CASUAL PAPERS

Cultural Resource Management

July, 1986, Vol. 2, No. 2

IN THIS ISSUE

★ ★ ★

Cultural Resource Management Center
Department of Anthropology
San Diego State University
San Diego CA. 92182-0377

SDSU

CULTURAL RESOURCE MANAGEMENT CENTER
DEPARTMENT OF ANTHROPOLOGY
COLLEGE OF ARTS AND LETTERS
SAN DIEGO STATE UNIVERSITY
SAN DIEGO CA 92182-0377

(619) 265-6300

September 8, 1986

Dear Colleague:

Enclosed for your information is Vol. 2, No. 2 of the Cultural Resource Management Center Casual Papers. If you have any questions about this or future issues, please write or call Larry Leach (265-6717) or Chris White (237-6764).

Sincerely,

Chris White

Chris White, Editor
Casual Papers
Cultural Resource Management Center
Department of Anthropology

CW:yt

Enc.

RURAL SAN DIEGO: HISTORICAL OVERVIEW AND RESEARCH ISSUES

Jerry Schaefer
Steven Van Wormer

ASM Affiliates, Inc.
San Diego, CA

INTRODUCTION

The goal of this historical review is to define research models that are applicable to rural Southern California historic sites. This is particularly necessary as development of outlying areas effect more historical sites. Models that can be applied to site survey data are especially useful for the evaluation of site significance through settlement pattern, archival, and architectural data bases, without recourse to subsurface excavation or artifact analysis. Limitations within the literature will also be discussed.

The history of rural San Diego County and California as a whole will also be briefly reviewed to provide a context for applying more general theoretical approaches. This overview is concluded with an annotated bibliography of references all of which are available at San Diego State University or the University of California, San Diego.

HISTORICAL OVERVIEW

Three major trends can be seen in the development of California agriculture for which San Diego is a microcosm (Reed, 1946, Redman 1976, Jelinek 1979). They are a pastoral phase from 1769 to 1850 that is contemporary with Spanish Missions and Mexican Ranches, a grain growing phase from 1850 to 1870 that coincides with early American development, and a fruit growing phase from transportation development and market-oriented cash cropping. All the phases overlap and aspects of each may be dominant in specific regions based on climatic and soil conditions (Reed 1946:252).

The Pastoral Phase

Large ranches or open ranch cattle raising typify the Spanish and Mexican periods. Little effort was put into improving the environment. Poor quality cattle and horses roamed free. Cattle were raised principally for hides and tallow sold to Boston and British merchants and agriculture was geared to provide subsistence needs only.

The Grain Phase

The sudden population influx into northern California's Gold Rush country created an ever-increasing demand for beef. Southern California ranchers in response, started producing larger numbers of beef cattle for drives north and they prospered as never before. Beginning in 1855, herds

from Texas and the southwest were also being driven into California, causing a drop in beef prices and the end of profitable cattle business by 1860. Disastrous floods in 1861-1862, followed by two drought years brought an end to the dominance of large cattle ranches in the state.

In spite of the decline of large ranches throughout the state, small enterprises were established in the eastern mountain ranches of the state, including western San Diego County. Small enterprises were established throughout the eastern mountain ranches of the County beginning in the late 1860's. These new ranches benefitted from improved strains of beef cattle brought in from Texas that virtually replaced the Spanish and Mexican breeds.

It was during this period that the McCain Ranch, for example, was first established in 1870-1872 by George Washington and Martha McCain. With their original home in Arkansas, they were part of a post Civil War migration of Texas and Arkansas ranchers who hoped to profit from increasing demand and higher prices for beef. The pattern of life established at the McCain Ranch has been maintained until the present.

With the Gold Rush era, a wheat boom also swept through the northern portion of the state from 1850 to 1870 (Reed 1946, Redman, 1976). The development of the San Joaquin Valley was spurred by a major export network to Great Britain, Australia, New York, and China (Jelinek 1976:34). The smaller cattle ranches in southern California also diversified to include wheat production and small multi-crop family farms were established on former ranches. The McCains were predominantly beef cattle ranchers although grain was produced for feed, and dairy products were produced to supply the Julian Gold Rush (McCain 1955).

Fruit Production and Diversification

With the introduction of the railroad, irrigation networks, and population booms of the 1880's, there was a rapid increase in intensive market oriented cash crop agriculture. San Diego County farms increased from 696 in 1880 to 2,474 by 1890. Both large operations and small family farms proliferated and rural communities emerged throughout the country. Wheat, oats and barley were grown in the coastal and foothill valleys with citrus and olive groves covering the hillsides and many inland valleys (Van Wormer 1980a).

The agricultural depression of 1920 to 1940 saw the decline of many small operations, and the rise of agribusiness after 1940. Throughout this period, the McCain Ranch continued to be a successful concern, specializing in beef cattle production. Specific fluctuations in the economic condition of the ranch has not been investigated, however.

General overviews of California agriculture have been prepared by Jelinek (1979) and Paul (1976). Detailed documentation of Southern California Pastoral period can be found in Cleland (1969) and Pitt (1966) with overviews of San Diego County prepared by Hughes (1975) and Van Wormer (1984). No overviews or synthesis of back country ranching during the Grain period has been undertaken. Studies of specific areas in San Diego

County include Jacques (1980a, 1980b, 1982), Burkenroad and Van Wormer (1981), and Burkenroad (1983), (1978), Van Wormer (1980), and Le Menager (1983). For a general overview of the fruit growing period, see Van Wormer (1980).

RESEARCH ISSUES

The literature that has been reviewed for this study can be arranged in a two-tiered paradigm. On the one tier, they represent different topical foci evaluating causes for change, regional historical sequences, or other themes associated with western frontier society. The discussion below is organized on this axis of the paradigm, examining the environment, cultural tradition and values, economic factors, the urban shadow, demographic and sociological factors. The second axis of the paradigm considers the geographical scope of each study. In order of inclusiveness they include:

1. general theoretical works on rural frontier development and expansion,
2. regional case studies in the western states or territories,
3. California agricultural histories,
4. southern California or San Diego County studies, and
5. studies of specific ranch or farm enterprises.

Causation and Change

The frontier rancher or farmer was subject to varied external forces that affected his livelihood, behavior, and world view. An understanding of these variables and their effect on the development of rural settlements is crucial in utilizing the diachronic models applicable to historical archaeology studies. Although often interrelated, these variables may be divided into several broad categories that have been treated simultaneously or discretely by different authors.

Environment

The influence of ecological and geographical factors in the formation of rural communities has been a major focus of frontier studies. Ever since the pioneering work of Frederick Jackson Turner (1947), the environment has often been seen as the independent variable that formed the rural, social, political and ideological character of rural America. Even national ideals of democracy and independence are seen by Turner to spring from pioneer response to the challenges of the frontier environment. This environmental influence is particularly causal at initial stages of settlement when populations were most vulnerable to fluctuation in rainfall, pests, and other environmental perturbations. In one study (Fite 1976:277), pioneer phase farmers are characterized by a flexible, if not complacent attitude towards nature.

Turner stimulated a generation of frontier studies, with each author elaborating or challenging the ideas he set forth. A prevalent holistic view of rural development has emerged from these efforts, integrating concepts from ecology, human geography, social history, economics, and cultural anthropology. The holistic approach stems from studies to explain modernization in farming history as new legal codes explained economic networks and affected farming practices and society. As defined by Swieringa, this "New Rural History" comes very close to the manifesto of "New Archaeology" as it was conceived in the 1960's and '70's.

> To begin, I offer a broad definition: The new rural history is the systematic study of human behavior over time in rural environments. This definition is composed of four phrases. The first, systematic study, includes the use of social science theory or "hypothesis testing" to determine the questions, analytic methods based on quantitative (preferably disaggregate) sources, and a comparative and interdisciplinary research design.
>
> The second phrase is human behavior. The emphasis is properly in historical experience "as it was actually lived" by rural people in the past. Rural history centers on the lifestyle and activities of farmers and villagers, their family patterns, family practices, social structures, political activities, and community institutions. All pertinent economic, social, political, and environmental forces impinging on human behavior are part of the picture. The end is to provide a unified conception of rural life, a "holistic" history, in which human behavior is the key variable.
>
> The third phrase, over time, distinguishes rural history, rural sociology, or rural geography. Historians should primarily be concerned with secular change in social behavior from one general or historical era to the next. I emphasize "should" because such major scholars as Frederick Jackson Turner and James Claude Malin viewed the time factor as less significant than other factors-space and society for Turner, and cultural values for Malin.
>
> The last phrase in the definition is rural environments. In common usage, rural means simply "outside of large cities" or "outside suburban areas, say of more than 2,500 inhabitants." The standard operational definition of rurality includes two criteria-residence in an area of low population density and chief livelihood earned in agriculture. But ruralness is more than location or an occupation; it is a way of life. Rural life, as distinct from urban living, traditionally involved physical if not social isolation, extended family networks, simple social organizations, seasonal labor patterns and unceasing handiwork, and an attitude of complacency in the face of nature's forces (Swieringa 1982:495-496).

This approach is most applicable to historical archaeology because it focuses on behavioral responses to an array of environmental, social, economic, and cultural forces. Through bridging or mid-level theory (Schiffer, South 1977), archaeological data provides a means of tracing changing behavior patterns through time.

Along different lines, Barker (1978) explored the relationship between the natural (ecological) environment and psychological (perceptual) environments to explain aspects of behavior among prairie settlers. Originating from the work of behavioral psychologist (Kurt Lewin 1936, 1951), Barker examines how pioneer settlers adapted to three attributes of newly occupied frontiers:

1. they were undermanned;
2. they were new environments with poorly known conditions, environment parameters, and social environments; and
3. they were unfinished as to physical and social institutions.

These environmental factors effected the range of behaviors exhibited in all frontier areas, according to Barker, and differentiate frontier patterns from town, or urban, patterns. In contrast, frontiersmen among other actions will:

1. carry out more actions;
2. work harder;
3. engage in a wider variety of behavior;
4. act to sustain in settings they inhabit;
5. more frequently act to correct behavior of others;
6. attempt to carry out more difficult actions more frequently;
7. suffer from greater wear and fatigue, resulting in reduced stamina and higher morbidity and morality;
8. accept lower levels of performance;
9. engage in more important actions for maintaining a setting;
10. engage in actions with less certain outcomes; and
11. are more involved with natural environment.

Many more general patterns are also discussed. Each behavioral pattern may be seen to have material correlates, as extensively discussed by South (1977). For example, aspects of stress and fatigue, as morbidity and morality may be addressed from recovered medicine and alcohol bottles, as well as archival sources.

Some of the ways in which environmental factors influenced southern California ranchers are known. The great droughts of 1856 and 1863-1864, and flood of 1861-62 were largely responsible for major shifts in socio-economic patterns (Jelinek 1979:27,32). The Mediterranean climatic system was an important role in many aspects of California agriculture (Jelinek 1979). For example, in McCain Valley, the seasonal variability of grazing lands led those ranchers to adopt a transhuman pattern whereby herds were driven down to lower Sonoran habitats to the east in Winter and up to the mountains in the Summer. Cattle were also driven to Imperial Valley when irrigated grazing land became available after 1909 (Jacques 1980:272-275).

Significantly, this pattern of seasonal migration parallels that of the prehistoric Kumeyaay who as hunters and gatherers were also closely attuned to environmental conditions. The prehistoric human geography and settlement patterns are oriented to different resources, however, than those of historic ranchers (Cook and Fulmer 1981:124-132).

Cultural Traditions and Values

While the environment clearly influences human behavior, it cannot predetermine possible strategies or responses to conditions encountered by frontier settlers. Several authors have examined how prevailing sociocultural environments and pre-frontier cultural traditions affect decision-making and patterns of change. Applying this approach, Steffen (1978) still finds connections between the frontier as a stimulator of fundamental ideological and behavioral change throughout the United States. Large tracts of free land, isolated from the rest of American culture that was centered east of the Mississippi, promoted the erosion of traditional Euro-American traditions and the growth of new patterns such as individualism, self-sufficiency and social equality. Steffen sees this as only one frontier pattern most characteristic of plains agriculturalists and called it "The Insular Frontier." The social, environment, and technological conditions of the great plains, characterized by deficient labor pools and other factors already discussed, were viewed by Turner and others as requiring substantial changes in world new and cultural traditions by the European or eastern American immigrants.

The second type of frontier is described as "Cosmopolitan," where no fundamental economic, political, or social changes were necessary or desirable (Steffen, 1978). These were areas where the economies and technology of the enterprises required the maintenance of ties with established European and American institutions. These include ranching, fur-trading, and mining frontiers. For the purposes of back-country San Diego, the ranching frontier is most relevant to our discussion.

Methods of grazing, branding, and marketing cattle all had precedents in colonial American or Spanish cattle industries (Steffen 1978:107). This is particularly true for San Diego where American cattlemen were often migrants from Texas and other southern states. The nature of cattle ranching required close symbiotic ties with European and eastern or western American Urban Markets; whether for the sale of the hides (Spanish Period) or Beef (American Period) (Jelinek 1979). Thus, cattle ranching was as influenced by market fluctuations and costs as by local environmental conditions or technological changes. Thus, cattlemen can be seen as frontier equivalents of mercantile capitalists, often starting their herds with capital acquired through non-agricultural enterprises. In that light, advances in ranching were not the result of new agricultural technology but improved management and efficiency.

Because ranchers were dependent on outside ties, Steffen sees them as maintaining former cultural traditions. This is reflected in the lack of homogeneity among early cattlemen, with the exception of entreprenurial behavior. Steffen concludes:

> Western scholarship would be better served if studies of these individuals, like all frontier dwellers, concentrated on the relationship between established patterns of behavior and different environments that may or may not have demanded changes from them. Cattlemen should be viewed as problem solvers acting within a limited range of options placed before them by external frontier circumstances and internal prefrontier intellectual preparation (Steffen 1979:107).

The manner in which prevailing cultural values determine decisions is examined by Berkofer in his re-evaluation of the Turner thesis (1964). He contends that cultural values determined what options are employed, particularly in the early stages of settlement. Although specific ways in which the pioneers' "cultural baggage" influenced frontier adaptations are not enumerated, acceptance of Steffan's essay would suggest that these influences were more pronounced among ranching populations.

Archaeology correlates to cultural persistence and changes are readily found in at least two major data sets. One is food remains and the other is architecture. Dietary traditions tend to be particularly conservative and often provide an expression of group solidarity and ethnic identity. Family events and religious festivals are often the focus of traditional meals where specific dishes may even have symbolic meaning. Substantial attention has been paid to Chinese dietary practices as represented by recovered bones, observed butchering marks, and imported glass ceramic food containers (Schuyler 1980). Little attention has been paid to traditional European and particularly Anglo-American dietary traditions. One interesting study at the Serrano Adobe revealed a high frequency of sheep bones that Langenwalter and Brock (1984) related to changing patterns in the cattle industry. "Exotic" oriental dietary patterns may be easier to distinguish from mainstream Anglo cooking but aspects of European or eastern American dietary patterns should also be distinguishable from western traditions on the frontier.

Architecture provides another measure of cultural continuity and change. This is particularly true of vernacular housing or "folk housing" that often dominates the first settlement phases of a region or the more isolated rural regions where housing design and construction are controlled by the original occupants. In one study, Kniffen (1965) traces the diffusion of vernacular farm houses from the east coast to the south and midwest. He found three major cultural areas as the source for nineteenth century rural housing, with European precedents for each building type. As housing styles diffused to different environmental settings, changes can be seen in construction, particularly the barn types.

Architectural studies may be expanded to a consideration of entire ranch intra- and inter-site settlement patterns. Cultural values and regional traditions not only determined building styles but also the placement and configuration of structures, out-buildings, corrals, pastures, and even fences (Kiefer 1972). A now classic study in ethnoarchaeology examined how Morman world view effects the spatial patterning of buildings, fences and irrigation canals (Leone 1973). In addition, landscaping of rural farms may also be culturally determined. Both the species planted and the association of trees to structure may reflect the cultural values of the initial settlers (Lewis 1982).

These studies, and particularly the typology of barn styles by Kiefer (1972), also emphasize the importance of climate, local geography, hydrology, and even township and range surveys on spatial placement of farm facilities. Although providing some frameworks for analysis, none deal specifically with California or cattle ranches but their useful application is obvious.

Economic Factors

Several authors have emphasized the entrepreneurial aspects of post-pioneer ranching and farming. While the first settlers may have been subsistence farmers, they soon became market-oriented capitalists whose behavior is effected by supply and demand, expanding transportation networks, and agriculture oriented legislation (Berkhofer 1964:29). The choice of crops and introduction of specific technology were often responses to economic conditions on a national or international scale (Rome 1982:40). Local, regional, and national factors all influenced the course of San Diego County rural life. In the Spanish and Mexican periods, ranching activities are described as "pastoral" (Reed 1946:252, Jelinek 1979). Half-wild cattle, raised for their hides and tallow, roamed unfenced pasturelands. Demand for beef following the Gold Rush brought the introduction of large herds from Midwest and Texas and the growth of a Southern California beef cattle industry. Although the 1850's and 60's saw the beginning of specialized agriculture in the central and coastal valleys, marginal inland areas remained as cattle country. Wheat, barley, rice, and fruits became important cash crops and the introduction of the railroad furthered the market-oriented rural life.

As commercial ties between rural areas and urban areas were tightened, agricultural development was increasingly affected by boom and bust cycles of the regional and national economy. Important dates in the economic cycle of San Diego City and County are enumerated below (Table 1).

The extent to which specific households adapted to changing economic conditions cannot be readily predicted. Not all farmers or ranchers will be affected in the same way by recessions or economic expansion. One pattern found during boom and bust cycles is that small landholders with extensive capital will be periodically forced out during economic busts, to the advantage of expanding larger ranchers. Those farms that do survive also do so by applying new methods of management (Rome (1982:441). Also to be considered are the complex economic situations caused by interest rates, farm mortgages, labor markets, and technology (Fife 1970:283).

The Urban Shadow

Rural land use and commodity consumption patterns also reflect the influence of increased urbanization and economic ties to urban centers. One model of agricultural change in the midwest, developed by Conzen (1971) can be compared to San Diego rural development. In phase one, frontier pioneers grow local provisions for subsistence needs with wheat predominating. In phase two, intense specialization on cash crops is a response to forward linkages to distant markets. Phase three is a trend toward diversification resulting from interregional competition. Finally, phase four sees specialization that is better adjusted to regional resources and localized urban growth.

TABLE 1

Economic Cycles in the Development of San Diego County, 1850-Present Local, Regional and National Processes

Date	Phase	Process
1850-1852	growth	Gold Rush period speculation, Davis' New Town
1852-1861	decline	Depopulation and localized depression
1861-1865	"dormant"	Civil War, military occupation
1867-1873	growth	Horton's Addition, boom cycle
1873-1885	decline	Panic of 1873-1878, bust cycle
1885-1893	growth	Railroad arrives, Spreckels arrives 1887, national growth, boom cycle
1893-1900	decline	Panic of 1893-1897, bust cycle
1900-1907	"dormant"	Currency stablilizatin, slow recuperation
1907-1908	decline	Panic of 1907; bust cycle
1908-1912	growth	Spreckels investment, slow recuperation
1912-1918	growth	World War I, U.S. Navy development
1918-1929	growth	Increased military development, boom cycle
1929-1939	decline	Great Depression, bust cycle
1939-1945	growth	World War II, military activity
1945-Present	growth	Gradual development and change

Like the midwest, San Diego's latter phases were characterized by the emergence of market gardening (truck) farms located near the city fringe, to be further replaced by specialized dairying. In addition, export oriented citrus and avocado growing were a response to improved transportation and demand from urban centers outside of the region.

Urban centers also provided a wider array of goods and services to rural areas, and with the growth of major cities, also came the emergence of satellite towns and cities that were closer to farmers and provided an intermediate level of goods and services. A transition may therefore be traced from a predominantly agricultural focus of a region to one based on occupational diversity (Robbins 1973). Modelling the interconnection of this hierarchy of settlements from the rural ranch to the urban center has been a focus of central place theory in historical geography. While widely applied to ancient Mesoamerica and Mesopotamia, central place theory has not been extensively used by historical archaeologists. This is ironic since central place theory is best applied to European and American landscapes with well defined urban centers with rural hinterlands (Vance 1970).

Historical archaeological data are exceptionally well suited to tracing changing economic networks and effects of increased urbanization. Embossed bottles, ceramic markers, patented items, and other geographic specific products indicate the intensity and extent of purchases that can be modelled through "network analysis" (Klein 1974, Schuyler 1977).

Demography and Sociology

An important and fruitful area of rural historic research concerns dynamic demographic and sociological patterns. Profiles of age, sex, country of origin, and occupation are accessible through studies of census enumerations and legal documents. Patterns of mobility can also be reconstructed through prosopographic research and assessment records.

As expected, farming frontier populations are younger and have larger families. The number of men in their twenties was 25 percent higher than the national average, while men over 40 years of age was 20 percent less than the national average. Settlement by family units was the norm with 10 percent more children under 10 years of age than in other parts of the country. While mining towns may have had few women, the percentage of women in frontier agricultural areas was equal to that in previously settled regions. The place of origin for 85 percent of western frontier agricultural settlers was the United States--particularly New England, Middle States, or states contiguous to the frontier (Eblen 1965).

Ranches and farms were most likely to be headed by mature males who had accumulated enough capital to invest in sufficient land and equipment to be economically viable (Doyle 1984:466-476). In one recent synthesis of western socio-economic mobility studies, several patterns emerge (Mann 1984). Social mobility was very high, particularly at the initial stages of settlement when the best land and opportunities were available. After

that time, a substantial minority could still gain prestigious, better-paying positions or acquire land. However, for every success story, there were many more stories of failure. In that regard, failures in urban settings were more numerous than in rural. Geographical mobility was more prevalent than upward mobility. Poorer and less successful groups also tended to be transient.

Among those arrivals who did not already possess sufficient capital to begin a ranch or farm, a typical sequence of steps toward upward mobility may be traced. An individual may work for wages, taking temporary jobs to save money. He may then lease or rent a farm, paying from one-half to one-third his harvest. The next step would be to acquire equipment or arrange an exchange relationship with neighbors. Finally, he could acquire some land and hire temporary help himself (Hatch 1974:21).

In early days of California, the Spanish and Mexican rancheros were the social elite. But as the rancho system began to erode in the 1860's, they were replaced by a new group of European and American immigrants who quickly succeeded in both urban and rural entrepreneurial enterprises. For Native Americans, Hispanics, Blacks, and Chinese alike, lack of capital and social prejudice prevented any attempts at mobility (Mann 1984:482ff).

Economic bust cycles also hindered mobility as capital became scarce for the initial investment necessary to start an enterprise. In addition, large agricultural and ranching concerns, often corporately owned, increasingly gobbled up a smaller farms during periods of economic instability (Hatch 1974:27).

Where Work is Needed

Several major gaps in the data base became all too clear as attempts were made to find theoretical works that are applicable to the McCain Ranch and similar types of occupation. Almost every general study of western rural populations focused on small towns or aggregations of farmers. They generally fail to examine smaller communities or the adapative patterns of isolated ranches such as might be found in the furthest hinterlands. Such communities consisted of a cluster of farms, ranches, with possibly a school, post office, general store, or blacksmith shop. These "hamlets" never became market or service oriented towns and tend to be overlooked by historians and geographers for the purposes of synthetic or comparative studies. When specific ranch histories in southern California are found, they tend to be very specific anecdotal, local ranching histories. In order to understand the nature of rural life,these communities and household-based ranches will have to be studied as intensely as small towns.

Synthetic studies of western frontier development also tend to bypass Southern California. While several excellent histories are available of California or San Diego area rural development (Pau 1976, Jelinek 1979), none apply a theoretical framework beyond sequential history. Those "new" geographers and historians who have applied behavioral or spatial models that would benefit the archaeologist have instead foucused on the Midwest.

It is therefore the responsibility of the local historical archaeologist and historians to generate and articulate theoretical models appropriate to the history and cultural development of rural San Diego County. The studies cited above and in the bibliography do, however, provide a corpus of ideas and approaches to rural historical sites that might otherwise appear to have limited research potential.

BIBLIOGRAPHY

Berkhofer, Robert F., Jr.
1964 "Space, Time, Culture, and the New Frontier." Agricultural History, Vol. 38, No. 1, pp. 21-30.

A re-evaluation of Turner's frontier thesis emphasizing that the prevailing cultural system is considered a far more fundamental influence than physical environment.

Bowen, Joanne
1975 "Probate Inventories: An Evaluation from the Perspective of Zooarchaeology and Agricultural History at Mott Farm." Historical Archaeology, Vol. 9, pp. 11-25.

