and semiextended burials, primarily with northwest orientations;
(35) loosely flexed burials, primarily with northwest orientations;
(36) wide-stemmed projectile point made of obsidian (CCO-696, 6.9 microns Napa Valley);
(37) millingslabs and oval bifacial handstones;
(38) small round handstones;
(39) cobble-core tools;
(40) cairn burial (CCO-696, Burial 160, 5540 cal B.C.).
Approximate timing and duration of human use in the project area based on combined radiocarbon and obsidian hydration evidence. Courtesy of Jack Meyer.