Burkenroad, David and Stephen R. Van Wormer
1981 "History," in Final Report Cultural Resource Survey of the Laguna Mountain Recreation Area, San Diego County, CA by William R. Graham, Archaeological Systems Management, Inc., San Diego, CA for the Cleveland National Forest, San Diego, CA, pp. 159-192.

1978 "History," in Overview of the Prehistory and History of Inland San Diego County. Report prepared by Wirth Associates, Inc. for USDI, Bureau of Land Management.

Cleland, Robert Glass
1969 The Cattle on a Thousand Hills, Southern California 1850-1880. Huntington Library, San Marino, CA.

Good overview of ranching purchase.

Conzen, Michael P.
1971 Frontier Farming in an Urban Shadow: The Influence of Madison's Proximity on the Agricultural Development of Blooming Grove, Wisconsin. The State Historical Society of Wisconsin, Madison.

Cook, John R. and Scott Fulmer, editors
1981 The Archaeology of the McCain Valley Study Area in Eastern San Diego County, California. Report prepared by Archaeological Systems Management, Inc. for the USDI, Bureau of Land Management, Riverside, CA.

Dayle, Don Harrison
1977 "Social Theory and New Communities in Nineteenth-Century America." Western Historical Quarterly, Vol. VIII, No. 2, pp. 151-166.

Historiographical essay and overview providing a summary of recent interpretations on 19th century frontier community social order; the fact that populations were highly mobile, and the role of formal institutions in providing stability.

Eblen, Jack E.
1965 "An Analysis of 19th-Century Frontier Populations. Demography, 1965, Vol. 2, pp. 399-413.

Demographic analysis of farming frontier populations concluding young single men did not predominate. Adults over 40 were common, and the movement was family oriented.

Fite, Gilbert C.
1966 "Daydreams and Nightmares: The Late Nineteenth-Century Agricultural Frontiers." Agricultural History, Vol. XL, No. 4, pp. 285-294.

Boom and bust periods typified the agricultural frontiers throughout the west.

1976 "The Pioneer Farmer: A View Over Three Centuries." Agricultural History, Vol. 50, No. 1, pp. 275-289.

Discussion of common elements in the experience of pioneer agriculturalists. Very broad and general.

Frederic, Paul B.
1974 "Geography and Living Historical Farm Sites." Agricultural History, Vol. 47, No. 1.1, pp. 5-10.

Historiographical essay on how geographers have interpreted agricultural land use patterns; good references.

Goldschmidt, Walter
1947 As You Sow, Three Studies in the Social Consequences of Agribusiness. Allanheld, Osmun and Company, Publishers, Monclair.

Study of three rural communities in the San Joaquin Valley studying the effects of industrialization, urbanization on family farm life. Concludes that industrialized corporate farming erodes traditional rural life-styles.

Green, Stanton and Stephen M. Perlman (editors)
1985 The Archaeology of Frontiers and Boundaries. Academic Press, Orlando.

Several approaches for historic sites archaeology are explored in this volume.

Hatch, Elvin
1974 "Stratification in a Rural California Community." Agricultural History, Vol. 49, No. 1.1, pp. 21-38..

Changes that occur in farm life from 1900-1940 causing the need for larger, increased mechanization, and decreased opportunity.

Hughes, Charles
1975 "The Decline of the Californios: The Case of San Diego, 1846-1856." Journal of San Diego History, Vol. 21, No. 3, pp. 1-31.

Pitts thesis applied to San Diego rancheros.

Jacques, Terri
1980a "Research-History," in The Archaeology and History of the McCain Valley Study Area. A Class II Cultural Resource Inventory. Edited by John R. Cook and Scott G. Fulmer, Archaeological Systems Management, Inc., San Diego, CA for U.S. Department of Interior, BLM, Riverside, CA, pp. 4.1-4.7.

1980b "History of Manzanita Indian Reservation" in Manzanita Indian Reservation Cultural Resource Inventory by Clifford V. F. Taylor and Richard L. Carrico, WESTEC Services, Inc., San Diego. For the U.S. Deparetment of Interior, National Park Service, Western Archaeological Center, Tucson, AZ, pp. 3.8-3.8.3.3.

1982 "Campo Indian Reservation History," in Final Report Campo Indian Reservation Cultural Resource Inventory by WESTEC Services, Inc. For U.S. Department of Interior, National Park Service, Western Archaeological Division, Tucson, AZ, pp. 11-19.

Jelinek, Lawrence J.
1979 Harvest Empire, A History of California Agriculture. Boyd and Fraser Publishing Company, San Francisco.

An excellent overview of major trends.

Johnson, Hildegard, Binder
1974 " A Historical Perspective on Form and Function in Upper Midwest Rural Settlement. Agricultural History, Vol. 47, No. 1, pp. 11-25.

Influence of the Federal Government survey laws on settlement patterns.

Kiefer, Wayne E.
1972 "An Agricultural Settlement Complex in Indiana." Annals of the Associations of American Geographers, Vol. 62, No. 3, pp. 487-506.

Farm buildings reflect an increase in farm size and a shift from general farming to a concentration on cash crops since WW II.

Klein, Joel I.
1973 Models and Hypothesis Testing in Historical Archaeology. Historical Archaeology 7:68-77.

Kniffen, Fred
1965 "Folk Housing: Key to Diffusion." Annals of the Association of American Geographers 55(4):549-577.

Excellent analysis of the evolution of folk housing designed and how they reflect immigration patterns.

Langenwalter, Paul E. II, and James Brock
1984 1984 Phase II Archaeological Studies, Prado Basin and the Lower Santa Ana River. Report prepared by ECOS Management Criteria, Inc. for the U.S. Army Corps of Engineers, Los Angeles District.

Le Menager, Charles R.
1983 Off The Main Road: San Vicente & Barona. Eagle Peak Publishing Company, Ramona, CA.

Historic overview of Barona region.

Leone, Mark P.
1973 Archaeology as the Science of Technology: Mormon Town Plans and Fences, in Research and Theory in Current Archaeology, edited by Charles Redman, pp. 125-150. John Wiley and Sons, Inc., NY.

Lewis, Peter F.
1982 "Axioms for Reading the Landscape: Some Guides to the American Scene" in Material Cultures Studies in America; Thomas J. Schlereth, editor. American Association for State and State and Local History, Nashville, pp. 174-182.

Mann, Ralph
1984 "Frontier Opportunity and the New Social History." Pacific Historic Review, Vol. LIII (1984), pp. 463-491.

Historiographical essay providing a summary of the new social history's interpretations of the frontier. Very good literature overview.

Martin, Robert F.
1936 Income in Agriculture 1929-1935. National Industrial Conference Board Inc., 247 Park Avenue, NY.

Basic economic data given by region including income taxes, rent, depreciation, wages, price parity purchasing power, and income status includes tables and evaluations based on the Census of Agriculture, gives a fundamental idea of basic cost expenses and revenues from farming.

McCain, Ella
1955 Memoirs of the Early Settlements. Dulzura, Potrero, and Campo. South Bay Press, National City.

Otto, John Solomon
1977 "Artifacts and Status Differences - A Comparison of Ceramics from Planter, Overseer, and Slave Sites on an Antebellum Plantation" in Research Strategies in Historical Archeology, Stanley South, editor, pp. 91-118. Academic Press, NY.

Vessel shape and ceramic type reflect dietary and cultural differences in distinct populations.

Pisani, Donald J.
1984 From Family Farm to Agribusiness, the Irrigation Crusade in California and the West, 1885-1931. University of California Press, Berkeley.

History of water law and reclamation projects.

Pitt, Leonard
1968 The Decline of the Californios: A Social History of the Spanish Speaking Californians. University of California Press, Berkeley.

Excellent overview of California Ranching, 1850-1880.

Reed, Howard S.
1946 "Major Trends in California Agriculture." Agricultural History, Vol. 20, No. 4 (1946), pp. 252-255.

Outlines three major trends of California agriculture, ranching, grain, and fruits. "All overlap to a certain extend and each is still dominant in regions defined by climatic soil and conditions."

Robbins, William G.
1973 "Social and Economic Change in Roseburg, Oregon, 1850-1885: A Quantative View." Pacific Northwest Quarterly, Vol. 64, No. 2, pp. 80-87.

Transition from a predominantly agricultural society to one of greater occupational diversity characterized Roseburg's emergence from the frontier period.

Rodman, Paul W.
1976 "The Beginnings of Agriculture in California Innovation vs. Continuity." The Journal of American History, Vol. 43, No. 3, pp. 16-27.

Rome, Adam Ward
1982 "American Farmers as Entrepreneurs, 1870-1900." Agricultural History, Vol. 56, No. 1.1, pp. 37-49.

How American farmers adopted business management and marketing methods during the late 19th century.

Schlereth, Thomas J.
1980a "Chapter 7: Vegetation as Historical Data: A Historian's Use of Plants and Natural Material Culture Evidence" in Artifacts and The American Past by T. J. Schlereth. Americation Association for State and Local History, Nashville, TN, pp. 147-159.

Interpreting the cultural context of landscaping.

1980b "Chapter 9: Above Ground Archaeology: Discovering a Community's History through Local Artifacts" in Artifacts and the American Past by T. J. Schlereth, American Association for State and Local History, Nashville, TN, pp. 184-203.

A good introduction to the ideas of interpreting the cultural landscape.

Schulz, Peter D. and Sherri M. Gust
1983 "Faunal Remains and Social Status in 19th Century Sacramento." Historical Archaeology, Vol. 17, No. 1, pp. 44-53.

The usefulness of faunal remains as evidence of socio-economic differences in historic Euro-American sites is examined using 19th century cattle bones from Sacramento, CA.

Schuyler, Robert E. (editor)
1980 Archaeological Perspectives on Ethnicity in America. Baywood Publishing Co., Farmingdale, NY.

Schuyler, Robert E.
1977 Archaeology of the New York Metropolis. Bulletin of the New York State Archaeological Association 9:1-14. Ann Arbor.

South, Stanley
1977 Method and Theory in Historical Archaeology. Academic Press, NY.

Steffen, Jerome
1979 Insular Versus Cosmopolitan Frontiers: A Proposal for Comparative American Frontier Studies, in American West; New Perspectives, New Dimensions, edited by Jerome Steffen, pp. 94-123. University of Oklahoma Press, Norman.

Swierenga, Robert P.
1982 "Theoretical Perspectives on the New Rural History: From Environmentalism to Modernization." Agricultural History, Vol. 56, No. 3, July 1982.

Historiographical essay summarizing past environmentalists school to present-day modernization interpretations. Also provides a definition of the "New Rural History."

Vance, James E. Jr.
1970 The Merchant's World: The Geography of Wholesaling. Prentice-Hall, Inc., Englewood Cliffs.

Models for tracing the flow of goods and the relationship of settlements.

Van Wormer, Stephen R.
1980a A History of the Jamacha Valley. ACT. El Cajon, California. Prepared for Rancho San Diego Land Company, Spring Valley, CA. Copy on file San Diego Historical Society Research Archives.

1980b "Southern Diegueno Ethnohistoric Overview" in Manzanita Indian Reservation Cultural Resource Inventory by Clifford V. F. Taylor and Richard L. Carrico, WESTEC Services, Inc., San Diego for the U.S. Department of the Interior, National Park Service, Western Archaeological Center, Tucson, AZ, pp. 3.7-3.7.7.

1983 "History" and "Historic Significance" in Cultural Resource Inventory and Evaluation for the Pamo Reservoir Project by Mooney-Lettieri and ASM, San Diego, CA for San Diego County Water Authority, 2750 4th Avenue, San Diego, CA, pp. 163-180, 182-183.

1984 "Legal Hocus-Pocus: The Subdivision of Jamacha Rancho." Journal of San Diego History, Vol. 30, No. 2, pp. 77-96.

Case study of ranching in the Jamacha Valley during the Mexican and early American periods.

SAMPLING MARINE SHELL: HOW MUCH IS ENOUGH?

Don Laylander
Caltrans District 11
San Diego, CA

Many coastal archaeological sites in Southern California contain marine shell in abundance. It is evident that such shell contains potentially important information about such topics as prehistoric chronology, seasonality, paleoenvironmental conditions, harvesting knowledge and technology, cultural dietary preferences, population size, and postdepositional site disturbance. Equally evident is the fact that identifying and analyzing all of the shell recovered from even a fairly modest excavation can be a dauntingly large undertaking.

The obvious solution to the problem of an unmanageable volume of shell is to analyze only a portion of the shell from the area excavated. How that portion is selected, and its size, however, will tend to determine what questions can be addressed using the shell and with what precision and accuracy the questions can be answered.

One possible approach would be to analyze only the shell from selected excavation units. A major drawback in this strategy is that information otherwise available about intrasite horizontal variability would be greatly reduced or lost. The potential for confirming or contradicting any vertical patterning seen in the portion of the shell which is analyzed would also be lost.

Another possible approach would be to analyze only a selected category of specimens, such as whole shells, large shells, or the hinge pieces of bivalves. The drawback in this approach is a potentially crippling bias which it would introduce into some aspects of the analysis, because different species of shell have naturally very different size ranges and fracturing characteristics.

A final approach is to draw an unbiased sample from the recovered shell, or from the shell which potentially could have been recovered, and to analyze only that sample. This is the approach to be examined further here. The problem of producing a genuinely unbiased sample is not without serious technical pitfalls, but those pitfalls will not be considered here. The present problem is to consider the influence of the size of the sample which is taken on the validity and range of the conclusions which can be drawn from the sample.

Defining the Objectives

The concept of "redundant information" in archaeology is a crucial one, but it is also a concept seriously abused at times. It sometimes seems to have been thought that a general point could be objectively defined statistically, at which archaeological data collection would become

redundant, independently of reference to any specific objectives for which the information is being considered. This simply is not so, as some of the examples in this paper will attempt to illustrate. Redundancy is a function of the specific patterns in the data which are being considered and of the precision and accuracy with which they need to be known. If the patterns of interest are sufficiently subtle, or if sufficiently great accuracy is needed, no amount of data will ever be redundant. If the patterns in question are sufficiently simple, general, or crude, redundancy may be reached very quickly.

A variety of data patterns may be of interest with respect to archaeological shell middens. Two of them will be considered here. The first pattern is the range of shellfish species which is represented. The second pattern is variation in the proportions of different species, whether between sites, between site subareas, or, in particular, vertically between excavation levels.

The Problem of Species Range

A reasonably complete listing of the different shellfish species from which shells have been recovered in an archaeological deposit is of potential interest in at least two respects. Minor species may help to delimit the range of probable environments in which shellfish collecting was occurring, especially if the major species represented in the deposit have relatively broad environmental tolerances. Minor species may also suggest chronological and paleoenvironmental clues, if presently-extinct species are included or if the present environment of the site is near the edge of or outside of the geographical range of those species.

(It should be stressed that the specific problem addressed here is that of the species range which has been recovered archaeologically, not the species range for the site deposit as a whole. To address the latter issue would necessitate bringing in the problem of excavation sampling strategy, in addition to the problem of sampling from a recovered collection. Also, it is assumed here that the problem of bias in sampling, for instance bias against small shells or shell fragments, is not an issue. Similarly, for simplicity it is assumed that recognition of the species to which a shell or shell fragment belongs is not a problem.)

To solve the species range problem, two questions, not of fact but of values, must be answered. First, how common a species in the collection is it acceptble for the sampling to miss? If the answer is that one must know every last species, no matter how rarely it is represented, then there is no alternative to analyzing the whole collection; no form of sampling will suffice. If, however, one is prepared to settle for a listing of species which are represented in at least a certain definable abundance, such as 1% of the collection, or 0.1%, then sampling may be possible. The second question asks how great a risk of overlooking a species represented above that threshold percentage is considered acceptable. Again, if no such risk is acceptable, no sampling is possible. If a definable risk such as 10%, or 1%, is acceptable, then sampling may be possible.

To illustrate the solution, consider a large collection of identifiable shells. Shells drawn in an unbiased way from the collection should conform to a binomial distribution, in which

$$Pr(0) = q^n$$

where Pr(0) is the probability of no representative of one particular species being drawn in the sample, q is the fraction of the collection which all the other species together actually constitute, and n is the number of shells drawn in the sample. Solving for n,

$$n = \log Pr(0) \div \log q.$$

Suppose that it is desired to know whether a species constitutes at least 1% of this collection, with a 10% risk being acceptable of the species being present in that frequency but being missed in the sampling; then

$$n = \log (0.1) \div \log (0.99) = 229.1$$

meaning that a sample of 230 shells is sufficient to give 90% assurance that a species which composes at least 1% of the collection is not being overlooked.

To give a second second illustration, if items as rare as 0.1% are of interest and 95% assurance is needed, the sample size should be at least 2,995. Beyond samples of these sizes, any additional sampling and shell identifications can be considered redundant, but only within the context of the defined objectives.

The Problem of Species Ratios

The comparison of marine shell species ratios from different portions of archaeologically-recovered collections has, justifiably, been an objective of considerable interest, particularly when the portions in question are vertical levels within a single excavation unit. Contrasts in such ratios between levels may reflect important environmental changes in the exploited areas through time, or they may reflect changes in cultural strategies or preferences. Even when not readily interpretable chronologically or culturally, significant contrasts may serve to demonstrate the absence of postdepositional mixing of the deposit, or its incompleteness.

Given any reasonable sample size, the presence of some sort of contrast in species ratios is virtually assured; even fully random samples will rarely if ever be exactly identical. The archaeological problem is to decide which contrasts are trivial and which are significant. By itself, expressed in percentages or ratios, a given contrat in the proportions of different species cannot be interpreted as either significant or trivial. For example, a contrast between a ratio for two speices of 1.0 (equal amounts) in one case and 0.5 (1:2) in a second case may or may not be significant. If the 0.5 ratio involved a sample of only three shells, for instance, the departure from the 1.0 ratio is just what would be expected

in a situation of purely random selection. On the other hand, if the 0.5 ratio involved a 100-shell sample, there is a probability of less than 0.3% of having such a low ratio (0.5) drawn randomly from collection having an overall ratio as large as 1.0.

A crucial problem in determing the sample size which is necessary to be able to evaluate shell species ratios is the selection of appropriate units of measurement to express that size. Archaeologically-recovered shell, in quantity, is most commonly and conveniently weighed, and the sample size is expressed in grams. To describe the patterning of the distribution of shell species, any convenient units are adequate and interchangeable, whether they be grams, percentages, ratios, or other units. To analyze the same patterning statistically for its significance or randomness, however, the size of the sample in terms of some potentially independent, randomizable units must be taken into account. One thousand grams do not necessarily constitute 1,000 potentially independent units, nor does one kilogram constitute merely one such unit.

One indirect way to use sample weights in evaluating the effect of sample size would be to take multiple random subsamples of the shell from each excavation level and then to calculate the means and the standard deviations of the species proportions. If the subsamples were composed of relatively few units (in this case, shells and shell fragments), the standard deviations for the subsamples would be large; sets of subsamples with numerous units would have small standard deviations. A statistical "t test," comparing one level's subsample mean and standard deviation with the corresponding "mean" ratio for the excavation unit as a whole, would tell, within a certain level of confidence, whether the contrast between those two means were too great to be merely random.

Unfortunately, this method of multiple subsamples has a fatal flaw for dealing with the sample size problem for archaeological shell. The standard deviation of the subsample means would in reality deal with the problem of sample size only if the potentially-independent units at the time of the subsampling (that is, the shell fragments) were also potentially-independent units when their hypothesized randomization within the excavation unit occurred. If all of the fragmentation of the shell occurred before or at the time of initial deposition, and if the problem were to see whether postdepositional randomization (mixing of the deposit) had occurred, then the method would be valid. However, if shell fragmentation was caused by postdepositional disturbance and by the process of excavation itself, as is usually the case, then the t test method is unsuitable, because a misleading clustering of later-produced fragments would likely mask any earlier randomization.

One solution to the problem of evaluating the significance of shell species contrasts which are expressed in weights is to divide those weights by a figure which will express the maximum size of the potentially independent units. For example, shell valves may be considered potentially independent units in terms of postdepositional mixing processes. If chione valves are found normally to weight 20 grams or less, then a conservative "Estimated Minimum Number of Units" (EMNU) for chione valves would be the

weight in grams of the chione recovered archaeologically, divided by 20 and rounded upward. Thus, 150 grams of chione fragments should represent at least eight potentially-independent units at the time of deposition.

Given suitable units of analysis, such as EMNU, the problem of evaluating the significance of contrasts in species ratios is solvable. For instance, suppose that an excavation unit had five levels, with only chione and pecten shells and shell fragments represented. Suppose further that in 250-gram shell samples from each of the levels, the percentages by weight of chione were 35%, 60%, 40%, 50%, and 65%. If the normal maximum weights for chione and pecten valves are each 20 grams, the EMNUs for the samples can be calculated:

	percentage		weight (gm)		EMNU (valves)	
	chione	pecten	chione	pecten	chione	pecten
level 1	35	65	87.5	162.5	5	9
level 2	60	40	150	100	8	5
level 3	40	60	100	150	5	8
level 4	50	50	125	125	7	7
level 5	65	35	162.5	87.5	9	5

Using the Chi-Square (X^2) test of significance for the EMNU distribution, $X^2 = 3.69$ (with four degrees of freedom), which is not significant even at the 10% level; that is, there is not as much as 90% assurance that the variation in chione/pecten ratios among the levels is not merely random.

However, if the same ratios were to be obtained instead from 1,000-gram samples from each level, the conclusions would be different.

	percentage		weight (gm)		EMNU (valves)	
	chione	pecten	chione	pecten	chione	pecten
level 1	35	65	350	650	18	33
level 2	60	40	600	400	30	20
level 3	40	60	400	600	20	30
level 4	50	50	500	500	25	25
level 5	65	35	650	350	33	18

In this case, $X^2 = 12.8$, which is significant at the 5% level, meaning that there is a 95% assurance that the variation in chione/pecten percentages among the levels is not merely random.

For smaller contrasts in the ratios, the same sample size will produce a lower level of confidence.

	percentage		weight (gm)		EMNU (valves)	
	chione	pecten	chione	pecten	chione	pecten
level 1	40	60	400	600	20	30
level 2	60	40	600	400	30	20
level 3	40	60	400	600	20	30
level 4	50	50	500	500	25	25
level 5	60	40	600	400	30	20

For this distribution, $X^2 = 8.0$, which is significant at the 10% level but not at the 5% level, meaning that there is a 90% but not a 95% assurance that the variation is nonrandom.

A further refinement of this method may be useful in some cases. Two different sorts of "sampling" are involved in the problem as discussed so far. The shell from a given excavation level may be thought of as a "sampling," perhaps random, perhaps not, of the shell for the excavation unit as a whole. If this "sample" is too small, it may not be possible to say that it is nonrandom with much precision or accuracy. The second sampling is the selection by the archaeologist of only a portion of the shell from the level for identification by species. The second sample is legitimately used to represent the characteristics of the first "sample," but it can do so only with a certain loss of precision and accuracy, although with a gain in economy. In the preceding discussion, this second sample has been compared with the shell for the whole excavation unit, from which it has been drawn in two steps, and the size of the second sample has been the limiting factor in the accuracy and precision with which nonrandomness can be recognized.

In some cases, however, it may be useful to consider the second sample in its relation to the first "sample" as well. If shell is heavily broken up but still identifiable, and if unbiased subsamples of shell can be drawn, then, as noted earlier, subsamples which may be fairly small in terms of weight but large in terms of the number of fragments composing them may give a fairly precise estimate of the species composition of the excavation level as a whole. Multiple subsamples will express this precision by having a relatively small standard deviation. As noted earlier, this precision cannot be used directly in comparisons with the species composition of the whole excavation unit, because of shell breakage which may have occurred after the level was formed. However, their precision can be applied to the estimate which they give of the shell ratios for the level as a whole. That estimate for the level can then be evaluated in comparison with the figure for the excavation unit, if allowance is made for the limitations on accuracy and precision caused both by the size of the subsamples and by the size of the whole level of "sample."

To illustrate, consider again the last-mentioned hypothetical excavation unit which had a X^2 which was significant at the 90% but not the 95%

level of confidence in the previous analysis. Instead of a single 1,000-gram sample, suppose that the shell from each level had been analyzed in four 250-gram subsamples. Further, suppose that each of those 250-gram subsamples had consisted of about 1,000 identifiable shell fragments, and furthermore that the total amount of shell recovered from each level was about 4,000 grams. The mean percentages by weight of the shell from level 1 are again found to be 40% of chione and 60% for pecten. With four 1,000-fragment subsamples as the basis for these means, the standard error of the means is likely to be approximately

$$s_{\bar{x}} = ((p \times q) - (N \times n))^{1/2}$$

where p and q are the probabilities of choosing chione and pecten shell fragments respectively, N is the size of a subsample, and n is the number of subsamples. In this case, $s_{\bar{x}} = 0.77\%$, which implies that there is a 97.5% assurance that the actual percentage of chione for this level as a whole is no higher than (40% + 1.96 x 0.77%) or 41.5%. If that were the actual percentage of chione, then there would be 1,660 grams of chione and 2,340 grams of pecten, or, in Estimated Minimum Numbers of Units (EMNUs), at least 83 chione valves and 117 pecten valves in the level as a whole. For a 200-shell sample drawn randomly from a population with even numbers of chione and pecten valves, the standard deviation is $s = (n \times p \times q)^{1/2} = 7.07$ valves, so that there is a 98% probability of both species having more than 83 and less than 117 valves in a randomly chosen sample. But the probability that neither the actual ratio for the level as a whole was as even as 41.5:58.5 nor was the 83:117 ratio of valves a random departure from a 50:50 ratio, is (.975 x .98) = .956 = 95.6%. Therefore, there now is 95% confidence that the differences between the level and the rest of the excavation unit are not merely random. It should be noted, however, that the success of this method of analysis is contingent on the presence of large numbers of fragments in each subsample and upon large quantities of shell from the levels as wholes.

Conclusions

(1) Archaeological shell samples and their identification and analysis can be considered redundant only within the context of some specifically defined problem.

(2) Adequate shell smaple size is a function of that specific problem, the precision of the information needed to address it and the accuracy required in the answer.

(3) Shell species patterning can be described in tabulations using any units desired (e.g., grams, percentages, ratios), but it can be evaluated only if the analysis explicitly or implicitly deals with counts of appropriate, potentially-independent units (e.g., shell fragments, valves, organisms, Estimated Minimum Numbers of Units).

(4) To identify the range of species present in an archaeological shell population, with a 95% assurance of including any particular species making up at least 1% of the population, a sample on the order of 300 shells, or perhaps about 6,000 grams, will be needed.

(5) To identify significant frequency variations in shell species on the order of 15%, with 95% confidence, shell samples on the order of 50 valves, perhaps 1,000 grams, are likely to be necessary.

(6) For very large collections of heavily fractured shell, analysis in terms of multiple subsamples may improve the accuracy and precision attainable with a given sample size.

Acknowledgements

The examination of this problem was begun as part of an archaeological project for Caltrans (11-SD-5, P.M. R30.0/R34.5). The stimulation of Marty Rosen's skeptical interest was particularly helpful. Charles Bull and Susan Hector of Recon were most generous with their time in helping to thrash out many of the issues discussed here. The conclusions proposed here are of course the responsibility of the author alone.

COMMENTS ON "SAMPLING MARINE SHELL: HOW MUCH IS ENOUGH?" by Don Laylander

Dr. Dwight W. Read
Department of Anthropology
UCLA

The question of what constitutes an adequate sample size arises not only for estimating proportions of shellfish species in a midden, but whenever a sample is used to estimate a population parameter. Regardless of the context, the general answer is, as Laylander notes, the same: It depends on the accuracy and precision and the risk (usually measured as the probability of Type I error) that is acceptable. This point cannot be overly emphasized. there is no "correct" sampling proportion, such as a 10% or 20% sample. The only statistically correct sample size is one sufficiently large to provide an estimate with the desired degree of accuracy at a specified level of risk.

The latter is a choice made by the researcher who must weigh the relative "costs" of Type I (rejecting a true Null Hypothesis) and Type II errors (accepting a false Null Hypothesis)--with that decision typically (though not necessarily) made by allowing for a 1% or 5% probability of a Type I error. Likewise, accuracy must be decided upon by the researcher. Is it sufficient to know that a proportion is 0.4 as opposed to 0.6, or must one know that it is 0.45 versus 0.557? Will it suffice to know that the average site size for sites in the region is between 600 and 800 square meters with 95% certainty, or will it be necessary to know that the true value is between 690 and 710 square meters with 99% certainty? It is only after the researcher provides answers to questions such as these that it is meaningful to discuss what constitutes an adequate sample size for purposes of statistical estimation and inference. (Obviously, other considerations may take precedence, such as the intensity of survey mandated under CRM legislation, and these may lead to quite different answers.)

When the problem is well-specified, then an exact solution can be given. Specification is made in terms of the accuracy and risk that are needed and acceptable, respectively, in the estimate of a population parameter. The solution is the minimal sample size needed to meet those requirements. It should be noted that the sample size is specific to the parameter being estimated, and might be larger or smaller when a different question is considered. In the context discussed by Laylander, where the data have already been collected and are far more numerous than are needed for the question at hand, then the matter of sample size is one of subsampling and can be handled on a problem by problem basis. But for the situation where the researcher is asking how large a data sample should be collected in the first place, then it is necessary to take into consideration the range of questions that will be addressed by these data and to use the worst case situation as a guideline for a minimal sample size.

The procedure discussed by Laylander can be given a more general formulation which illustrates the concepts involved (though the specific equations will depend on the application). Generally speaking, statistical inference--that is, using properties of a sample to estimate population parameters--is probabilistic. One is using sample data to both estimate a population parameter and to compute the standard error of that estimate. The computations for the former are derived from estimation theory (What computation based on sample data will give an unbiased estimate of a population parameter? What computation will give an estimate with minimum variance? Is there a computation that will both be unbiased and have minimum variance?), and the latter is determined by mathematically defining the distribution that will ensue when the Null Hypothesis is valid for the population under investigation. (In Laylander's first example, estimation theory establishes that the sample proportion is an unbiased, minimum variance estimator for the population. The implicit Null Hypothesis (H0) is: "The proportion of the species in question is 1%" and the (one sided) Alternative Hypothesis (H1) is: "The proportion of the data will tend to follow a binomial distributin with parameters n (sample size) and p (the probability specified in H0). Laylander's q is related to p by $q = 1 - p$).

Once the distribution that will ensure when H0 is true is known, then the relation amongst sample size, n, values in the distribution (such as the value of 0, i.e., no sites, in Laylander's example) and the probability (risk) that such a value will be realized in a sample of size n may be mathematically determined. When the distribution is known (i.e., H0 has been specified) and the degree of accuracy that will be necessary has been stated, then if the risk is specified, the sample size, n, corresponding to that degree of risk and accuracy may be computed, as Laylander has illustrated. While the specific computations depend on the parameter in question and the form of the distribution, some general results may be noted that give a sense of the relation between accuracy, risk and sample size, regardless of the specific question being used.

In the case of random sampling, a minimum variance unbiased estimator (such as the sample proportion or the sample mean) will tend to have a normal distribution with variance for the estimates inversely proportional to the sample size, n. The square root of the variance of the estimates, or the standard error (σ_{SE}) of the estimates is thus given by the following proportion:

$$\sigma_{SE} \sim 1/\sqrt{n}$$

This implies that a (2-sided) confidence interval for an estimate $\hat{e}$ of a population parameter $\mathcal{E}$ will have lower and upper limits proportional to:

$\hat{e} - z_{1-\alpha/2}\sigma_{SE}$ and $\hat{e} + z_{1-\alpha/2}\sigma_{SE}$, respectively,

where: $\hat{e}$ is the estimate of $\mathcal{E}$

α is the significance level

$z_{1-\alpha/2}$ is the z-score with $\alpha/2$ of the standard normal distribution to the right of $z_{1-\alpha/2}$

σ_{SE} is the standard error of the estimate e of

and

n is the sample size.

Thus the quantity $z_{1-\alpha/2}\sigma_{SE}$ is proportional to the accuracy that is desired with risk = α. In other words, doubling the accuracy, say from 10 units to 5 units, would require 2^2 or 4 times the sample size needed for the lower accuracy; to change the accuracy by a factor of 5 to 2 units from 10 units,

would require 5^2 or 25 times the sample size previously required. In general, the change in sample size is proportional to the square of the factor by which the accuracy is changed.

For the estimator, $\bar{x}$, of the population mean μ, the standard error is given precisely by: $\sigma_{\bar{x}} = \sigma / \sqrt{n}$ (or, for sample data, $s_{\bar{x}}$ is an estimate of $\sigma_{\bar{x}}$). The term, σ, cannot be controlled by the researcher as it is an inherent property of the population in question. The effect of the standard deviation, σ, on accuracy and precision in an estimate of μ can be seen by considering data from a population that has twice the standard deviation of another population. The former will require a sample size twice as large to obtain the same degree of accuracy and precision as for the other population. Hence the basis for stratification in sampling designs: stratify in a manner that reduces the variance within strata. Thus, when a region is stratified in a manner which reduces variance in a stratum in comparison to the region taken as a whole, a smaller overall sample size is needed for the same degree of accuracy in the estimate of a parameter since the sample size needed for a given degree of accuracy is proportional to the standard deviation in a stratum which, in this example, is less than the overall standard deviation for the region without stratification.

As noted, accuracy is related to the standard deviation of the parent population, hence cannot be reduced by manipulation of the data. In his last example, Laylander appears to do just this. The population in question is the number of individual organisms represented in the shell midden. The data, because of various destructive factors, consist of shell fragments. Laylander computes a standard deviation ($s_{\bar{x}}$, or estimated standard error of the mean) using the total number of fragments in the sample (4,000). The implicit null hypothesis is of the form HO: $p = q + 0.5$. (That the sample is divided into 4 parts does not affect the calculations since the term $N \times n$ is just the total sample size.) At question here is the use of the number of fragments rather than the number of individuals in the calculations.

One may see why the number of fragments should not be used if one notes that the comparison of the distribution of shell species in one level of the sample to the overall distribution of shell species in the sample

taken as a whole should not be determined by the amount of breakage, as the latter is variable but the species proportions are constant. Suppose it were the case that none of the shells were broken. The value for $s_{\bar{x}}$ would be based on the number of individual organisms in the sample, not the number of fragments, hence would take on a different value and different conclusions would be reached. Or, suppose the data were fragmented even more after collection, so that the figure of 4,000 is greatly increased. Again, the conclusions drawn would be different since the value of $s_{\bar{x}}$ would change. Yet in all three cases the population of concern has remained fixed.

Since in this example, Laylander is testing whether or not HO: $p = q - 0.5$ should be accepted for the data in level 1, the EMNU's for each species should have been computed, assuming the null hypothesis is valid, and the total EMNU used to compute $s_{\bar{x}}$. Based on a total weight of 4,000 grams for the sample from level 1, the EMNU would be 200, $s_{\bar{x}} = 0.346$ and the upper estimte for chione would be 46.8% intead of 41.5%, and so on.

The null hypothesis, HO, for level 1 can be tested in a slightly easier fashion. One could ask: Given HO and a sample size of 200, in what range will 95% of the sample estimates for p lie? Here, $s_{\bar{x}} = [(0.5 \times 0.5)/200]^{1/2} = 0.0354$ and 95% of the time the sample proportion will lie in the range [0.43, 0.57]. A sample value of 0.40 is outside of this range, hence HO can be rejected at the 5% significance level.

One could also test the proportion observed in level 1 against the proportion observed in the whole sample, where now both of these proportions are estimates. The Null Hypothesis would be that the proportion in level 1 is the same as the overall proportion. Standard statistics references give the details for such a test (e.g., Blalock 1972:228-230).

REFERENCE

Blalock, Hubert
1972 Social Statistics. McGraw Hill, NY.

RESPONSES TO COMMENTS BY DWIGHT W. READ

Don Laylander

I welcome Dr. Read's comments on the statistical problems of shell sampling and his linking of those problems to other archaeological concerns.

I would like to attempt to clarify one particular point to which Read raises objections: the argument that, under conditions of highly fractured shell, multiple subsamplings may improve the confidence with which the Null Hypothesis of randomness can be rejected, or reduce the sample size necessary for rejection of it.

Read suggests that "accuracy is related to the standard deviation of the parent population," that the standard deviation "is an inherent property of the population in question," and that consequently the accuracy "cannot be reduced by manipulation of the data." These assertions are perhaps not quite exact. The parent population, such as the shell from an excavation unit or from a level, does not itself possess a standard deviation. The population possesses certain parameters, such as, say, a chione proportion of 58.2%; but this parameter is constant and "exact." What is inconstant and inexact is our estimate of the parameter, based on some samples we may draw from the population. For a given method of sampling (meaning, primarily, a given sample size), if we repeat the same sampling procedure over and over again, the standard deviation of our sampling estimates of the parameter will converge on a particular, mathematically-predictable value. That standard deviation is an inherent property of the parent population plus the sampling method, not of the parent population alone. Change the sampling method (increase or decrease the size of the samples) and the standard deviation will change, too.

Dividing a shell sample into, say, four subsamples will certainly not change the resulting estimate of the population parameter (the species ratio), nor will it change the error between that estimate and the actual ratio, nor will it change the sample size. What it may do is give us a better way of estimating how large that error is. If we choose (for good practical reasons) not to count the shell pieces in our sample, we may estimate the error by in effect assuming that the units of our sample consist entirely of whole, 20-gram valves--a "worst-case scenario" which protects us very well from making a Type I error (incorrectly rejecting a true Null Hypothesis of randomness) but which may expose us to inordinate and unnecessary risks of making a Type II error (incorrectly accepting a false Null Hypothesis). By more accurately defining the size of the error in our estimate, instead of assuming it to be the maximum-possible, "worst-case" value suggested by EMNU, we can maintain high security of avoiding a Type I error while at the same time reducing somewhat the risk of a Type II error.

In evaluating the error in our estimate of the population parameter (in this case, the shell species ratio for a particular excavation level), the true sample size is proportional to the number of fragments in the sample rather than to the EMNU in the sample, because each fragment of broken shell in the level has an independent chance of being chosen in each sampling. In contrast, to evaluate the deviation of the level as a "sample" of the whole unit, EMNU rather than fragment counts must be used, because the fragments are not necessarily independently "chosen"; fragmentation of the shell may have occurred after the level "sample" was "drawn."

To illustrate, take an unrealistically extreme case. Suppose that we want to estimate the proportion of chione in a level, based on a 40% analyzed sample. We draw the sample, and our estimate of that proportion is found to be 75%. To make an estimate of how large our error may be in this 75% estimate, we need more information. Say that the total shell for the level weighs 200 grams. Using the arbitrary but conservative EMNU figure of 20 grams per valve, we would suppose that there were 10 valves in the level, and that our sample consisted of 4 valves. If we kept taking 4-valve samples over and over again, and if the actual chione proportion for the level were 50%, we would find that the standard deviation among our repeated samples would be about 30%. The error of our first sample, at 75%, or 25% off the real value, was entirely expectable.

Suppose now that we crush the 10 valves, each valve breaking into 100 pieces, before we draw a sample. The 80-gram, 40% sample will now consist of 400 pieces. If the actual chione proportion is 50%, the standard deviation of repeated samples would be found to be about 2.5%, and the chance of our ever getting so anomalous an estimate of the parameter as 75% (300 pieces of chione in a sample) will be extremely remote.

Turn it around the other way. If we don't count the fragments, but only weigh the shell, we can find out whether the distortion caused by small sample size (small number of fragments, not small percentage or weight or EMNU) is large or small by taking several subsamples and considering the standard deviation among them. Instead of one 40% sample, with about the same work we may take four 10% samples. If the shell we sample is whole (each sample being a single valve), the standard deviation of the four estimates will be found experimentally to be something like 50%. If the shell consists of about 100 pieces per sample, the standard deviation will be about 5%. The former case tells us that our estimate is very crude and that in order to avoid a Type I error when we compare this estimate with the whole-unit estimate we will have to accept very wide divergences as being still possibly only random. The latter case allows us to put more faith in our level estimate and to reject such wide divergences while still retaining confidence that we are not committing a Type I error. The population parameter is the same in both cases, the sample percentage is the same, and the EMNU would be the same, but the sample size (four whole valves versus 400 fragments) makes all the difference.

The essential point to stress is that a two-step analysis is involved in the subsampling method discussed in the article: first the species ratio for the level is estimated, and then the deviation of that estimate from the whole-unit average is evaluated. Two deviations are present: the

deviation of the level estimate from the actual level ratio, and the deviation of the level estimate from the whole-unit average. To evaluate the first, shell fragments are legitimate sampling units; in the second, the use of EMNU's is necessary. Read's calculation of the range of values for rejection of the Null Hypothesis ignores the consequences of the initial stipulation that only a 1,000-gram (50-valve) sample, rather than the entire 4,000 grams (200 valves), was to be sorted. It was to address the problem of sampling within the level that subsampling and calculations based (implicitly) on fragments rather than EMNU's were employed.

REPLY TO REPONSE (CLOSURE AT LAST?) Dr. Dwight W. Read

One of my comments was unclearly stated and needs amplification. By my statment that "accuracy is related to the standard deviation of the parent population" I was referring to the general property that in simple random sampling the standard error (SE) of a parameter estimator (at least for maximum likelihood estimators) is proportional to $\sigma/\sqrt{n}$, where σ is the standard deviation (parameter) of the parent population for the measure in question and n is the sample size. What Laylander is calling "standard deviation" can be more clearly referred to as the SE for the estimates of the parameter in question (in this case, the proportion of chione in the population). The standard deviation (in the sense I was using the term as a population parameter) cannot be varied as it is exact and fixed for the population. What can be varied, as Laylander notes, is the SE via change in sample size. This leads to my next comment.

The numerical value of the SE varies inversely with the sample size; larger samples lead to smaller values for SE and hence to more precise and accurate estimates. The question is: How can the researcher legitimately vary the sample size when a fixed quantity (measured in grams) of shell constitutes sampled material? Clearly, if one were to excavate whole shells only, and then break them up and use the number of fragments as the sample size, the reduced value for SE based on the large number of fragments would be an artifice and have no meaning. Laylander suggests, however, that if the shell is broken (by whatever process) prior to excavation, then the fragments found in a given level can be used as the sample size for that level. This may or may not be valid.

If, for example, the shells were discarded whole, next became part of the midden and finally fractured, so that the fragments are essentially in same location as when the shell was whole, then it is not valid to use the number of fragments as the sample size. Contrariwise, if the fragmentation process occurred early and then the fragments were randomly discarded (or there was so much mixing of material during and after occupation the fragments ended up being randomly distributed through the midden), then it would be legitimate to use the number of fragments as the sample size, provided that the fragmentation process was the same for all species (the latter could be verified via the EMNU and the number of fragments per species).

In the first situation, the lack of randomization of fragments through the midden implies that the sampling whole shells and then fragmenting them after the sample is obtained. In the second situation (assuming the same fracturing rate for each species) the fragments have the same ratio for the species as throughout the midden then allows the conclusion that the sampling is random; i.e., "each fragment of broken shell in the level has an independent chance of being chosen." Laylander quite correctly notes the problem in comparing levels leads precisely to the first situation; presumbably, the midden is vertically stratified, hence the fragments are not randomly distributed throughout the midden. The same problem can, and quite likely may, arise in a single level as well.

RISING GLEN: SDM-W-143/146 (SDI-5213 C & D)

A MAJOR COASTAL LUISENO HABITATION SITE

Mary Robbins-Wade
RBR & Associates, Inc.
San Diego, CA

ABSTRACT

Rising Glen, SDM-W-143/146 (SDI-5213 C & D)*, is a major coastal habitation site located between Buena Vista Lagoon and Agua Hedionda in Carlsbad, California. Obsidian hydration, radiocarbon dates, and time-sensitive artifacts place the earliest occupation of the site in the Early Milling/Late Prehistoric transition period. Habitation continued into Late Prehistoric times. The coastal lagoons have long been recognized as an important resource base and have been the subject of much research (e.g., Crabtree, Warren, and True 1963; Gallegos 1985; Shumway, Hubbs, and Moriarty 1961; Warren 1964). However SDM-W-143-146 is the first coastal Luiseno village to have been studied. It provides a wealth of information as well as an abundance of questions to be addressed in future research.

INTRODUCTION

As part of the environmental review process for the Rising Glen subdivision, a data recovery program was undertaken at SDM-W-143/146 during September 1984. The excavation documented what had previously been thought about the site: it is a major coastal occupation area located within what is ethnographically Luiseno territory. Little is known about coastal Luiseno groups because both ethnographic and archaeological research have focused on the inland Luiseno. Therefore, an important aspect of the research on Rising Glen was a comparison of the coastal Luiseno (represented by SDM-W-143/146) and the inland Luiseno (represented by Molpa, SDi-308). A valid definition of the Luiseno/San Luis Rey Complex must include both coastal and mountain sites.

Another important question addressed regarded the traditional interpretation of the La Jolla Complex. At Rising Glen, "La Jolla" cobble tools occurred in association with ceramics, Cottonwood Series projectile points, and late dates suggesting (as others have done) that "La Jolla" tools are not a cultural/chronological marker but an environmental one.

The vast amount of faunal remains(including shellfish, animal bone, and fishbone) provided a great deal of information on subsistence as well as on seasonality. Many important questions remain to be answered, but Rising Glen provides a start, an initial look at a Luiseno coastal village.

*SDM-W-143/146 corresponds to SDi-5213 C & D

NATURAL SETTING

Rising Glen is located strategically between Buena Vista Lagoon and Agua Hedionda, just 3 km inland from the present day coastline (Figure 1). The Coastal Plains physiographic province is noted for its equable climate; the mean annual temperature is 16°C (61°F) and rarely falls below 5°C (42°F) in January. Annual rainfall averages 8-13 inches (Bowman 1973). Over the last 18,000 years, the climate of southern California has become progressively drier and warmer, despite minor climate fluctuations. Although the absolute extent of these climatic changes is uncertain, present day conditions are believed to reflect the past 2,200 years (Heusser 1978).

The site comprises a series of northeasterly trending ridge fingers dissected by narrow deep drainages and deep erosional cuts. Elevation ranges from 40 m to 95 m above mean sea level. Today, water is available in the canyons on a seasonal basis.

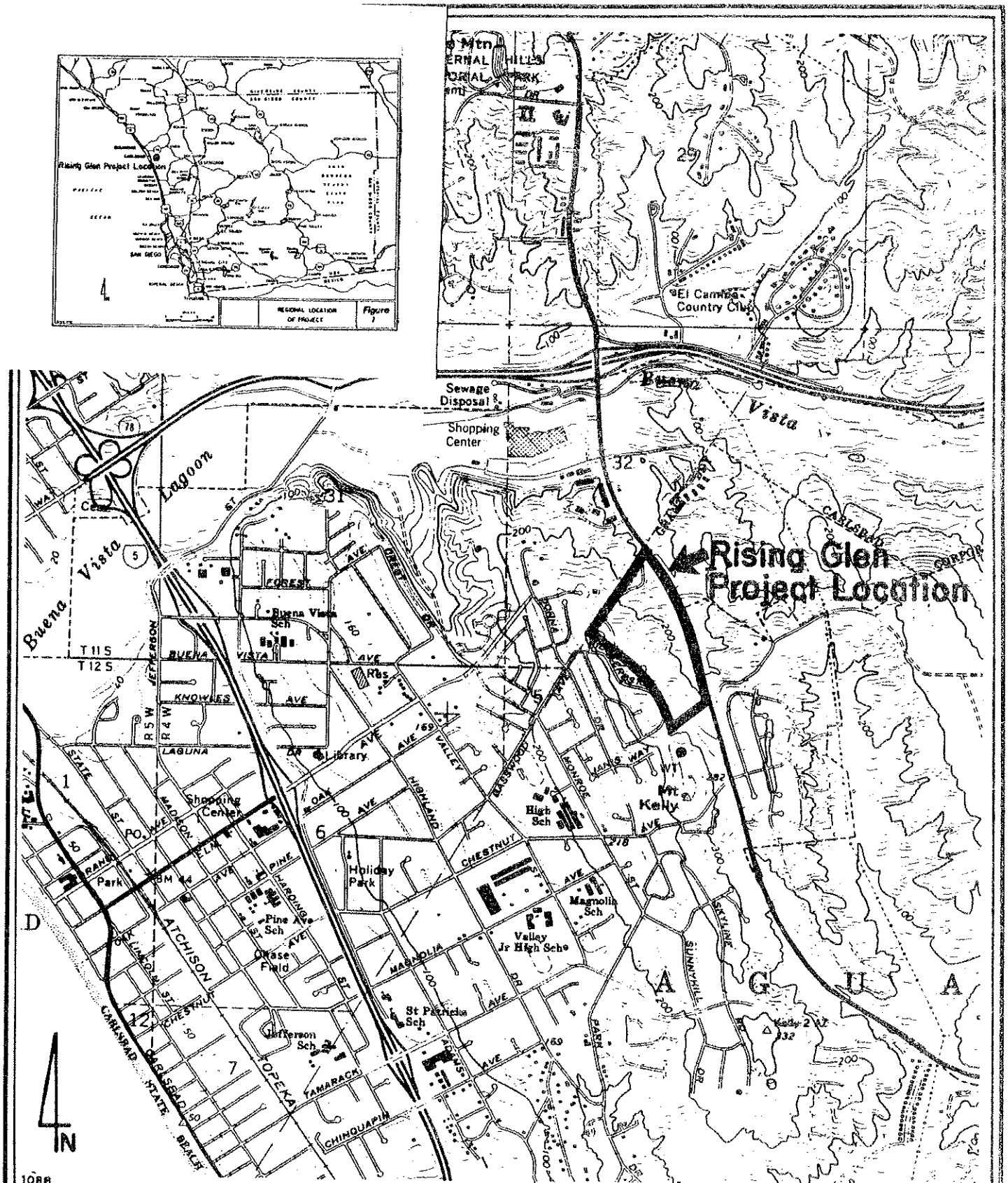
The site and surrounding area currently support a great deal of non-native plant life; the area has been cultivated for years. It is assumed that the site supported a Coastal Sage Scrub community during prehistory. This community is characterized by California Sagebrush (Artemesia california) and includes a number of plants useful to prehistoric inhabitants for subsistence, fuel, shelter, tools, medicine, and ceremony. This plant community undoubtedly supported a varied fauna, exploited by the aboriginal population. Buena Vista Lagoon, which during prehistoric times covered a much greater area than its current extant, presumably offered prehistoric inhabitants a wide variety of finfish and shellfish in addition to other animal life.

THE SITE

Background

Malcolm Rogers (1929) recorded four sites (SDM-W-143, SDM-W-144, SDM-W-145 and SDM-W-146) within and immediately adjacent to the Rising Glen subdivision. Regarding SDM-W-143, Rogers wrote, "This site is only the nucleus of a great Shoshonean occupation as the steep benches above the ridge above and saddles in the ridge carry the same occupation. It is almost impossible to divide this region into specific sites as the occupation is almost continuous for 3/4 of a mile and 1/2 mile wide" (Rogers 1929). SDM-W-144 is noted as part of this same occupation. Rogers mapped SDM-W-145 as being adjacent to SDM-W-143 and SDM-W-146. He wrote that the top of the deposit appeared to be Luiseno, but that this component did not necessarily continue throughout. One flexed burial had been found during construction on SDM-W-146 prior to 1929. Rogers recorded that relic collectors had taken away many artifacts from these sites. Portions of SDM-W-144, SDM-W-145, and SDM-W-146 have since been destroyed by construction.

Keith Polan surveyed the property in 1983. Because there was no discernible break between the sites, they were treated as a single resource, SDM-W-143/146. Polan noted the site as a significant archaeological resource



PROJECT SITE AND VICINITY

(BASE MAP: U.S.G.S. 2000' SCALE, SAN LUIS REY QUADRANGLE, 1975)

Figure 7

(Polan 1983). A testing program supervised by Dennis Gallegos in 1983 called out the site as "a significant intact midden deposit" representing "potential continuous occupation at SDM-W-143/146 for the past 7,000 years" (Cardenas and Robbins-Wade 1985). These descriptions of the site were borne out by the data recovered during the excavating of Rising Glen.

Excavation Procedures

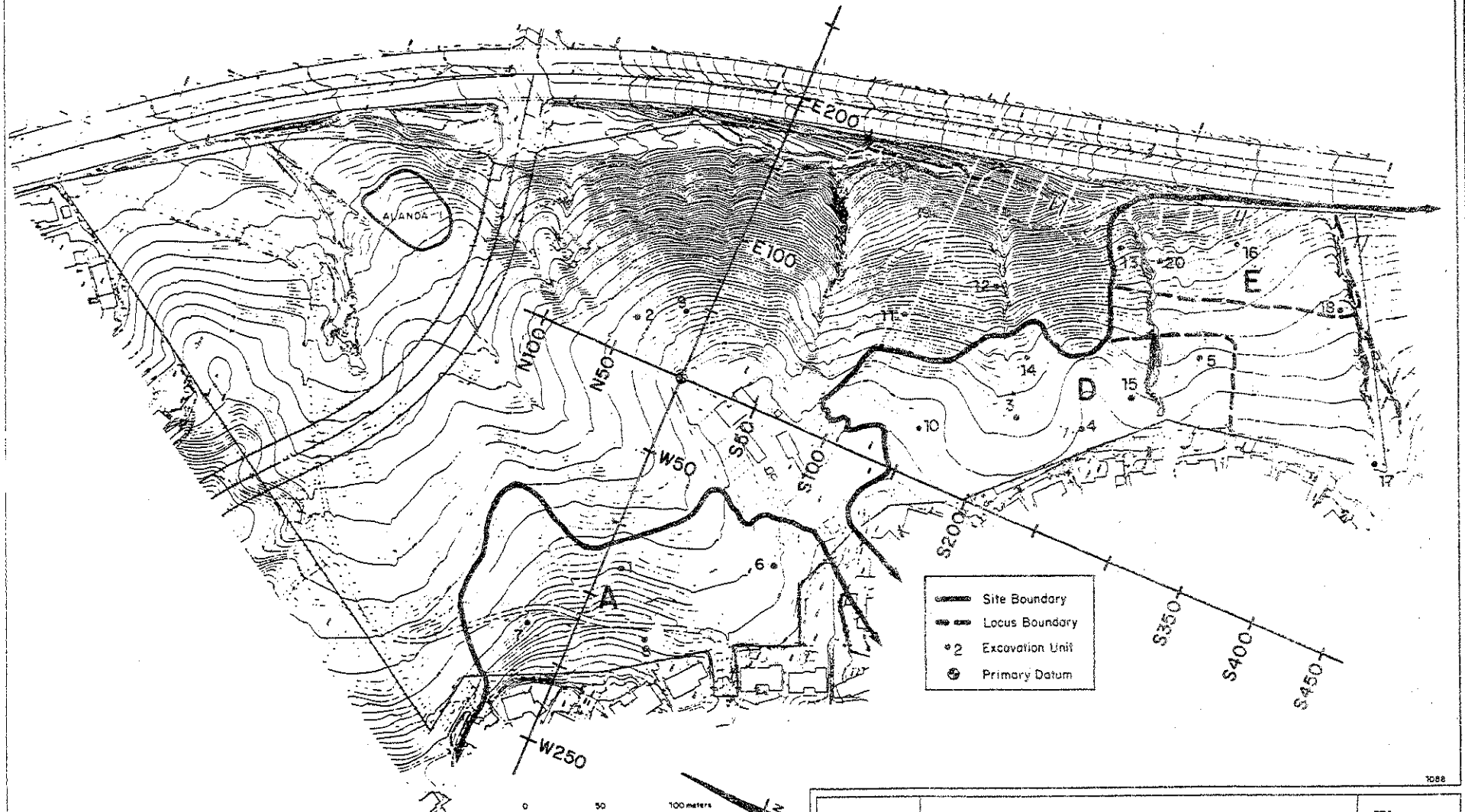
The extant portion of SDM-W-143/146 covers 140,470 m^2. The site comprises three loci (Figure 2), differing in topography, depth of deposit, faunal remains, artifact types, and presumably, function. A grid system was set up on the site, and each unit was given a grid address as well as a number (e.g., Unit 2 N50E29). The grid system and the units themselves were oriented to true north. Twenty units were excavated, 1 m east-west by 2 m north-south. Units were excavated in arbitrary 10 cm levels, as no natural stratigraphy was evident until completion of the units. If the lowest corner of the unit was more than 20 cm below the datum corner, the unit was dug by contour level. That is, depth was measured from each corner, not only from the vertical datum. In those units with less than 20 cm difference between the high and low corners, levels were dug in relation to depth from the vertical datum. Thirteen units were excavated by contour level (Units 2, 4, 5, 6, 7, 9, 10, 12, 13, 14, 16, 17, and 19). The remaining seven units (1, 3, 8, 11, 15, 18, and 20) were excavated using the vertical datum corner. Soil was passed through one-eighth inch mesh screen. Because of the large amount of shell, bone, and material of small size mixed in with gravel, all material in the screen was sent to the lab for washing and processing. A great deal of soil was in and around the shells; this was removed in washing and cultural material was caught in window screen-size mesh. This is the reason for the high recovery rate of bone (especially fishbone and otoliths) and charcoal, which normally fall through eighth inch mesh.

Stratigraphy

SDM-W-143/146 consists of three loci; however, the stratigraphy is similar across the site, the main difference being the depth at which sandstone is encountered. Medium brown sandy loam is the predominant soil, with pockets of an orange soil mixed. Five units (three of Locus A and two on Locus E) bottomed out on sandstone at depths ranging from 50 cm to 100 cm. Three units on Locus D were terminated after hitting hard compact clay devoid of cultural material. One of these units was stopped at only 20 cm; the other two went to 80 cm and 90 cm. Seven units across the site failed to hit either sandstone or clay and were halted following one sterile level or when all cultural material recovered was in rodent burrows. The remaining five units (Units 2, 9, 11, 12, and 19) all consisted of hard compact clay. These units mark the outskirts of the site; they are all outside the site boundaries.

Cultural Features

A concentration of cobbles and two apparently fire-affected pieces of sandstone were found in Unit 3 at a depth of 67 to 90 cm and designated Feature 1. The feature was originally thought to be a hearth. However, of



RISING GLEN SDM-W-143/146
REVISED LOCI DESIGNATIONS

Figure 2

33 cobbles none were burned or fire-cracked, and only 1.4 g of charcoal were recovered. Although Feature 1 is not a hearth, it does appear to be a discrete concentration of cobbles, therefore the feature designation remains.

Feature 2 was an apparent hearth in Unit 15 at 65 cm to 90 cm. It consisted of a concentration of fire-affected cobbles and groundstone tool fragments. Charcoal, shell, animal bone, and fish bone were recovered from the feature, along with two scrapers and 17 flakes. The levels above Feature 2 had been disturbed by the laying of a water pipe; however, the feature itself does not appear to have been disturbed. Other tools recovered in Unit 15 at the same depth as the feature are: a chopper, a chopper/hammer, three scrapers, three pieces of unclassified groundstone, five manos, two pestle fragments, one metate fragment, two cores, and 189 flakes. Apparently several activities were carried out in close proximity to each other. The chopper/hammer may have been used in lithic tool production, of which the cores and flakes are the byproducts. The other tools, especially groundstone, are often associated with food processing, as are hearths.

ARTIFACT ASSEMBLAGE

Groundstone

MANOS: Forty-two manos were recovered from SDM-W-143/146, all but one from Locus D (n = 26) and Locus E (n = 15). Of the 42 manos, 15 are unclassified fragments, 5 are unifacial, 21 are bifacial, and one is multifacial. Four specimens are metavolcanic; the remaining 38 are granitic.

PESTLES: Two granitic pestle fragments were recovered from the site, both shouldered. Both pestle fragments came from Unit 15 and were associated with the hearth, Feature 2.

METATES: A total of 11 metates and metate fragments were recovered: nine basin metates (with grinding surface concave from use), one slab metate (with flat grinding surface, no appreciable depth), and one unclassified fragment. All eleven specimens are granitic. Three of the metates were from Locus E; the remaining eight came from Locus D.

MORTARS: Mortars are similar to basin metates; however, the concavity of a mortar is much deeper, with steep sides. Pestles were the grinding implements used with mortars, in contrast with manos which were used with metates. One granitic mortar was recovered on the surface of Locus D. The paucity of mortars may be due to collection by relic hunters.

PENDANT: A fragment of groundstone, possibly a pendant, of unknown material was recovered from Locus D.

BALL: One groundstone ball was recovered at SDM-W-143/146. Similar balls have been found at other sites (Crabtree, Warren and True 1963; Warren, True and Eudey 1961; Greenwood 1969). Though the function of these artifacts is unknown, Greenwood suggests that they may have been used "for grinding in a circular motion within the basket mortars" (Greenwood 1969: 25).

UNCLASSIFIED GROUNDSTONE ARTIFACTS: Groundstone fragments which are too fragmented to allow identification are unclassified. Nine unclassified groundstone fragments were found at the site: five were from Locus D and four from Locus E. All nine are granitic.

Flaked Stone - Unifacial Tools

Unifacial tools exhibit intentional retouch on one surface along one or more edges. Edge angle and use wear are used to define functional tool types.

CHOPPER: This tool type evidences unifacial retouch and bifacial faceting use wear. Three unifacial choppers were recovered, all from Locus D. One is a fine-grained metavolcanic, one a medium- to coarse-grained metavolcanic, and one quartz.

SCRAPER PLANES: The unifacially retouched scraper plane has at least one planate surface and a tendency toward a steep working edge angle of between 66 degrees and 75 degrees. Edge wear characteristically shows evidence of unifacial microstep flaking and/or nibbling. A total of six scraper planes were recovered. Three are flake-based, one core-based, one cobble-based, and one unclassified. The material types vary between fine-grained metavolcanic (n = 1), medium- to coarse-grained metavolcanic (n = 1), quartzite (n = 2), and quartz (n = 2). Scraper planes range in size from 6.8 cm x 5.3 cm x 2.3 to 10.2 cm x 5.5 cm x 3.1. Two scraper planes were recovered from Locus A; the remaining four came from Locus D. There is some question as to whether some artifacts normally called scraper planes are not actually cores, rather than tools. The scraper planes represented in the Rising Glen collection, however, evidence use wear, strengthening their designation as tools.

SCRAPER PLANE/SCRAPER: A scraper plane/scraper is a multifunctional tool exhibiting those characteristics of both a unifacial scraper plane and a unifacial scraper (as individually defined). Only five scraper plane/scrapers were found during the mitigation of SDM-W-143/146. Four are flake-based; the other is cobble-based. Two are made from fine-grained metavolcanic and three are medium- to coarse-grained metavolcanic. The two scraper plane/scrapers from Unit 3 resemble small domed scraper planes. The other three exhibit far less reduction and are slightly larger. The scraper plane/scrapers range in size from 3.4 cm x 3.3 cm x 1.9 cm to 7.2 cm x 6.8 cm x 2.7 cm. Three specimens were recovered from Locus D and two from Locus E.

SCRAPER: A unifacially retouched scraper tends to have a working edge angle of 46 to 60 degrees. Edgewear characteristically shows evidence of unifacial microstep flaking and/or nibbling. During the mitigation of SDM-W-143/146, 34 unifacial scrapers were recovered: 22 flake-based, two cobble-based, and 10 of unclassified production base. The material types of scrapers include fine-grained metavolcanic (n = 7), medium- to coarse-grained metavolcanic (n = 13), quartzite (n = 5), chert (n = 5), quartz (n = 3), and obsidian (n = 1). Scrapers range in size from small pressure retouched thumb-nail scrapers to split-cobble or core-based scrapers produced by minimal direct percussion and measuring as large as 11.8 cm x 7.7 cm x 3.3 cm. Two scrapers were recovered from Locus A, 20 from Locus D and 12 from Locus E.

SCRAPER/PERFORATOR: A unifacially retouched scraper/perforator is a multifunctional tool exhibiting those characteristics of a scraper on one or more edges, along with those of a perforator (i.e., modification such that a beaked or nosed edge results; edge wear is confined to the beaked or nosed edge and consists of edge rounding). Only one scraper/perforator was recovered, from Locus E.

HAMMER: A unifacially retouched tool, the hammer exhibits heavy edge battering. The examples from SDM-W-143/146 was found on Locus E. It is made of quartz on an unclassified production base.

Flaked Stone - Bifacial Tools

Bifacial tools exhibit continuous retouch on both faces along one or more edges. Use wear may be exhibited on one or more working edges.

CHOPPER: A tool with bifacial retouch along one or more edges, a chopper characteristically shows evidence of bifacial faceting or micro-step flaking. Ten bifacial choppers were recovered from SDM-W-143/146. Two specimens were found on Locus A, seven on Locus D, and one on Locus E.

CHOPPER/HAMMER: A bifacially retouched chopper/hammer is a multifunctional tool exhibiting those characteristics of a chopper along with the characteristic edge damage of a hammer, including faceting, edge crushing, and possible abrasion. Four chopper/hammer tools were recovered from SDM-W-143/146. Three were found on Locus E. All are of medium- to coarse-grained metavolcanic.

KNIFE: This category includes both formally shaped knives and very informal and less modified specimens. Two bifacial knives were recovered from SDM-W-143/146 during data recovery. Both have an unclassified production base. Though fragmentary, one specimen appears to represent Type I described for Molpa (True, Meighan and Crew 1974). The other knife is very informal and less modified. Both knives were recovered from Locus D. The Type I specimen is chert; the other knife is a medium- to coarse-grained metavolcanic.

PROJECTILE POINT: Two projectile points, one whole and one nearly whole, were recovered at the site. One is chert, the other clear quartz. Both points are triangular in shape with a concave base and no side-notching. The whole specimen measures 2.6 cm in total length, 2.2 cm in axial length and 1.5 cm at maximum width. The nearly whole specimen is complete enough to project the total length at 2.2 cm, the axial length at 1.9 cm, and the maximum width at 1.7 cm. Both points belong to the Cottonwood Triangular Series and specifically correspond to True's Type I (1970: 21). Both projectile points were recovered from Locus D.

PREFORM: Three flake-based preforms were found at SDM-W-143/146. Two came from Locus D; one was found in a non-locus area. All three were manufactured from quartz.

BIFACIAL TOOL FRAGMENT: One artifact was recovered which shows evidence of bifacial retouch, but its fragmentary condition precludes a functional determination. The specimen is chert and was recovered from Locus E.

Flaked Stone - Utilized Tools

The utilized tool category consists of flakes and cores exhibiting modification due solely to use wear without purposeful retouch.

UTILIZED SCRAPER: This tool type characteristically shows unifacial microstep flaking and/or nibbling. Sixteen utilized scrapers were found. One came from Locus A, and nine from Locus D, and one from Locus E. Material types include: medium- to coarse-grained metavolcanics (10), obsidian (3), chert (1), quartz (1), and metamorphic (1). Utilized scrapers vary greatly in size, from 1.6 cm x 1.1 cm x 1.0 cm to 10.0 cm x 9.0 cm x 6.0 cm.

UTILIZED HAMMER: A formal tool exhibiting heavy edge battering, but which is otherwise unmodified, is here called a utilized hammer. One utilized quartzite hammer, measuring 7.0 cm x 3.2 cm x 3.0 cm, was found on Locus E of SDM-W-143/146.

Flaked Stone - Lithic Waste

CORE: A total of 15 cores was recovered: 11 from Locus D, 3 from Locus E, and 1 from a non-locus area. No subtypes were defined. The material types include quartz (n = 6), chert (n = 3), fine-grained metavolcanic (n = 3), medium- to coarse-grained metavolcanic (n = 2), and quartzite (n = 1).

FLAKES: This category includes both flakes and shatter with no evidence of modification or utilization. A total of 6,371 flakes were recovered during the excavation of SDM-W-143/146. The material types include medium-to coarse-grained metavolcanic (n = 3,779), fine-grained metavolcanic (n = 1,169), quartz (n = 636), quartzite (n = 483), chert (n = 272), chalcedony (n = 20), obsidian (n = 9), and metamorphic (n = 3).

Ceramic Artifacts

A total of 139 ceramic artifacts were recovered at SDM-W-143/146, including body sherds, rim sherds, neck sherds, and one sherd abrader. Four ceramic wares are represented. Tizon Brown Ware comprises 96.4% of the collection. In addition to Tizon Brown Ware, a possible red ware is recognized in two recovered sherds; a possible tan-orange ware is recognized in two other sherds and a possible buff ware is recognized in a single sherd. The buff colored sherd may represent Lower Colorado Buff.

Locus A yielded only 12 ceramic sherds. Twenty-eight sherds came from Locus D, 84 from Locus E, and 15 from non-locus units.

Bone Artifacts

Fifteen items of worked bone were recovered from SDM-W-143/146: eight from Locus D (Unit 3, all from below 80 cm) and seven from Locus E (Unit 20, all from above 80 cm). Ten of these artifacts were awls (five from each unit). One bone bead was recovered from Unit 3 (90-100 cm). One bone tool from Unit 3 (120-130 cm) is described by Reynolds (Cardenas and Robbins-Wade 1985) as "plummet-shaped with all surfaces worked on coarse stone. On one side there is a deep groove which might have been intended for a string attachment.... It is not an unfinished harpoon toggle." Another bone tool recovered from Unit 3 was a deer-sized rib with biface cuts evidencing sawing action. Reynolds feels it was possibly used for dressing the edge of a biface to remove irregularities. Two pieces recovered from Unit 20 were burned coyote-sized bones with "long axis striations indicative of working with rough stone."

Shell Artifacts

Ten shell beads were recovered from SDM-W-143/145: five from Locus D and five from Locus E. All appear to be made from Olivella shells, except for a single Donax specimen.

SHELLFISH AND FAUNAL REMAINS

Shellfish

A total of 407,424 g of shellfish remains was recovered from SDM-W-143/146. The distribution of shellfish remains across the site is variable, with almost half of the total shell recovered from Unit 3 (188,565g, 46.3%). Locus A produced 19,777g of shell (4.8%), Locus D 296,465g (72.8%), Locus E 58,755g (14.4%), and the non-locus units 32,427g (8.0%). Although a wide variety of shell types were recovered, five types of shell comprise the majority (78.1%) of the collection. These are Chione sp. (C. californiensus and C. undatella) (42.3%), Argopecten aequisulcatus (14.8%), Donax sp. (10.2%), Ostrea sp. (6.2%), and Chione fluctafraga (4.7%).

Bone

Over 2,690g (more than 30,933 specimens) of animal bone and over 90g (greater than 1,900 specimens) of fishbone were recovered from the sites. The animal bone was analyzed by Richard L. Reynolds. He identified several food sources, including rabbits, fish, and occasional deer, rodent, bird, marine mammal, carnivore, crab, turtle, snake, lizard, and frog. Rabbit (including Jackrabbit) was an important food soruce; Reynolds noted that he had never worked with a site where brushrabbit was so heavily exploited (Cardenas and Robbins-Wade 1985).

Fishbone was analyzed by Mark A. Roeder. He identified 42 species of marine fish, both lagoonal species and open ocean species. Seasonality studies on 22 otoliths indicate that 14 of the specimens (63.6%) were taken during the summer season (mid-May to early October). Seven otoliths (31.8%) were from fish caught during the early-to-mid-winter. One specimen (4.5%) fell in the late winter season (March to mid-May).

DATING

Dating methods used were obsidian hydration and radiocarbon analysis. Thirteen pieces of obsidian were recovered; all were sourced and hydrated. Table 1 gives the hydrated measurements and approximate dates using three methods of determination. Ten samples were submitted to Beta analytic laboratories for radiocarbon analysis: nine charcoal and one shell. The shell specimen was dated to 2830 ± 70 years: 880 B.C. (Beta - 13123). The dates obtained on charcoal samples ranged from 440 ± years: A.D. 1510 (Beta 13120) to 2190± 90 years: 240 B.C. (Beta 13122). Table 2 gives results of the radiocarbon analysis.

ANALYSIS AND DISCUSSION

Chronology and Cultural Identification

Several dating techniques were applied to materials recovered at Rising Glen. Because two of three radiocarbon dates associated with obsidian hydration measurements support the formulae used by Chace (1980) for both Coso and Obsidian Butte sources, Chace's equations are employed hereafter.

Ten samples were submitted for radiocarbon analysis: the results are given in Table 2. Two C-14 samples from the same unit and level (Unit 3, 180-190 cm) were dated to 880 B.C. ± 70 (on shell) and 240 B.C. ± 90 (on charcoal). The 640 year discrepancy is believed to be due to the inaccuracy of dating shell. Shell dates tend to be older than charcoal dates. Geologist Michael Waters feels that shell samples can often contain much older carbon isotopes which have been absorbed from minerals in the water (Waters 1983). Therefore, the date of 880 B.C. is considered inaccurate and will not be considered in the discussion.

The basal date of 240 B.C. ± 90 places the beginning of the occupation during the transition between the Early Milling and Late Prehistoric Periods. The latest date of A.D. 1510 ± 70 continues the occupation firmly into the Late Prehistoric Period. A radiocarbon date of 1390 ± 70 years: A. D. 560 (Beta-13-121) from the 110-120 cm level of Unit 3 dates the first occurrence of cobble tools on the site. The series of radiocarbon dates from Locus D documents a continuous occupation of SDM-W-143/146 for some 2,000 years, from roughly 240 B.C. to well after A.D. 1500. The obsidian hydration dates correlate well with this chronology. The earliest obsidian date is A.D. 88 ± 210 with A.D. 1722 ± 40 being the most recent obsidian date.

Two domed scraper/scraper planes from the 130-140 cm and 140-150 cm levels of Unit 3 are of a type which at SDi-4648 was associated with the late Early Milling Period, but continues later in time (Cardenas and Van Wormer 1984). These are the only recovered artifacts which suggest an Early Milling Period occupation. Other time-sensitive artifact types recovered are associated with the Late Prehistoric Period. Ceramics were recovered at all loci of the site. Two Cottonwood Triangular Series projectile points were found at Locus D. Both correspond to True's Type I, which

TABLE 1

OBSIDIAN HYDRATION

Unit/ Level	Hydration Band (microns)	Obsidian Source	Ericson Date (BP)	Chace Date (BP)	Linear (Dominici) Date (BP)
3/10-20	4.7 ± .2	Coso	990-1686	770-912	
3/60-70	2.6 ± .2[1]	Obsidian Butte	684-879	271-368	188-219
10/10-20	2.2 ± .1	Obsidian Butte	598-722	207-249	164-180
14/20-30	2.7 ± .1	Obsidian Butte	741-879	318-368	203-219
14/30-40	5.0 ± .1[1]	Coso	1078-1754	912-988	
15/40-50	2.7 ± .2	Coso	550-998	237-320	
15/60-70	5.5 ± .3	Coso	1144-1995	1028-1278	
15/90-100	6.7 ± .2	Coso	1430-2374	1606-1809	
16/50-60	5.5 ± .3	Coso	1144-1995	1028-1278	
17/30-40	4.7 ± .3	Obsidian Butte	1254-1570	910-1175	344-391
17/70-80	2.5 ± .2	Obsidian Butte	656-849	249-343	180-211
20/90-100	0.0 ± .0*	Coso	---	---	
20/100-110	7.0 ± .4	Coso	1452-2546	1655-2081	

[1] Associated with radiocarbon dates.

* No visible hydration.

TABLE 2

RADIOCARBON DATES

Lab Number	Unit/Level	Date (BP)	Comments
Beta-13119	3/40-50	450 ± 70	
Beta-13120	3/60-70	440 ± 70[1]	
Beta-13121	3/110-120	1390 ± 70	
Beta-13122	3/180-190	2190 ± 90	
Beta-13123	3/180-190	2830 ± 70	shell
Beta-13124	8/40-50	1360 ± 90	
Beta-13125	14/30-40	910 ± 100[1]	
Beta-13126	17/70-80	Modern	
Beta-13127	18/90-110	730 ± 70	
Beta-13128	20/110-120	1140 ± 70	

[1] Associated with analyzed obsidian.

is the most common Late Prehistoric Period projectile point type found in San Diego County (True 1970:21). One knife fragment was recovered at Locus D. Though fragmentary, it appears to represent Type I described for Molpa (True, Meighan, and Crew 1974), indicative of the Late Prehistoric.

One important aspect of the analysis of Rising Glen is that the lithic assemblage consists primarily of cobble tools, which have traditionally been associated with the La Jolla Complex. The presence of these tools throughout a deposit which dates to the Late Prehistoric Period, and their occurrence along with ceramics and Cottonwood Series points suggests that that the traditional "La Jolla" cobble tool assemblage is not a cultural manifestation but an adaptation to a coastal environment. This has been suggested in the past, but (perhaps through force of habit) cobble tool assemblages still tend to be labeled "La Jolla" and thrown into the Early Milling Period. At Rising Glen there are no stratigraphic breaks. The predominance of cobble tools continues throughout the assemblage. Ceramics and Cottonwood Series projectile points are added to the assemblage later in time, but the basic cobble tool constituent remains unchanged. Based on absolute dates and time sensitive artifacts, SDM-W-143/146 represents a Luiseno occupation. The occurrence of a high proportion of cobble tools in a coastal Luiseno site supports the hyothesis that cobble tools are an environmental adaptation, not a temporal or cultural marker.

Site Function

SDM-W-143/146 is believed to have been a small village or large base camp throughout much of its occupation. The five identified activity categories (heavy processing, medium processing, light processing, milling, and lithic production) are all represented at the site. The diversity among the loci and, indeed among the individual units, indicates that different activities were carried out in various areas.

Locus A probably represents the peripheries of a larger area of intense occupation centered somewhere to the west, on the now-developed ridgetop. It is also possible that Locus A was never more than a specialized or limited activity satellite to the main area of occupation of Locus D.

Locus D appears to have been the focus of the site throughout its occupation. It contains the most variation in artifact types and activity categories. It also has the deepest cultural deposits (190 cm), the only cultural features encountered during the mitigation phase, and the greatest amount of faunal material of the entire site.

The presence of bone awls and a scraper/perforator at Locus E indicate hideworking and/or basketry was being done there. Locus E produced a large amount of bone and shell. Indeed, the amount of bone recovered from Locus E per volume of excavated dirt (28.9g/level) exceeds that recovered from Locus D (23.2g/level). Four ceramic vessel forms were also identified at Locus E: three types of wide-mouthed ollas, and one type of cooking bowl. In addition, eight rabbit (Sylvilagus sp.) bones from Unit 20 were noted by Reynolds as showing evidence of roasting on an open fire (Cardenas and

Robbins-Wade 1985). Although the quantity of faunal remains is less than that recovered at Locus D, Locus E was still a locus of food preparation and consumption, in addition to lithic tool production and other activities.

Site function does not appear to have changed significantly over time. The species of shell and animal bone recovered, as well as the types and proportions of artifacts found, do not show significant differences throughout the depth of the deposit.

There is some evidence to suggest that a small inland group, bearing an inland/hunting tool kit first settled the site by 240 B.C. At first, this group may have visited the coast on a seasonal basis only. It is believed, however, that they soon settled permanently to exploit the rich lagoonal and coastal resources, and as they adapted to the coast their tool kit altered. The tools found below 230 cm are small, formal, well-made tools showing controlled percussion and pressure flaking) reminiscent of inland assemblages such as that from SDi-4648 (Cardenas and Van Wormer 1984). In addition, these tools are made of fine-grained metavolcanics and chert which were probably brought to the site from somewhere to the east. Above 120 cm, the tools become more generalized in form and are made from locally available cobbles, for the most part. The material used is not always conducive to the manufacture of small or "nice-looking" tools. The tool assemblage from above 120 cm looks like what is traditionally associated with the coast; a typical "La Jolla assemblage," with a Late Prehistoric hunting tool kit added to the levels above 60 cm. However, it must be remembered that the sample from below 120 cm consists of only four tools, all from a single unit (Unit 3). Inferences are limited based on such a small sample.

Seasonality studies of the animal bone and fish otoliths suggest that SDM-W-143/146 was occupied year-round. Based on the recovered rabbit bone and his estimation of the availability of water, Reynolds suggests the site was inhabited during January and February and perhaps part of December and March (Cardenas and Robbins-Wade 1985). Seasonality analysis of the fish otoliths indicates fish were caught year-round. Of the 22 specimens studied, 14 were taken during the summer season (mid-May to mid-October), 8 during the winter season (mid-October to mid-May). The majority of the individuals (20) were caught between mid-May and the end of December. These data suggest that the site was occupied by at least a few individuals throughout the year. It would appear that rabbits may have replaced fish as a food source during the winter months (December to March), when fish are not plentiful.

Regional Settlement Patterns

Archaeologists in San Diego County have long recognized the importance of the coastal lagoons to prehistoric populations. However, these estuaries usually have not been considered a productive resource base available to Late Prehistoric populations. Warren, True and Eudey (1961) and Warren (1964) proposed that the La Jolla Complex reached its cultural peak between 7,000 and 4,000 years ago, and that by 3,000 to 4,000 years B.P., the lagoons had silted in sufficiently to preclude dependence upon them as a

resource base. Shumway, Hubbs and Moriarty (1961) place this date later in time; they make reference to "the apparent retention of bay conditions until about 1000 years ago" (Shumway, Hubbs and Moriarty 1961:128). Although they suggest a later date than does Warren, Shumway et al. do not contest the fact that the lagoons silted up and the aboriginal populations moved away. "The shellfish-gathering populations seem eventually to have largely abandoned the coast north of La Jolla, although they persisted in southernmost California and northern Baja California where bays and rocky shores remained" (Shumway, Hubbs and Moriarty 1962:116-117). Warren states: "That the lagoons silted in and reduced the food supply of the original population along the San Diego Coast appears to be an obvious and accepted fact. The disagreement lies in the date when the lagoons silted in to the extent that they could no longer support large populations of shellfish" (Warren 1964:113). Gallegos (1985) has shown that at Batiquitos Lagoon this siltation and abandonment did occur, but it was not permanent. Given the data from SDM-W-143/146 and other sites in the vicinity, Buena Vista Lagoon, and perhaps Agua Hedionda Lagoon to the south, were a viable resource base for the aboriginal inhabitants some 2,190 years ago (2,830 years ago if the shell date is accepted). From that point on, the population at SDM-W-143/146, as estimated from recovered shell weight from Unit 3, shows a slow and gradual increase, with population peaks around A.D. 1500 and probably A.D. 1700, and a minor peak around A.D. 560. In the Regional Historic Preservation Study for the Carlsbad area, it is noted, "Local native populations, some of which lived at Mission San Luis Rey, continued to use the local lagoons on a seasonal basis for fishing, hunting and as sites for rancherias" (WESTEC Services 1980). Obviously, the lagoons continued to be a vital resource system into the Historic Period.

A review of various reports on archaeological testing and/or data recovery programs at 11 sites in the vicinity of Rising Glen shows that this site is unusual in the sheer numbers of artifacts and ecofacts recovered per cubic meter of soil. SDM-W-143/146 is quite different from the other coastal sites around it.

Molpa (SDi-308) has been defined as the Luiseno/San Luis Rey II type site (True, Meighan, and Crew 1974) and has been used to aid in determining the cultural identity of other Luiseno sites. Molpa is an inland village, located on the slopes of Palomar Mountain; no coastal type site has ever been defined. Unfortunately, defining a cultural tradition in relation to a single environment necessarily gives a narrow view of the range of cultural activity and cultural remains.

Table 3 lists artifacts recovered at Molpa and those recovered at SDM-W-143/146. Before comparing the two sites, ceramics were subtracted from the artifact totals: otherwise, the large number of ceramic items at Molpa (n = 2,788; 77.72%) would skew the comparison. Using these adjusted percentages, some interesting differences can be seen.

A hunting tool kit is heavily represented at Molpa. The 423 projectile points found comprise 52.9% of the artifact assemblage. Knives (n = 74) account for 9.3% of the artifacts. At SDM-W-143/146, on the other hand, the projectile points and knives combined comprise less than 3% of the asemblage: two points (1.1%) and two knives (1.1%). Combined with the

TABLE 3

COMPARISON OF MOLPA AND SDM-W-143/146

Artifact Type	SDi-308 (Molpa) No.	%	% Minus Ceramics	SDM-W-143/146 No.	%	% Minus Ceramics
Unclassified groundstone				9	(2.81)	(4.97)
Manos	88	(2.45)	(11.01)	42	(13.12)	(23.20)
Pestles	8	(0.22)	(1.00)	2	(0.62)	(1.10)
Basins metates	18	(0.50)	(2.25)	9	(2.81)	(4.97)
Slab Metates				2	(0.62)	(1.10)
Mortars	9	(0.25)	(1.13)	1	(0.31)	(0.55)
Edge ground cobble	1	(0.03)	(0.12)			
Groundstone ball				1	(0.31)	(0.55)
Scrapers	17	(0.47)	(2.13)	34	(10.62)	(18.78)
Utilized scrapers				16	(5.00)	(8.84)
Scraper plane/scraper				5	(1.56)	(2.76)
Scraper plane	2	(0.06)	(0.25)	6	(1.88)	(3.31)
Choppers	1	(0.03)	(0.12)	13	(4.06)	(7.18)
Chopper/hammer				4	(1.25)	(2.21)
Hammer	7	(0.20)	(0.88)	2	(0.62)	(1.10)
Hammer grinder	2	(0.06)	(0.25)			
Scraper/perforator				1	(0.31)	(0.55)
Projectile point	423	(11.79)	(52.94)	2	(0.62)	(1.10)
Irregular flake knives	1	(.03)	(0.12)	1	(0.31)	(0.55)
Utilized flake knives	1	(.03)	(0.12)	1	(0.31)	(0.55)
Knife fragments	72	(2.01)	(9.01)	1	(0.31)	(0.55)
Unclassified tool fragment				1	(0.31)	(0.55)
Bifacial flake-based preform				3	(0.94)	(1.66)
Worked flakes	59	(1.64)	(7.38)			
Ceramics - sherds	2774	(77.33)		138	(43.12)	
Ceramics - other	14	(.39)		1	(0.31)	

Table 3 (continued)

Artifact Type	SDi-308 (Molpa) No.	%	% Minus Ceramics	SDM-W-143/146 No.	%	% Minus Ceramics
Bone Artifacts						
Awls	33	(.92)	(4.13)	10	(3.12)	(5.52)
Ornamental	1	(.03)	(0.12)	1	(0.62)	(0.55)
Other	25	(.70)	(3.13)	4	(1.25)	(2.76)
Shell						
Beads	16	(.45)	(2.00)	10	(3.12)	(5.52)
Pendants	3	(.08)	(0.38)			
Smoothing stones	1	(.03)	(0.12)			
Point stone	1	(.03)	(0.12)			
Crystals	2	(.06)	(0.25)			
Wand insert	1	(.03)	(0.12)			
Historic						
Knives (steel)	2	(.06)	(0.25)			
Trade beads	2	(.06)	(0.25)			
China/glass	3	(.08)	(0.38)			
Total	3587	(100.02)		320	(100.24)	

differential occurrence of vegetal processing tools, these data document the importance of hunting in the overall subsistence of the inhabitants of Molpa, and a greater reliance on the gathering of plant and animal resources at the coastal site. Unfortunately, no data was given regarding faunal material at Molpa. The subsistence base for Molpa, therefore, must be inferred from the recovered artifact assemblage. As noted, the assemblage indicates that hunting was of paramount importance.

The percentages of bone awls at both sites are similar: 4.1% (n = 33) at Molpa and 5.5% (n = 10) at SDM-W-143/146. This suggests that basketry and possibly hide-working were of similar importance at both sides.

Another area of difference between the two sites is in the occurrence of shell and bone beads and ornaments. Twenty such items were found at Molpa, comprising 2.5% of the assemblage. The 16 items in this class recovered at SDM-W-143/146 constitute 6.1% of the artifacts from that site. Shell beads were not merely ornamental, they were important economic items in far-reaching trade networks. The implications of a greater percentage of shell beads at a coastal village are not known. It is possible that proximity to the coast and easy access to shell are the only reasons for the greater representation; trade and economics may have no bearing on the frequency of shell beads at the two sites though this seems unlikely.

The amount of pottery found at the two sites reflects another major difference. At Molpa, ceramics comprise almost 80% of the artifact assemblage (n = 2,798; 77.772%). At SDM-W-143/146, ceramics account for less than half of the recovered artifacts (n = 139; 44.4%). This difference may be due to a differential distribution of good pottery-making material between the mountains and the coast. It is also possible the coastal people made use of basketry more than ceramic vessels. Unfortunately, basketry is seldom preserved in the archaeological records.

A final important feature of Luiseno culture is religion and the ceremonial aspects of the aboriginal inhabitants' lives. The presence of pictographs is one of the major criteria distinguishing the San Luis Rey II Complex from the San Luis Rey I Complex. On the coast, however, suitable rocks for rock paintings do not occur. The coastal dwellers undoubtedly found substitutes to replace the role that pictographs played in the ceremonial lives of the mountain Luiseno. No crystals, wand inserts of shaman stones were recovered at SDM-W-143/146, however, some ceremonial objects were found at SDM-W-137 (Flower, Ike and Roth 1977). It may be that the nearby site served as a ceremonial focus for the occupants of SDM-W-143/146, SDM-W-137, and the vicinity. It appears equally likely, however, that ceremonial objects are present at SDM-W-143/146, but were not recovered due to the extremely small sample size acquired during the excavation.

As evidenced in the above discussion, definition of Molpa as the Lusieno/San Luis Rey II type site is a narrow one. Many differences can be seen between the artifact assemblages from Molpa and SDM-W-143/146. Subsistence patterns differ. The abundance of ceramics, ornaments, shell beads and ceremonial items is also very different between the two sites. It is suggested that the differences seem to derive from location and the use of available resources. The inhabitants of Molpa relied heavily on

hunting for protein; the occupants of SDM-W-143/146 subsisted on fish, shellfish and small mammals, which were gathered or trapped rather than hunted. SDM-W-143/146 has a higher percentage of shell beads; it has greater access to shell. There is no doubt that movement between the coast and the mountains occurred during prehistory; groups from the two areas must have been in close contact with one another. A valid description of the Luiseno/San Luis Rey II Complex, however, must include both coastal and inland sites.

Summary

SDM-W-143/146 is a unique coastal Luiseno village or base camp. No large coastal Luiseno habitation sites have been previously studied. The coastal lagoons have long been recognized as a major resource base, yet little is known about the settlement patterns around Buena Vista Lagoon. The data from SDM-W-143/146 show that it is unlike other sites in the vicinity, if not always in terms of the types of artifacts and ecofacts recovered, then surely in the vast amount of cultural material recovered. SDM-W-143/146 appears to be an important population center; perhaps other nearby sites, such as SDM-W-137, are satellites.

The faunal material from SDM-W-143/146 evidences a strong reliance on lagoon resources, such as shellfish and finfish, as well as on small mammals. The importance of vegetal foods is inferred from the artifact assembalge, Seasonality analyses of faunal material suggest the site was occupied year-round. Probably small task groups left the base camp for short periods, but the site was occupied by at least a few people all year.

The artifact assemblage from SDM-W-143/146 differs significantly from that of Molpa, the Luiseno/San Luis Rey II type site. The differences are probably a function of the different locations and subsistence strategies of the two sites, as discussed above. A valid definition of the Luiseno Complex, however, must include both coastal and inland sites.

ACKNOWLEDGEMENTS

The excavation of Rising Glen was financed by Multitech Properties. My thanks go to RBR & Associates, Inc., for providing typing and graphics. Maps were done by Troy Davis. Also thanks to Sean Cardenas, Cathy Winterrowd, and Steve Van Wormer for discussing the site with me and helping to clarify ideas.

REFERENCES

Bowman, Roy H.
1973 Soil Survey, San Diego Area, California, Part I. United States Department of Agriculture.

Cardenas, D. S. and Mary Robbins-Wade
1985 An Archaeological Investigation of SDM-W-143/146: An Unique Coastal Luiseno Occupation Site in Carlsbad, California. RBR & Associates, Inc., San Diego, CA. Ms. on file at the City of Carlsbad.

Cardenas, D. S. and S. R. Van Wormer
1984 Archaeological Investigation of SDi4648 and SDM-W-348. RBR & Associates, Inc., San Diego, CA.

Chace, Paul G.
1980 Dating the Obsidian Trade in San Diego: Evidence From the Nelson Site. San Diego County Archaeological Society Newsletter 8 (5).

Crabtree, Robert H., Claude N. Warren, and D. L. True
1963 Archaeological Investigations at Batiquitos Lagoon, San Diego County, California. Los Angeles: University of California, Los Angeles, Archaeological Survey Annual Report, 1962-1963: 319-349.

Dominici, Debra Ann
1984 Calibration of the Obsidian Butte Hydration Rate And Its Implications Regarding Late Prehistoric Exchange. Master's thesis, San Diego State University.

Ericson, Jonathon E.
1977 Prehistoric Exchange Systems in California: The Results of Obsidian Dating and Tracing. Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Flower, Douglas M., Darcy Ike, and Linda Roth
1977 Preliminary Draft, Archaeological Investigations at W-137. Flower, Ike, and Roth, San Diego.

Gallegos, Dennis
1985 Batiquitos Lagoon Revisited. Casual Papers 2(1). Cultural Resource Management Center, Department of Anthropology, San Diego State University, San Diego.

Greenwood, Roberta S.
1969 The Browne Site Early Milling Stone Horizon in Southern California. American Antiquity 34(4): part 2.

Heusser, Linda
1978 Pollen in Santa Barbara Basin, California: a 12,000 Year Record. Geological Society of America Bulletin 89:673-678.

Polan, H. Keith
1983 An Archaeological Reconnaissance of the Alanda Project, Carlsbad, California. Heritage Environmental Services, San Diego.

Rogers, Malcolm J.
1929 Unpublished field notes. On file, San Diego Museum of Man.

Shumway, George, Carl L. Hubbs, and James R. Moriarity
1961 Scripps Estates Site, San Diego, California: A La Jolla Site Dated 5460 to 7370 Years Before the Present. Annals of the New York Academy of Sciences 93(3): 37-132.

True, D. L.
1970 Investigation of a Late Prehistoric Complex in Cuyamaca Rancho State Park, San Diego County, California. Department of Anthropology, University of California, Los Angeles.

True, D.L., C.W. Meighan, and Harvey Crew
1974 Archaeological Investigation at Molpa, San Diego County California. University of California Publications in Anthropology II, Berkeley.

Warren, Claude N.
1964 Cultural Change and Continuity on the San Diego Coast. Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Warren, Claude N., D. L. True, Ardith A. Eudey
1961 Early Gathering Complexes of Western San Diego County: Results and Interpretations of an Archaeological Survey. Archaeological Survey Annual Reoport, University of California, Los Angeles.

Waters, Michael R.
1983 Lake Holocene Lacustrine Chronology and Archaeology of Ancient Lake Cahilla, California. Quaternary Research 19: 373-387.

WESTEC Services
1980 Regional Historic Preservation Study. WESTEC Services, Inc., San Diego, CA.

AVOCADO HIGHLANDS: AN INLAND LATE LA JOLLA AND PRECERAMIC YUMAN PHASE SITE FROM SOUTHERN SAN DIEGO COUNTY

D. Sean Cardenas
RBR & Associates, Inc.
San Diego, CA

INTRODUCTION

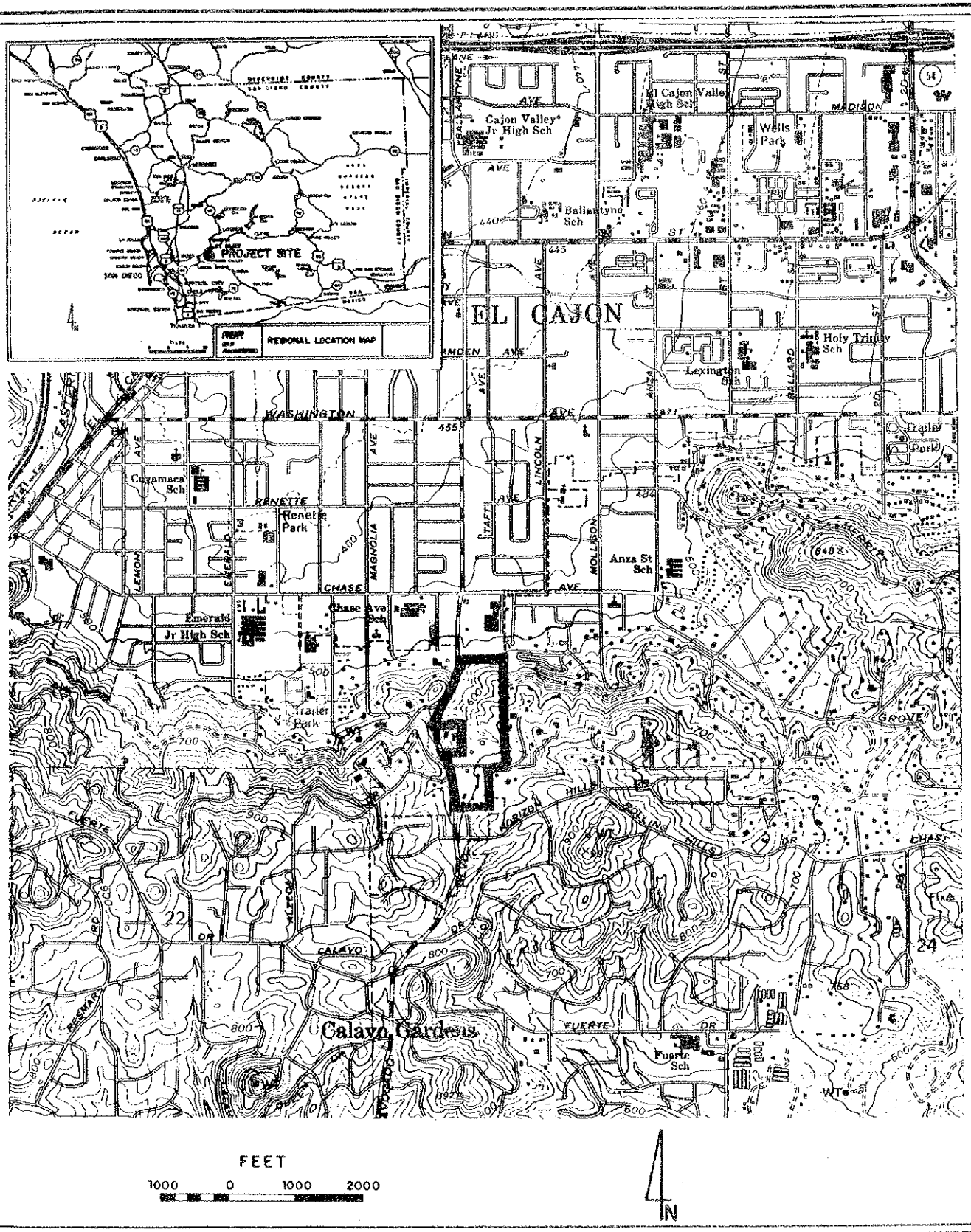
The Avocado Highlands site (SDi-4648) is one of two previously recorded sites in El Cajon, California tested and excavated by the author during the Fall of 1983 (Cardenas and Van Wormer 1984). The site was occupied primarily during the late Early Milling Period (3000 B.C. - A.D. 500), as evidenced by the occurrence of Elko series projectile points. Well-documented late Early Milling Period sites are rare in San Diego County, notable exceptions being the Harris site (Warren 1966) and SDM-W-1556 (O'Neil 1982). Elko series projectile points have also been found sporadically at other sites in the County (May 1982; Rogers 1966; True and Beemer 1982). This situation has led to a proliferation of terms referring to the late Early Milling Period in the region, including the Encinitas Tradition (Warren 1966, 1968), Campbell Tradition (O'Neil 1982; Warren 1966, 1968), the Pauma Complex (True 1958; True and Beemer 1982; Warren, True and Eudy 1961), the Amargosa Complex (May 1976, 1982), and the La Jolla II and II Complexes (Moriarty 1966). The results of excavation at Avocado Highlands are presented because they provide comparative evidence regarding late Early Milling Period occupation in San Diego County.

NATURAL SETTING

SDi-4648 is located in the foothills of southwestern San Diego County, approximately 20 km inland from the present day coast (Figure 1). The foothills are a belt of narrow, winding valleys and rolling hilly uplands which lie between the coastal plain and the mountains. Underlain by granite and metavolcanic rock, the foothills are roughly 47 km wide. Elevation ranges from 183 to 610 m above mean sea level (Bowman 1973).

The present climate in the foothills is semi-arid. The mean annual temperature is 15.5^{0} C, with a mean minimum temperature of 3^{0} C. Precipatation varies greatly from year to year. Annual rainfall ranges from 305 cm to 510 cm, with increasing precipitation at higher elevations. Most rain occurs during the period from December to April (Bowman 1973). This climate has been relatively stable for the last 2200 years (Heusser 1978).

The Avocado Highlands site is situated on the southern rim of El Cajon Valley, at an elevation of 204 to 216 m (Figure 1). The site is next to a deeply cut, unnamed creek, presently disguised as Avocado Boulevard, and above a permanent spring. The valley floor and the Late Prehistoric base camp site SDM-W-348 lie below at 155 m. Although disturbed by ORV trails, dumping, limited plowing and some grading, the site area supports an inland sage scrub community. The drainages are occupied by a riparian woodland community.



RBR and Associates

PROJECT LOCATION MAP

(BASE MAP: U.S.G.S. 7.5' QUADRANGLE - EL CAJON 1975)

Figure 1

SDi-4648 is a midden site with five recognizable loci of activity among the granite boulders (Figure 2). The site covers roughly 14,600m^2. Locus A is the main focus of aboriginal occupation, occupying a shallow saddle some 90 m by 63 m. The four other loci (B through E) are limited activity areas and smaller in size.

FIELD METHODS

During the initial testing phase, the bedrock milling features of SDi-4648 were inventoried and a single 1 x 1 m unit was excavated. Due to the apparent significance of the site, a data recovery program was designed and carried out in September and October, 1983.

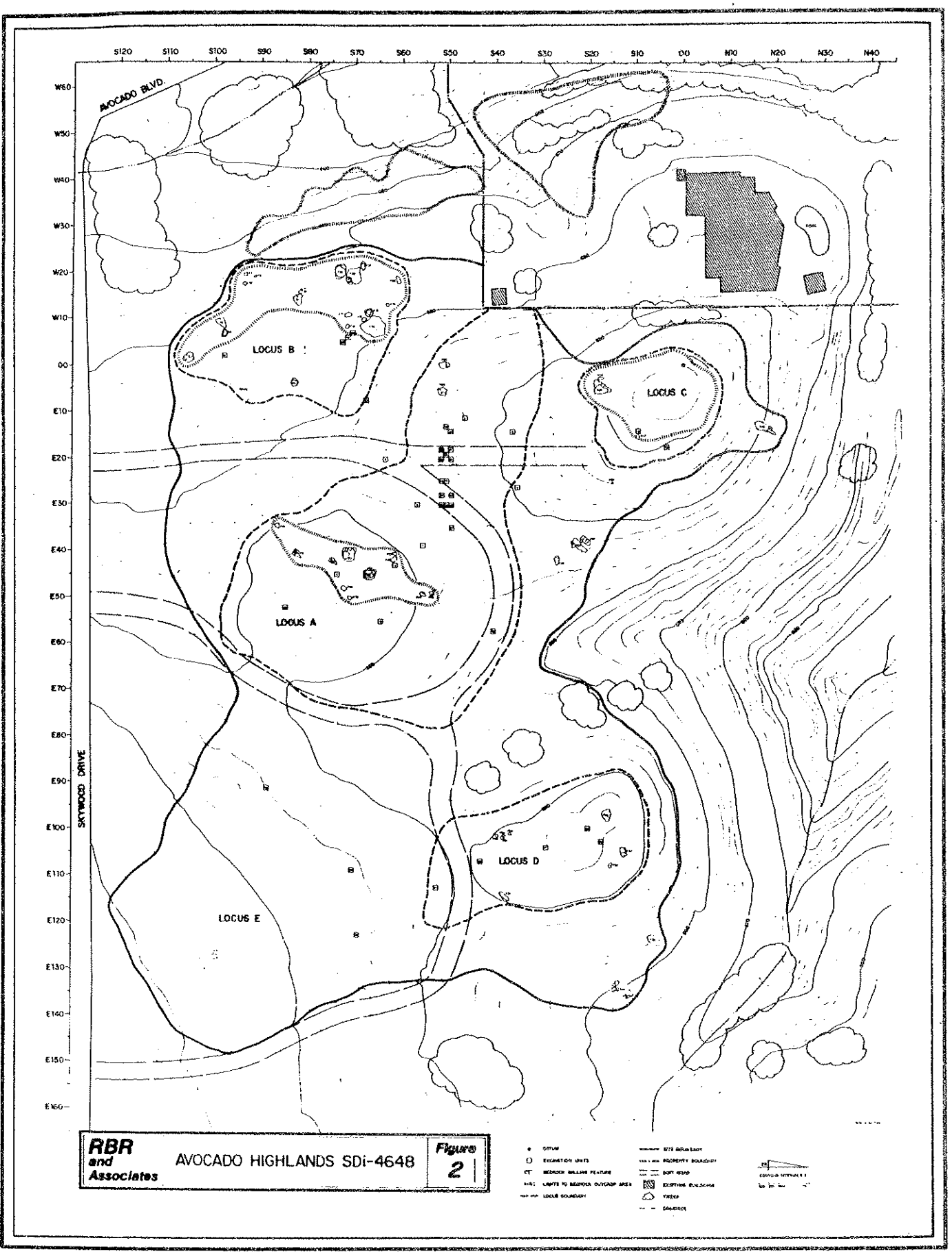
The site was first intensively surveyed to establish the site and loci boundaries. Then a grid of 5 m squares was established across the site area (Figure 2). A stratified random sample of 5 x 5 m surface collection units was scraped and screened with 1/8 inch mesh. This resulted in the collection of 11% of the surface area from Locus A, 8% from Locus B, 8% from Locus C, and 12% from Locus D. Locus E was not surface collected due to dense brush, a scarcity of surface artifacts, and the absence of midden soil. Site and loci boundaries, as well as bedrock milling features, were instrument mapped. In addition, each bedrock milling feature was recorded, drawn, and photographed.

Subsurface excavation consisted initially of 26 random 1 x 1 m units: 15 on Locus A, 2 on Locus B, 2 on Locus B, 2 on Locus C, 3 on Locus D, and 4 on Locus E. Units were dug in arbitrary 10 cm levels and screened with 1/8 inch mesh. Based on the results of the random units, 15 purposeful units were also excavated: 13 on Locus A and 2 on Locus B. The 41 excavated units comprise 0.4% of the site's midden surface (Figure 2).

STRATIGRAPHY

The stratigraphy at Avocado Highlands is not complex. At Locus A, cultural material occurred to a depth of 60 cm in the shallower units and to 110 cm in the deepest unit. All units bottomed out on decomposed granite or bedrock. In the deeper units, three soil strata were present. Dark brown sandy loam extended to a depth of roughly 60 cm. This rested on reddish brown coarse sandy loam which continued to approximately 80 cm. At that depth, a red clay horizon appeared, overlying decomposed granite. Rodent activity was evident throughout.

The other loci generally contained the upper sandy loam soil of Locus A only. At Locus B, cultural material was recovered to a depth of 60 cm. Soil consisted of brown sandy loam, resting on decomposed granite. Cultural deposits were found to a depth of 40 cm at Locus C. The stratigraphy duplicated that of Locus B. At Locus D, the deposits varied in depth, reaching 50 cm in the deepest units. The soil profiles showed light brown sandy loam, overlying decomposed granite. Locus E, the only non-midden locus at Avocado Highlands, yielded cultural material to 60 cm. A red brown to tan grey sandy loam was found resting on decomposed granite or red clay. As at Locus A, rodent disturbance was also evident at the other loci.



RBR and Associates AVOCADO HIGHLANDS SDi-4648 **Figure 2**

MATERIAL CULTURE

Bedrock Milling Features: A total of 70 grinding slicks, 15 basins, and 3 mortars were recorded at SDi-4648 on 56 separate bedrock milling features. These features were present at all of the activity loci: 17 at Locus A, 21 at Locus B, 5 at Locus C, 11 at Locus D, and 2 at Locus E (Figure 2). The ratio of basins to slicks is 1:3 at Locus A, 1:6 at Loci B and C, and 1:11 at Locus D. Two of the mortars were at Locus B, adjacent to the riparian drainage, the third at Locus A.

Other Features: Of 11 subsurface features identified at Avocado Highlands, eight were located on Locus A in close association with each other. All of these features occurred between 40 and 70 cm below the surface, with six clustered between 40 and 60 cm. Four features were tool clusters of manos, metates, hammerstones, and occasional scrapers. The other four included similar sets of tools together with fire-cracked rocks or unmodified slab rocks. Given the close vertical association of these features to each other, they may represent a series of living surfaces extending from 40 to 70 cm below the ground surface.

The three remaining subsurface features were encountered at similar depths; two on Locus B and one on Locus D. These also comprised clusters with manos, metates, and flaked-stone tools, plus a cluster of unmodified fieldstone.

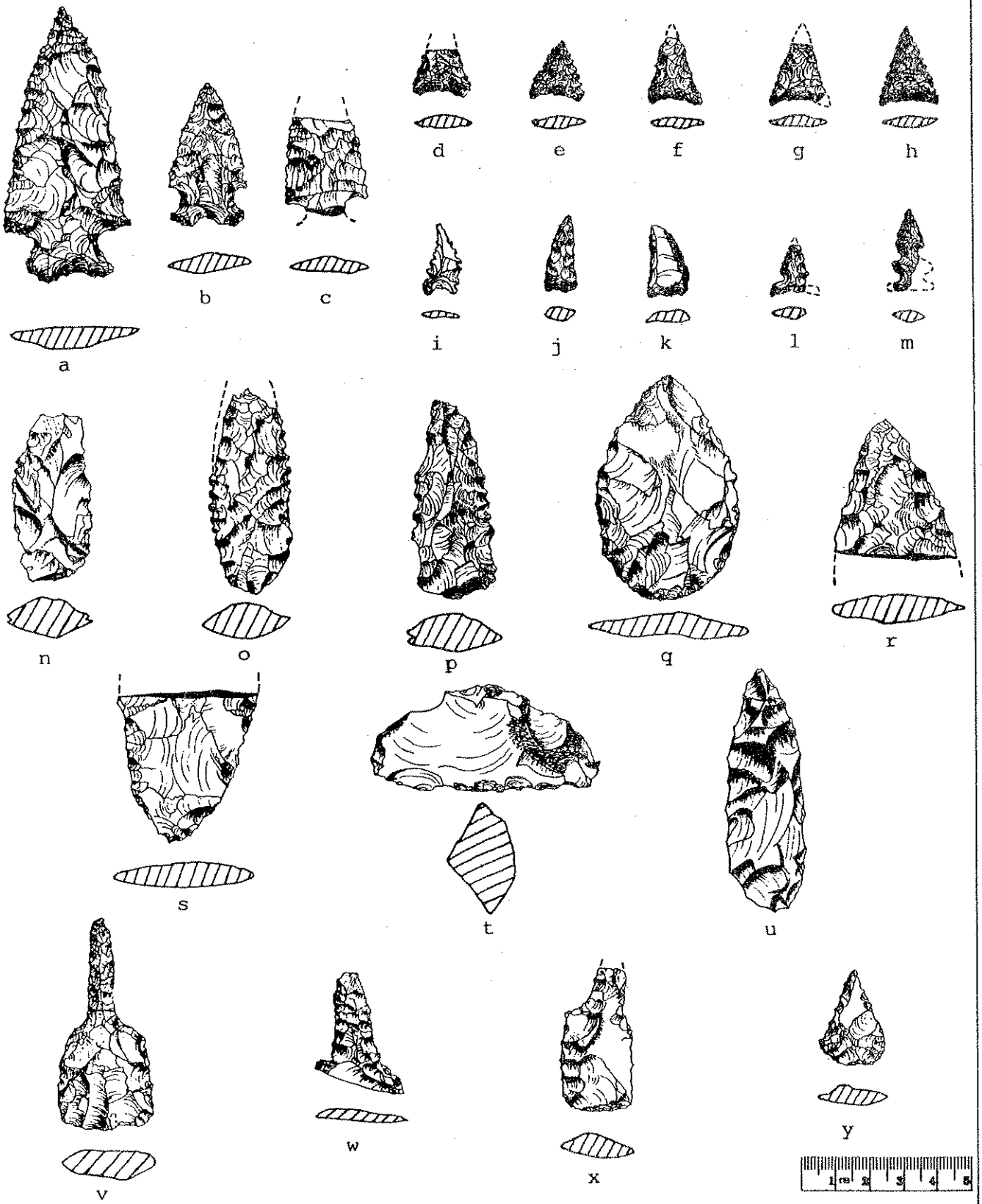
Projectile Points: A total of 33 projectile points was recovered from Avocado Highlands: 13 typable points and 20 fragmentary points. Metavolcanics are the most frequently observed material type (64%), followed by quartz (12%), obsidian (9%), chalcedony (9%), chert (3%), and an unknown material (3%). The term metavolcanic includes felsite, basalt, andesite, and rhyolite. All of the typable points are illustrated in Figure 3.

The 13 whole or nearly whole specimens were measured and typed according to attributes defined by Thomas and Bettinger (1976). Their typology was developed for and has been tested on numerous points from the Great Basin. A similar typology is lacking for San Diego County. The detailed attribute data has been presented elsewhere (Cardenas and Van Wormer 1984).

Elko series (3 specimens: all metavolcanic). Two whole specimens and one fragment were recovered (Figure 3a-c). The whole points are specifically Elko Eared dart points, one from Locus A and one from Locus B. Both were found between 30 and 50 cm. The fragment is from Locus E and can only intuitively be placed among the Elko series based on size and shape.

Cottonwood series (8 specimens: 5 metavolcanic, 1 obsidian, 1 quartz, 1 chalcedony). Six small, concave based Cottonwood Triangular points (3d-i) and two straight based Cottonwood Triangular points (Figure 3j-k) were found. Seven of these arrow points are from Locus A; one from Locus B. Only one Cottonwood point was recovered from below 30 cm.

Desert Side-notched series (1 specimen: metavolcanic). A single Desert Side-notched point was excavated from Locus B, 20-30 cm (Figure 3l).



BIFACIAL STONE TOOLS

Figure 3

True's Type 11 (1 specimen: quartz). A single multi-notched arrow point was recovered from Locus A, between 50 and 60 cm (Figure 3m). The point resembles True's (1970) small triangular points with side-notches and serrated sides (Type 11). In this case, however, the serrations appear to be deep and more like notches.

Bifaces: Six whole and 14 fragmentary bifacially flaked stone knives, similar to projectile points but generally larger and thicker, were found at SDi-4648. Metavolcanics are again the most frequently observed material type (90%), followed by equal amounts of obsidian and an unknown material. In analyzing the collection, two knife types are evident.

Knife type 1 (5 specimens: 4 metavolcanic, 1 obsidian). Type 1 knives are symmetrical and appear to be lanceolate in form (Figures 3n-p). The specimens are characterized by fine peripheral secondary retouch, frequently resulting in serrated or notched edges. The main attributes of this type are a narrow width combined with a relatively thick midsection (2.1 ratio). Four of the Type 1 knives are from Locus A; one from Locus D. They were recovered from between 40 and 90 cm, the majority (60%) coming from below 70 cm.

Knife type 2 (13 specimens: 12 metavolcanic, 1 unknown). Type 2 knives are symmetrical and oval in form, with a markedly convex base (Figure 3q-s). The flaking is rough and peripheral retouch is occasional. The type exhibits a broad width combined with a relatively thin midsection (4:1 ratio or greater). Nine of the Type 2 knives are from Locus A; three come from Locus B and one from Locus D. All were recovered from between the surface and 60 cm, with most (92%) occurring above 50 cm.

Untyped knives (2 specimens: both metavolcanic). Both untyped knives are from Locus A; one from between 20 and 30 cm, the other from monitoring during final grading. The knife with known provenience is a large flake with minimal bifacial retouch along one edge (Figure 3t). The other is symmetrical and lanceloate in form (Figure 3u). The flaking is rough and peripheral retouch is absent, but the specimen is narrow and thin.

Drills: Four bifacially retouched drills were recovered. All are from Locus A, and all are made from metavolcanic material. Two distinct types are represented.

Drill type 1 (3 specimens). Type 1 drills exhibit long, narrow tips broadening into rectangular, tabular bases (Figure 3v-x). The specimens are characterized by fine peripheral secondary retouch. All were found between 70 and 90 cm below the surface.

Drill type 2 (1 specimen). The Type 2 drill is small and triangular in shape (Figure 3y). It is also characterized by fine peripheral secondary retouch. The single example was recovered from the 10 to 20 cm level.

Other Bifacial Stone Tools: An additional 76 bifacially retouched tools were discovered at SDi-4648. The specimens with bifacial use wear are called choppers, those with unifacial use wear are called scrapers. Specimens whose function is indeterminate are not classified.

Choppers (14 specimens: 9 metavolcanic, 4 quartzite, 1 quartz). The bifacially retouched edge of the choppers is characterized by bifacial faceting or microstep flaking (Figure 4a-b). Three of the bifacial choppers are multipurpose tools (chopper/scrapers). All were recovered from Locus A, from the surface to 90 cm.

Scrapers (1 specimen: metavolcanic). This artifact type comprises bifacially retouched tools with unifacial use wear such as microstep flaking, scalar flaking, and/or nibbling. Scrapers tend to have a working-edge angle of 46 to 55 degrees. The single specimen was collected from the surface of Locus A.

Unclassified bifacial tools (11 specimens: 6 metavolcanic, 2 quartz, 1 obsidian, 1 chalcedony, 1 chert). Eleven fragments exhibited bifacial retouch, but could not be assigned a functional category. Ten came from Locus A, surface to 100 cm, and one from the surface of Locus B.

Unifacial Stone Tools: Unifacial tools are made on flakes and cores and exhibit intentional retouch modification in a single direction. The specimens with bifacial edge damage are termed choppers, those with steep working-edge angles are scraper-planes, those with a beaked edge are perforators, and the rest are scrapers. Multipurpose tools are also present, as are unclassified items whose function is unknown.

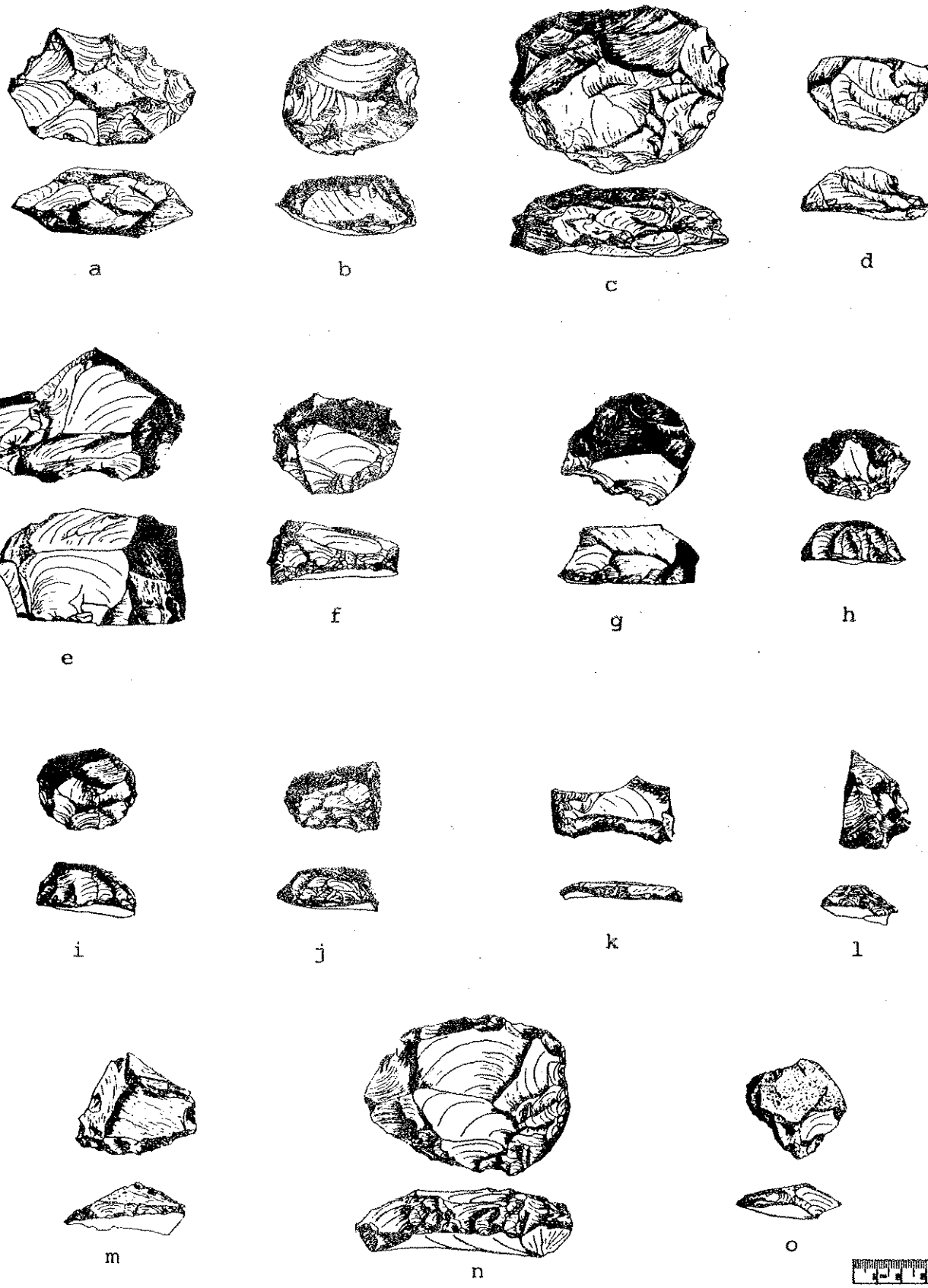
Choppers (13 specimens: 8 metavolcanic, 5 quartzite). The unifacially retouched edge of this functional type is again characterized by bifacial faceting or microstep flaking (Figure 4c-d). The majority (85%) were made on flakes. Unifacial choppers were distributed between loci as follows: 10 from Locus A, 1 from Locus B, and 2 from Locus D.

Scraper-planes (24 specimens: 20 metavolcanic, 4 quartzite). The scraper planes are plano-convex tools characterized by a working-edge angle of greater than 60 degrees (Figure 4e-g). These implments tend to have a width to thickness ratio of 2:1 or less. Formal subtypes are present, including "biscuit" scraper-planes (Figure 4h-i) and "keeled" scraper-planes (Figure 4j). Most scraper-planes (83%) were made on flakes. Twenty-two were recovered from Locus A, one from Locus B, and one during monitoring.

Scrapers (75 specimens: 64 metavolcanic, 8 quartzite, 1 chert, 1 chalcedony). Unifacial scrapers are characterized by a working-edge angle of 46 to 55 degrees (Figure 4k-m). Formal subtypes, such as "discoidal" scrapers and "domed" scrapers (Figure 4n), are present. The majority of unifacial scrapers (83%) are made on flakes. Locus A produced 59 of them, Locus B seven, Locus C three, Locus D five, and one was collected during monitoring.

Perforators (3 specimens: 2 metavolcanic, 1 quartzite). Unifacially retouched tools with a beaked or nosed working-edge that exhibits edge damage are called perforators (4o). Three were recovered from Locus A. All were flake-based tools.

Multipurpose unifacial tools (7 specimens: 5 metavolcanic, 2 quartzite). These are unifacial tools that exhibit characteristics of two or more distinct functional subtypes. Four scraper-hammers were collected



OTHER STONE TOOLS

Figure 4

(75% core-based): three from Locus A, one from Locus C. A chopper-hammer (core-based) was identified from Locus D and two scraper-choppers (flake-based) were found during grading.

Unclassified unifacial tools (41 specimens: 32 metavolcanic, 4 quartzite, 2 quartz, 2 chert, 1 chalcedony). A unifacially retouched tool fragment is considered unclassifiable when the functional subtype is not readily discernible. The unclassified unifacial tools were distributed between loci as follows: 33 from Locus A, 3 from Locus B, 1 from Locus C, 2 from Locus D, and 2 from Locus E.

Utilized Stone Tools: A flake based tool exhibiting modification due solely to use wear, without purposeful retouch, is considered a utilized flake tool. The specimens with an acute working-edge angle and bifacial edge damage are called knives, those with a beaked working-edge are perforators, and the rest are scrapers. Multipurpose tools are also present, as are unclassified items whose function cannot be determined.

Utilized scrapers (172 specimens: 157 metavolcanic, 15 quartzite) were recovered from four loci: 149 from Locus A, 12 from Locus B, 2 from Locus C, and 9 from Locus D. Utilized knives (14 specimens: 10 metavolcanic, 2 quartzite, 1 quartz, 1 chalcedony) were also present at these four loci: 9 at Locus A, 2 at Locus B, 1 at Locus C, and 2 at Locus D. However, utilized perforators (2 specimens: both metavolcanic), utilized tool fragments (7 specimens: 5 metavolcanic, 1 chert, 1 chalcedony) were found only at Locus A.

Hammerstones: At Avocado Highlands, hammerstones are divided into two groups, battered cores and unmodified stones exhibiting heavy edge battering. The second group is further subdivided by shape into angular and spherical hammerstones. Specimens whose original shape is unknown are unclassified.

Battered cores (26 specimens: 18 metavolcanic, 8 quartzite) occurred at three loci: 24 at Locus A, and one each at Loci D and E. Angular hammerstones (15 specimens: 4 metavolcanic, 11 quartzite) and spherical hammerstones (15 specimens: 3 metavolcanic, 10 quartzite, 1 quartz, 1 granite), however, were recovered from Locus A only. Unclassified hammerstone fragments (19 specimens: 8 metavolcanic, 8 quartzite, 1 granite, 1 sandstone, 1 unknown) were found at three loci: 16 at Locus A, 1 from Locus B, and 2 from Locus D.

Grinding Stones: SDi-4648 produced an extensive collection of manos (348 specimens), pestles (5 specimens), and metates (47 specimens). Bifacial manos are most common (40%), followed by unifacial manos (2.5%) and multifacial manos (1.5%). A large number of mano fragments (56%) are unclassified. Manos were recovered from all levels of all loci: 295 from Locus A, 23 from Locus B, 4 from Locus C, 17 from Locus D, 5 from Locus E, and 4 from monitoring. The pestles are all shouldered; 4 came from Locus A and 1 from C. The majority of metates are of the slab type (51%); basin metates are rare (4%). Many metate fragments (45%) remain unclassified, however. Metates occurred at three loci: 32 at Locus A, 10 at Locus B, and 3 at Locus D; two more were collected during monitoring.

Other Groundstone Artifacts: A fragment of a steatite pendant (Figure 5a), sourced to the Cuyamaca mountains, was recovered from Locus A at 30 to 40 cm. In addition, unclassified groundstone fragments (62 specimens) were collected from three loci (Figure 5b): 54 from Locus A, 5 from Locus B, and 2 from Locus D; a single fragment was also recovered during monitoring.

Blanks and Preforms: Blanks are unfinished bifacially retouched stone artifacts of adequate size and form for making tools, but lacking evidence of use. Three blanks (all metavolcanic) were found at Avocado Highlands. Preforms are further along in the production process than blanks, but are still defined as a bifacially worked, unfinished form of a tool lacking evidence of use. Two subtypes are recognized, projectile point and knife preforms. Nine preforms (7 metavolcanic, 2 quartz) were recovered. The ratio of projectile point preforms to knife preforms is 2:1.

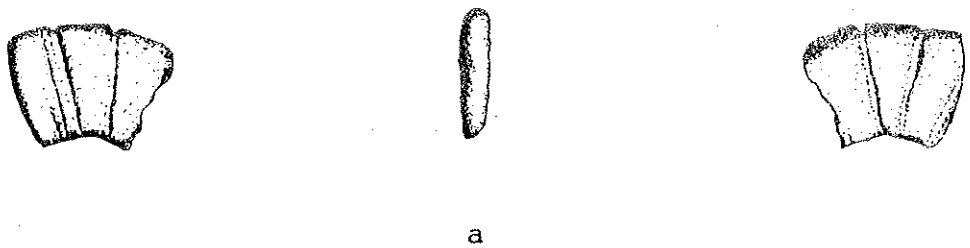
Cores and Debitage: Angular pieces of stone with varying degrees of patterned negative flake scars and no evidence of use are cores. Subtypes are present. Cores (28 specimens: 17 metavolcanic, 8 quartzite, 3 quartz) occurred at four loci: 20 at Locus A, 3 at Locus B, 1 at Locus C, and 4 at Locus D. Debitage includes unmodified flakes (21,696 specimens) and shatter (29,821 specimens). The results of the debitage analysis are presented elsewhere (Cardenas and Van Wormer 1984). While all stages of the lithic reduction process are represented, the overwhelming majority of flakes and shatter (92.5%) are the result of finishing and resharpening stone tools. Debitage (88.%% metavolcanic, 6% quartz, 4.5% quartzite, 0.5% chalcedony, 0.5% chert, 0.1% obsidian; fused shale and unknown material types also present) was recovered from all loci: 46,977 from Locus A, 2,921 from Locus B, 187 from Locus C, 1,281 from Locus D, 133 from Locus E, and 18 from monitoring.

Crystals: Forty-seven crystals (38 quartz, 7 tourmaline, 1 calcite) were found at Avocado Highlands. Quartz crystals occurred at three loci: 35 at Locus A, 2 at Locus B, and 1 at Locus d. The tourmaline and calcite crystals came from Locus A.

Abrading Pebble: A single smooth pebble exhibiting use as an abrader was recovered from Locus A.

Ceramics: Only 38 pottery sherds were found at SDi-4648; all Tizon Brown Ware. Most of the pottery was collected from the surface (58%) and upper levels of the site (32%). Only four sherds were recovered from below 30 cm. Ceramics occurred at three loci: 27 at Locus A, 9 at Locus B, and 1 at Locus D.

Bone Artifacts: Modified bone artifacts complete the Avocado Highlands artifact assemblage. These include 3 bone beads (Figure 5c-e), 1 antler tip (Figure 5f), and 27 fragments of polished bone. All were recovered from Locus A. Two of the beads came from the 0 to 10 cm level;the third bead and antler tip from 30 to 40 cm.



a

b

c

d

e

f

GROUNDSTONE AND BONE ARTIFACTS

Figure 5

FAUNAL REMAINS

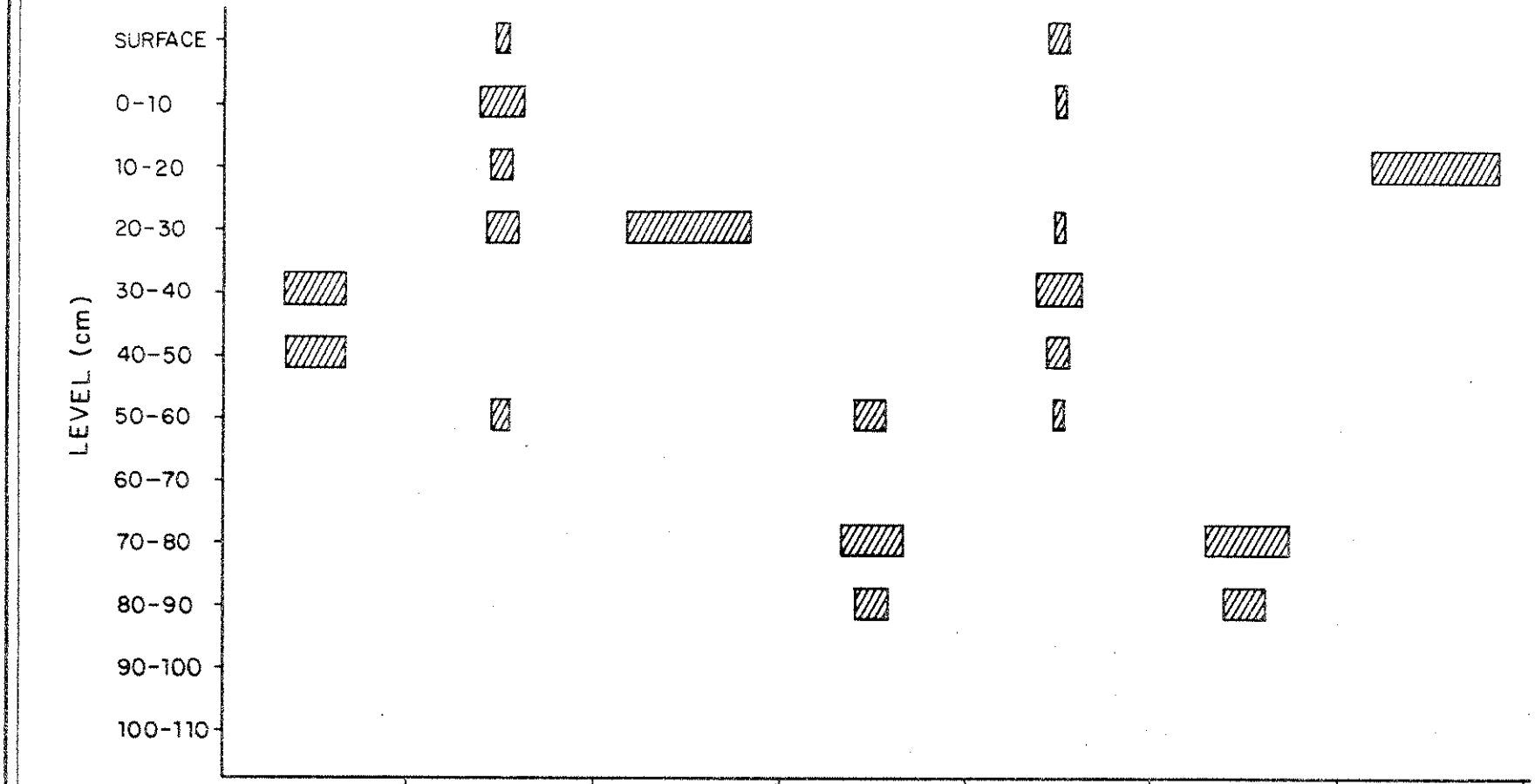
The faunal remains recovered from Avocado Highlands include both bone (2,101 specimens) and shell (19 specimens). The bone is well preserved, but extremely fragmented as a result of preparation. The majority of bone (85%) is from small mammals, including rabbit (Syvilagus audubonii and S. bachmanii), California ground squirrel (Spermophilus buchaji), pocket gopher (Thommomys bottae), and field mouse (Peromyscus sp.). Rabbit predominates. Medium-sized mammals constitute 6% of the bone assemblage, with most identified as jack rabbit (Lepus californicus), are rare (1%). Bird bone is also rare (0.1%), as is reptile bone (1%) and fish bone (2%). Interestingly, fish remains include stingray teeth and spine fragments. In addition, small fragments of human bone (80.3g) were also found. These were turned over to the appropriate Native Americans. Bone was recovered from four loci: 2,053 fragments from Locus A, 35 from Locus B, 2 from Locus C, and 11 from Locus D.

The small shell assemblage is also highly fragmented, resulting in a large proportion of unidentified shell (68%). The identified shell includes four fragments of cockles (Trachycardium quadragenarium), and one fragment each of scallop (Argopecten sp.) and Pismo clam (Tivela stultorum). The shell was distributed between the loci as follows: 17 fragments from Locus A, 1 from Locus D, and 1 from Locus E.

DATING THE DEPOSITS

Dating the occupation of Avocado Highlands is difficult. Radiocarbon dating was not attempted because no charcoal samples larger than 0.5 g were recovered. Stratigraphic seriation of time sensitive artifacts at SDi-4648 (Figure 6), however, suggests the presence of at least two, and possibly three occupational phases.

The upper levels of the site (surface to 30 cm) are characterized by a midden deposit containing grinding stones, Cottonwood Triangular and Desert Side-notched arrow points, Type 2 knives, Type 2 drills, and Tizon Brown Ware pottery. Small Cottonwood Triangular arrow points appear in the southern desert regions of California by A.D. 800 or earlier (Warren 1984a: 422-423) and in coastal Orange County perhaps as early as A.D. 500 (Koerper and Drover 1983:11). Small Desert Side-notched arrow points are later in time, first appearing around A. D. 1150-1200 in the Mojave Desert (Warren 1984a:426) and circa A.D. 1300 in the southern Sierra Nevadas (Moratto 1984:333). Type 2 knives are associated with Elko series points in the desert regions of California, as at Avocado Highlands (see below), and seem to continue into later times. Warren (1984:425) states that Brown and Buff wares first appear around A.D. 800 on the lower Colorado River. From there they diffused westward across the Colorado Desert and into the Peninsular Range by A.D. 900 (May 1976). The earliest occurrence of Tizon Brown Ware pottery in San Diego County, however, has been dated to circa A.D. 700 at two different sites (Berryman 1981; Moriarty 1966).



RBR and Associates	Diagnostic Artifacts at SDi-4648, Loci A & B	**Figure 6**

The upper midden deposit at Avocado Highlands is believed to date primarily to the early part of the Late Prehistoric Period, representing a Preceramic Yuman Phase occupation (A.D. 500-900). This conclusion is based on the presence of Cottonwood Triangular points throughout the upper 30 cm of the deposit and the relative scarcity of pottery. Only 38 pieces of pottery were found at the site, the majority on the surface (58%). By comparison, 1,743 pottery sherds were recovered from the Late Prehistoric base camp SDM-W-348 located on the valley floor below SDi-4648 (Cardenas and Van Wormer 1984). The recovery of 16 sherds and a single Desert Side-notched point from below the surface of Avocado Highlands is attributed to rodent activity. Obsidian hydration analysis of a single specimen recovered from the 0 to 10 cm level of Locus A also supports a Preceramic Yuman occupation. A Cottonwood Triangular point made of Obsidian Butte obsidian yielded a hydration measurement of 3.7 + .03 microns. This translates into an approximate date of A.D. 842 + 148 following Ericsons's (1977) linear model for Obsidian Butte obsidian.

The middle levels of Avocado Highlands (30 to 60 cm) are characterized by a midden deposit lacking ceramics and containing grinding stones, Elko series dart points and Type 2 knives. Large Elko series dart points, together with Humboldt Concave Base points, are diagnostic of the Gypsum Period (2000 B.C.-A.D. 500) in the southern Sierra Nevadas (Moratto 1984:333). In coastal southern California Elko series points seem to appear somewhat earlier, based on radiocarbon dating of shell. Extreme aution should be exercised in the acceptance of radiocarbon shell dates (Waters 1983), however, as shell samples frequently contain much older carbon isotopes absorbed from minerals in the water. Elko series-like points mark the emergence of the Campbell Tradition in the Santa Barbara region circa 2900 B.C. (Moratto 1984:138). In San Diego County, a La Jolla Phase deposit at the Harris site included an Elko series point and is associated with a date of 2770 B.C. (Warren 1966). Type 2 knives are associated with Elko series points in the desert regions of California, where they are called "Gypsum knives" (Warren 1984b). In light of the comparative evidence, the middle levels of Avocado Highlands are believed to date to the late Early Milling Period (3000 B.C.-A.D. 500).

The lower levels of the site (60 to 90 cm) are characterized by a non-midden cultural deposit containing grinding stones and an interesting assemblage of bifacial tools, including large, fragmentary dart points, Type 1 knives and Type 1 drills. The two fragmentary points are large mid-sections, and consequently untypable. The Type 1 knives are reminiscent of San Dieguito knives, and are identical to a specimen recovered from Rancho Park North, Site A (Moratto 1984:Figure 3.9a). Obsidian hydration analysis of a single specimen (made from Coso obsidian) recovered from the 70 to 80 cm level, however, produced a hydration measurement of 8.3 + 0.3 microns. This translates into an approximate date of 905 + 103 B.C. following Ericson's linear model or A.D. 124 + 66 following Meighan's (1983:607) linear model for Coso obsidian. Type 1 drills are similar, albeit more carefully worked, to T-shaped drills of the Gypsum Period in the desert regions of California. Thus the lower levels of Avocado Highlands also seem to date to the late Early Milling Period, while showing strong continuity with the earlier San Dieguito Complex in the form of Type 1 knives.

DISCUSSION AND CONCLUSIONS

Perhaps the most interesting aspect of the Avocado Highlands site is that it represents a base camp which was occupied for at least 2,000 years, roughly from 1000 B.C. to A.D. 900. After A.D. 900, the base camp was moved to a lower elevation on the El Cajon valley floor, and SDi-4648 continued to function as a limited activity area. The main occupation at Avocado Highlands was continuous and reflects a time period in San Diego County prehistory about which very little is known, the transition from the late Early Milling Period to the Late Prehistoric Period. While the bifacial tool assemblage shows close ties to the desert regions of California, the unifacial tool assemblage primarily reflects the coastal La Jolla Complex of the Encinitas Tradition. Like the Campbell Tradition of the Santa Barbara area (Moratto 1984:163), it appears that many Encinitas traits, including milling stones and coarse flaked-stone tools, were retained by the "inland La Jolla" as they evolved into the Yuman Tradition of the Late Prehistoric Period. Basically the bifacial tools at Avocado Highlands appear to represent the hunting component of the late La Jolla Complex, as suggested by Brott (1969:9).

In an effort to better understand this transitional period and determine whether Avocado Highlands represents an exception to the overall settlement system of the Encinitas Tradition in the San Diego region, the site collections of the San Diego Museum of Man were inventoried for Pinto and Elko series projectile points, as well as Type 1 and Type 2 knives. The results of this inventory are presented in Table 1 and Figure 7, together with data from sites documented in the literature.

A total of 73 sites were identified in San Diego County and Baja California from which Elko series points, Pinto series points, Type 1 knives, and/or Type 2 knives have been recovered. While this is far from a complete listing of sites with bifacial tools diagnostic of the Early Milling Period (6,000 B.C.-A.D. 500), it does provide a minimum number of sites in this category. The sites are found from the Pacific Coast to the Borrego Desert. The early part of the Early Milling Period (6,000-3,000 B.D.) is poorly represented. Pinto points have been recovered from only six early La Jolla Complex sites: two on the coastal plain (SDM-W-90, SDM-W-500); three in the foothills (SDM-W-181, SDM-W-253, SDM-W-256); one in the mountains (SDM-W-501). The late Early Milling Period (3,000 B.C.-A.D. 500), however, is represented at 70 sites: 37 on the coastal plain, 24 in the foothills, 7 in the mountains, and 2 in the desert (Figure 7). The sites extend southward from the Pauma Valley in the foothills and Agua Hedionda Lagoon on the coast, well into Baja California (Figure 7).

The distribution of these sites is constrained, in part, by our knowledge of the archaeology of the various physiographic provinces. Most of the work to date has been focused on the coastal plain and adjacent foothills region. It seems likely, however, that as our knowledge increases in other areas of the county, the sites with bifacial tools diagnostic of the Early Milling Period, and particularly the late Early Milling Period, will also increase. For this reason, it is somewhat premature to place too much

Table 1. Diagnostic Projectile Points And Knives Of The Early Milling Period From The San Diego Museum Of Man And Other Selected Sites

SITE #	SITE TYPE	ARCHAEOLOGICAL COMPLEX/ CULTURE PERIOD*	ELKO EARED	ELKO CORNER-NOTCHED	ELKO CONTRACTING STEM	PINTO SERIES	TYPE 1 KNIFE	TYPE 2 KNIFE
SDM-W- 8	V	SDIII (trace), LJ-II		1				
12B	V	SDIII, LJ-I&II						1
25A	V	LJII	1					
34	V	SDIII, LJI&II						2
41	TC	SDII (trace), LJII						1
48	TC,MS	SDII, LJII					1	1
70	V	SDII, LJII (trace), YIII						1
81	TC	SDII					1	2
84	TC	SDII, LJII (trace)		1				
90	TC	LJII, YIII	1	1		1		
92	V	SDII, (III trace), LJII						1
108	V	SDII (trace), LJII, YIII			1			
110	V	SDII&III, LJII, YIII		2			2	
111	TC,MS	SDII (III trace), LJII, YIII		1				
150	V	LJI&II, YIII	4	1			1	
155	TC (series)	SDII, LJII, YIII	1					
156	V	SDII&III			1			12
158	TC	SDII&III, LJII		1				
174	TC,MS	SDII, LJII			1		1	27
175	TC	SDII&III, LJII, YIII					1	1
179	TC,MS	SDII, LJII					1	1
181	TC	SDII&III, LJII				1		
183	TC,MS	SDII, LJII (trace)						4
198	TC	Campbell	1					4
205	V	SDII, YIII	1					
207	V	SDII&III, YIII	1					
208	TC	SDII&III, LJII?, YIII	3					4
227A	-----	Diegueno	1					
230D	TC	LJII, YIII	2	2	1			
231	V	SDIII	1					
234A	V	SDII&III, YIII			1			
235	TC	SDII, YIII						1
236	TC	SDII, Luiseno						1

*As recorded on Archaeological Site Record

TABLE 1 (continued)

SITE #	SITE TYPE	ARCHAEOLOGICAL COMPLEX/ CULTURE PERIOD*	ELKO EARED	ELKO CORNER-NOTCHED	ELKO CONTRACTING STEM	PINTO SERIES	TYPE 1 KNIFE	TYPE 2 KNIFE
SDM-W-239	TC	SDII, YIII or Luiseno						1
244	TC	SDII, YIII	1					
250	TC	SDIII, YIII	1					
253	V	SDII (trace), LJII, YIII				1		
256	TC,V	SDIII, YIII	1					
256A	TC	SDIII	5	1		1	1	
260	TC	YIII	1					
275	V	SDII, YIII	1					
276	V	SDIII, YIII		1				1
370	TC	Kumeyaay	2					
390	RS	Preceramic, Yuman, Kumeyaay			1			1
500	TC	SDII?				1		
501	LS,MS	LP		2	1	1		
502	TC	SDII?		1				
813	MS			1				
1137	V	LJ	1					
1213	Isolate	Campbell?	1					
1214	TC,MS	Campbell, Kumeyaay	1					
1339A	V	EM, LP			1			1
1504	TC	LJ			1			
1556	V	Campbell	14	1	1		1	3
3483	-----	-----						1
SDi-4648	TC	EM	3				5	13
SDi-9537	TC	Pauma	2				2	
Rincon 41a	TC	Pauma	2					
Rincon 132	TC	Pauma	1					
VC23	TC						1	
Campo	-----	-----	2					
LC 6	-----	-----						1
LC 25	V	LJII, YIII						1
LC 26	V	SDIII, LJII, YIII	8	2			3	58
LC 27	V	SD, LJII, YIII	1				1	
LC 29	TC	SDIII, LJII, YIII	2				3	15
LC 31	V	SDIII?, LJIII						1
LC 34A	V, TC	SDIII (trace), LJI&II, YIII	1					
LC 43	-----	SDIII, LJII, YIII	1					

*As recorded on Archaeological Site Record

TABLE 1 (continued)

SITE #	SITE TYPE	ARCHAEOLOGICAL COMPLEX/ CULTURE PERIOD*	ELKO EARED	ELKO CORNER-NOTCHED	ELKO CONTRACTING STEM	PINTO SERIES	TYPE 1 KNIFE	TYPE 2 KNIFE
LC 44		SD, Kumeyaay	2					
LC102	V	SDIII, YIII	2		3			
C 97	RS	Pinto	2					3
C158		LP	1					
	TOTAL		76	19	13	6	25	164

*As recorded on Archaeological Site Record

LEGEND TO TABLE 1

Site Designations

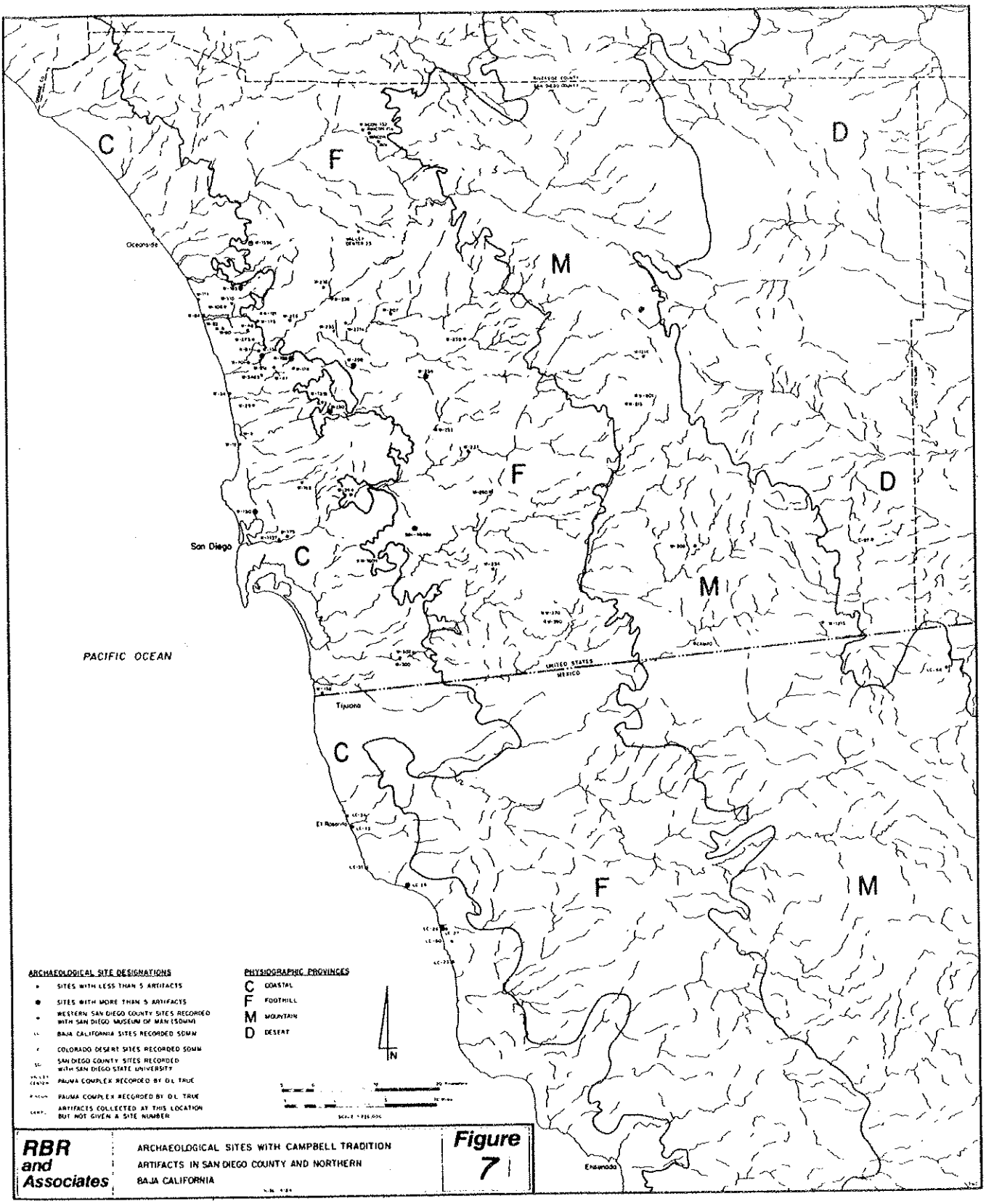
SDM-W = San Diego Museum of Man
VC = Valley Center
LC = Lower California
C = Colorado Desert
SDi = San Diego

Archaeological Complex/ Culture Period

SD = San Dieguito
LJ = La Jolla
Y = Yuman
EM = Early Milling
LP = Late Prehistoric

Site Type

V = Village
TC = Temporary Camp
MS = Milling Station
RS = Rock Shelter
LS = Lithic Scatter



RBR and Associates

ARCHAEOLOGICAL SITES WITH CAMPBELL TRADITION ARTIFACTS IN SAN DIEGO COUNTY AND NORTHERN BAJA CALIFORNIA

Figure 7

emphasis on the spatial patterning observed in Figure 7. Some general comments can be made, however.

It has been known for some 25 years that while the main cultural focus of Early Milling Period populations in San Diego County, as represented by La Jolla Complex sites of the Encinitas Tradition, centered on exploitation of coastal lagoons, Early Milling Period sites are also found in the foothills region in the Valley Center area (23 sites), Escondido-San Marcos area (13 sites), and Green Valley area (11 sites) (Warren, True and Eudey 1961:Map 2). This is further substantiated here by the distribution of sites containing bifacial tools diagnostic of the Early Milling Period (Figure 7), and extends the range of these sites into the mountains and to the western edge of the Colorado Desert. Furthermore, this appears to be a county-wide phenomenon, applicable to both the early and late parts of the Early Milling Period.

The relative scarcity of sites containing Pinto series points is undoubtedly due to several factors, the most important of which may well be the limited data base. It is suggested, however, that the small number of sites found in the foothills and mountain regions may also reflect a relatively small population base in these areas. The paucity of Pinto series points from coastal early La Jolla Complex sites, on the other hand, would appear to reflect economic factors. While early La Jolla Complex sites are abundant on the coastal plain, the primary subsistence strategy was a shellfish and vegetal gathering economy. This does not mean that fishing and hunting were not important, simply that they were of secondary importance. As a consequence, the hunting tool kit of early La Jolla assemblages is poorly represented on the coast.

The tremendous increase in late Early Milling Period sites containing Elko series points, as well as Type 1 and Type 2 knives, is also due to several factors. On the coastal plain, these diagnostic bifacial tools undoubtedly reflect the increased importance of hunting for late La Jolla populations associated with changing subsistence strategies as the coastal lagoons became less productive after 3,000 B.C. due to siltation. In the foothills region, where hunting would have always been an important part of the subsistence base, the apparent increase in late Early Milling Period sites undoubtedly reflects both local population growth and the movement of peoples from the coastal area.

The distribution of late La Jolla Complex sites on the coastal plain from Agua Hedionda Lagoon southward into Baja California (Figure 7) also indicates that it may be dangerous to wholeheartedly accept the hypothesized southward movement of late La Jolla populations, associated with lagoon siltation, suggested by the available radiocarbon dates (Smith and Moriarty 1982). In this regard, it is interesting to note that Buena Vista Lagoon was open and productive from circa 240 B.C. to A.D. 1510 based on evidence from Rising Glen, a major coastal Luiseno occupation site with two meters of dense shell midden (Cardenas and Robbins-Wade 1985). More excavation data and radiocarbon dates on charcoal are necessary, particularly in light of the fact that radiocarbon shell dates are unreliable and frequently much too old (Waters 1983). For example, there are two basal radiocarbon dates from the same unit and level (180 to 190 cm) at Rising Glen which differ by some 640 years (Cardenas and Robbins-Wade 1985). A

charcoal sample produced a radiocarbon date of 240 ± 90 years B.C.; a shell sample of *Chione undatella* produced a radiocarbon date of 880 ± 70 years B.C.

Finally, some suggestions regarding the terminology surrounding the late Early Milling Period in San Diego County are in order. The abundance and widespread occurrence of bifacial tools diagnostic of the latter half of this period argues against an intrusion of peoples or ideas associated with the Campbell Tradition of the Santa Barbara area (O'Neil 1982; True and Beemer 1982; Warren 1966, 1968). Furthermore, just as Warren (1984a) sees a continuous *in situ* cultural evolution from the Lake Mojave Period through at least the Saratoga Springs Period in the Mojave Desert, the evidence supports a continuous *in situ* cultural evolution from the San Dieguito Tradition of the Paleoindian Period through the Yuman Tradition of the Late Prehistoric Period in San Diego County. Avocado Highlands documents a continuous sequence from the late Early Milling Period (3,000 B.C.-A.D. 500) through the Late Prehistoric Period (A.D. 500-1769), including a Preceramic Yuman component. In addition, Type 1 knives at Avocado Highlands and elsewhere exhibit strong continuity with much earlier knives typical of the San Dieguito Complex. Finally, the bifacial tools diagnostic of the late Early Milling Period at Avocado Highlands represent nothing more than a hunting tool kit. The unifacial tools at the site, however, show a close relationship to those of the coastal La Jolla Complex. At the same time, the hunting tool kit of the coastal La Jolla Complex has been shown to be identical to that recovered from Avocado Highlands, although perhaps somewhat underrepresented. In short, the differences between coastal and inland La Jolla assemblages is believed to primarily reflect economic differences.

The occurrence of both Pinto and Elko series points does make a distinction between early and late La Jolla assemblages useful. There is no need, however, to identify distinct complexes such as the Pauma Complex (True 1958; True and Beemer 1982; Warren, True and Eudy 1961) or Amargosa Complex (May 1976, 1982) in order to explain the archaeological data.

ACKNOWLEDGEMENTS

The excavation of the Avocado Highlands site (SDi-4648) was financed by the Anden Group in Covina, California. I am especially grateful to Mr. Doug Garner, Project Manager for the M. H. Golden Company.

The field crew consisted of the author, Steven Van Wormer, Tirzo Gonzales, Fred Mueller, Joyce Reading, Rick Burk, Diane Fenicle, Jim Hall, Jack Hill, Carolyn Kyle, Linda Neyensch, Roy Pettus, Timarie Seneca, Carol Serr, and Cathy Winterrowd. Volunteer help was enthusiastically provided by Jan Bennet, Richard Brown, Molly Gardner, Marian Harvey, Valerie Lusk, Vernon Montoya, Virginia Seneca, and Ruth Stinson. The laboratory work was conducted by Therese Muranaka, Molly Gardner, Tami Miller, Mary Robbins-Wade, Louise Roderick, Carol Serr, Marsha Tepner, Sue Wade, and Cathy Winterrowd. The artifacts were illustrated by Carol Serr. The site map was prepared by Joyce Reading and Troy Davis. Obsidian sourcing and hydration measurements were carried out by Paul Bouey and Rob Jackson of the University of California, Davis, respectively. Steatite sourcing was carried out by Dr. Stephen Williams. Dayle Cheever analyzed the faunal remains. Word-processing was provided by RBR & Associates, Inc., with thanks to Lucy Avila. Special thanks are due to Steve Van Wormer who ran the field in my absence and wrote the bulk of the technical report.

REFERENCES CITED

Berryman, Judy A.
1981 Archaeological Mitigation Report for Santee Greens SDi-5669. Archaeological Consulting & Technology, Inc. Submitted to the City of Santee, CA.

Bowman, Roy H.
1973 Soil Survey, San Diego Area, California. United States Department of Agriculture, Washington, DC.

Brott, Clark W.
1969 A Taxonomic System for Far Western Prehistory. In The Western Lithic Co-Tradition, edited by E. L. Davis, C. W. Brott, and D. L.

Cardenas, D. Sean and Mary Robbins-Wade
1985 An Archaeological Investigation of SDM-W-143/146: An Unique Coastal Luiseno Occupation Site in Carlsbad, California. RBR & Associates, Inc. Submitted to the City of Carlsbad, CA.

Cardenas, D. Sean and Stephen R. Van Wormer
1984 Archaeological Investigation of SDi-4648 and SDM-W-348. RBR & Associates, Inc. Submitted to the City of El Cajon, CA.

Ericson, Jonathon E.
1977 Prehistoric Exchange Systems in California: The Results of Obsidian Dating and Tracking. Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Heusser, Linda
1978 Pollen in Santa Barbara Basin, California: A 12,000 Year Record. Geological Society of American Bulletin 89:673-678.

Koerper, Henry C. and Christopher E. Dover
1983 Chronology Building for Coastal Orange County: The Case from CA-Ora-119-A. Pacific Coast Archaeological Society Quarterly 19(2):

May, Ronald V.
1976 An Early Ceramic Date Threshhold in Southern California. The Masterkey 50(3):103-107.

1982 The Development of the Early Milling Horizon in Southern California: Evidence for a Great Basinc Archaic Intrusion During the Amargosa Period, 1500 BC to AD 900. Society for California Archaeology Newsletter, 16(3):8-9.

Meighan, Clement
1983 Obsidian Dating in California: Theory and Practice. American Antiquity 48:600-609.

Moratto, Michael J.
1984 California Archaeology. Academic Press, NY.

Moriarty, James R., III
1966 Cultural Phase Divisions Suggested by Typological Change Coordinated with Stratigraphically Controlled Radiocarbon Dating in San Diego. Anthropological Journal of Canada 4(4):20-30.

O'Neil, Dennis, H.
1982 Archaeological Excavation of W-1556: A Campbell Tradition and Late Prehistoric Hunting and Gathering Camp in San Marcos, California. Palomar Junior College, San Marcos, CA.

Rogers, Malcolm J.
1966 Ancient Hunters of the Far West. Union Tribune Publishing Company, San Diego.

Smith, Brian F. and James R. Moriarty, III
1982 The Use of Radiocarbon Dating to Conform the Demographic Movement of the La Jolla Complex in San Diego County. Paper presented at the Conference on Holocene Climate and Archaeology of the California Coast and Desert, San Diego.

Thomas, David Hurst, Jr. and Robert L. Bettinger
1976 Prehistoric Pinon Ecotone Settlement of the Upper Reese River Valley, Central Nevada. Anthropological Papers of the American Museum of Natural History 53(3):263-366. NY.

True, D. L.
1958 An Early Complex in San Diego County, California. American Antiquity 23(3):255-263.

1970 Investigation of a Late Prehistoric Complex in Cuyamaca Rancho State Park, San Diego County, California. University of California. University of California, Los Angeles, Archaeological Survey Monographs 1.

True, D. L. and Eleanor Beemer
1982 Two Milling Stone Inventories from Northern San Diego County, California. Journal of California and Great Basin Anthropology 4(2):233-261.

Warren, Claude N.
1966 The San Dieguito Type Site: M. J. Rogers' 1938 Excavation on the San Dieguito River. San Diego Museum of Man Papers, No. 5. San Diego.

1968 Cultural Tradition and Ecological Adaptation on the Southern California Coast. In Archaic Prehistory in the Western United States, edited by C. Irwin williams. Eastern New Mexico Contributions in Anthropology 1(3):1-14. University of New Mexico Press.

Warren, Claude N. (continued)
1984a The Desert Region. In California Archaeology, by M. J. Moratto, Academic Press, NY.

1984b Personal communication.

Warren, Claude N., D. L. True and Ardith A. Eudey
1961 Early Gathering Complexes of Western San Diego County: Results and Interpretations of an Archaeological Survey. University of California, Los Angeles, Archaeological Survey Annual Report 1960-1961:1-106.

Waters, Michael R.
1983 Late Holocene Lacustrine Chronology and Archaeology of Ancient Lake Cahuilla, California. Quaternary Research 19:373-387.

IF TIZON COULD TALK

John R. Cook
ASM Affiliates, Inc.
San Diego, CA

INTRODUCTION

Surface collection at SDi-7156, a Late Prehistoric Horizon temporary camp, McCain Valley, California, resulted in the recovery of 2,278 artifacts including 716 flaked stone items, 81 pieces of groundstone, 7 miscellaneous artifacts, and 1,474 ceramic sherds. The vast majority of this material were collected from a 200 square meter area north of than intermittent stream and spring. This area was gridded into 10 meter square units for systematic collection; two areas south of the stream drainage were also systematically collected.

Of all the artifacts collected at SDi-7156, the ceramic class was the most numerous. The problem of ceramic typology is one which of late has received considerable attention, primarily as a result of the research of May (1978) and Waters (1982). Each is said to have based their typologies on the earlier work by Malcolm Rogers, who unfortunately never actually published his final thoughts on the matter (see Townsend 1985). May's typology addresses both Tizon Brown and Lower Colorado Buff wares which he includes under the umbrella appellation of Hakataya ceramic tradition: ware, series and type divisions are proposed. Waters' typology is concerned only with Lower Colorado Buff wares which he placed under the general rubric of the lowland Patayan ceramic tradition; these are subdivided into three temporally sensitive rim variants and then finally into nine different types. No discussion is provided here of the validity of the two typologies, as detailed critiques are presented elsewhere, in particular Townsend (1985) and Laylander (1983). Instead, emphasis is placed on analysis of the recovered sample and its implications for ceramic typology, and more broadly Late Prehistoric culture of the region.

ANALYSIS

As the following analysis is preliminary only, it was decided that the scope of inquiry would be restricted to an evaluation of the two commonly posited alternative hypotheses, i.e., variability as a function of either resource availability or cultural tradition. With this in mind, the analysis focused on quantification of a series of paste/temper and vessel morphology/style variables.

From a review of pertinent literature and examination of the SDi-7156 sample, various attribute states were compiled for each of the variables. The actual statistical manipulation of the data was divided into three steps. The first entailed analysis of paste/temper related variables including: mica content; primary nonplastic component, i.e., primary temper and percent of primary temper; inclusions; other temper; and firing atmosphere. Nonparametric statistical tests were applied on a bivariate level

for each of the various combinations, and from this dependent and independent variables were identified. Step 2 followed essentially the same analytical method though, given the presence of interval-level measurements, other tests such as analysis of variance were also used. The variables involved in this step include: vessel form; vessel type; rim curvature type; rim diameter; lip type; and thickness. The final step of analysis was where the results of the previous statistical analysis were combined to determine if the independent variables could be used as diagnostic attributes for typological construction.

Given the kinds of ceramic variables that had to be investigated, quantification was only conducted on the rim sherds. Of these, 162 were classified as Tizon Brown (TB) and 7 Lower Colorado Buff (LCB). The LCB sherds comprised such a small sample that they were not amenable to separate statistical treatment, though they were classified according to Waters' typology. The TB sherds were, however, sufficiently numerous for statistical analysis. Because of the preliminary and exploritory nature of this analysis, it was decided that a 0.10 level of significance would be used (often 0.05 or better is used with larger samples).

Before proceeding, it is first necessary to describe the quantification and encoded instructions used for analysis. The encoded data are available from the author for $5.00 or a free lunch.

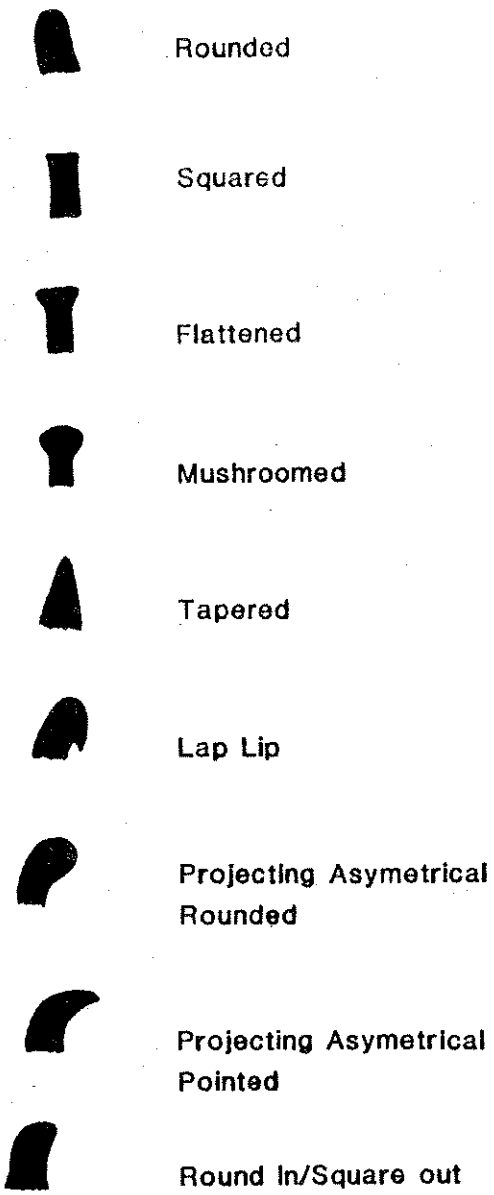
Variable No.	Variable Name	Attributes
1	Catalog No.	Grid No. - Artifact No.
2	Wave Type	Tizon Brown (2); Lower Colorado Buff (2)
3	Other Type	Analytic type (not used)
4	Vessel Form	Bowl (1); Jar (2); Pot (3)
5	Vessel Type	(see Figure 2)
6	Rim Curvature Type	Direct (1); Slightly Recurved (2); Recurved (2)
7	Rim Diameter	Measured to the nearest mm
8	Lip Form Quality	Undulating (1); Rough (2); Smooth (3)
9	Lip Type	Round (1); Squared (2); Flattened (3); Mushroomed (4); Tapered (5); "Lap-lip" (6); Reinforced (7); Projecting Asymmetrical Rounded (8); Projecting Asymmetrical Pointed (9);Combination (10); (see Figure 1)
10	Surface Finish Quality	Rough (1); Wiped (2); Smoothed (3); Burnished (4)

Variable No.	Variable Name	Attributes
11	Other Surface Finish	(not used)
12	Mica Content	None (1); Low (2); Medium (3); High (4)
13	Inclusions	Organics (burnt out) (1); Crushed Sherds (3); None (4); Shell (5)
14	Temper	Fine-Medium Grained Sand (1); Quartz/Feldspar (2); Crushed Grainite (3); Very Fine Sand (4)
15	Percentage of Temper	0-10% (1); 11-20% (2); 21-30% (3); 31-40 (4); 41-50% (5)
16	Other Temper	---
17	Firing Atmosphere	Reduction (1); Poorly Oxidized (2); Well Oxidized (3)
18	Thickness	Measured to the nearest mm.
19	Revised Vessel Type	---

As mentioned, the first step of analysis is investigation into paste/temper variability. Attributes included in this category are: Mica Content; Inclusions; Temper; Percent of Temper; Other Temper; and Firing Atmosphere. Regarding the distribution of mica, it was noted that variability is unimodal, an approximately normal distribution with low mica content as the median value. If, for example, mica was intentionally entered into the clay, one might expect a bimodal distribution with another high peak showing on the histogram towards the medium to high end. This, however, is clearly not the case and more than anything else, it can be suggested that mica is probably a natural occurrence which varies somewhat by clay source and not a culturally induced factor.

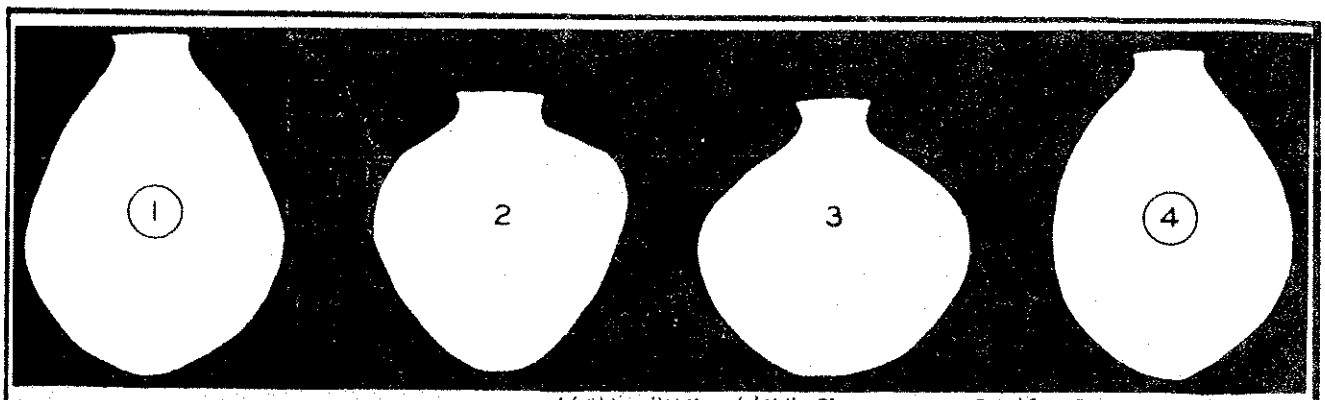
During cataloging, a fragment of each rim was broken off, crushed and mechanically separated by particle size. The predominant temper type was then identified and approximate percentage thereof estimated. (Future studies might concentrate on better quantification methods, but for a preliminary analysis such as this, the above technique was found to be useful.) The most frequently occurring temper was fine to medium grained sand representing 71% of all temporing materials, followed by quartz/feldspar at 26%, with crushed granite and very fine sand, each less than 3%. For the purpose of further analysis then, only the first two temper types are sufficiently represented for statistical treatment.

The results of the bivariate tests are interesting, though not necessarily unexpected. Regarding the first test, it was concluded that as the relative amount of mica increases, so does the probable occurrence of

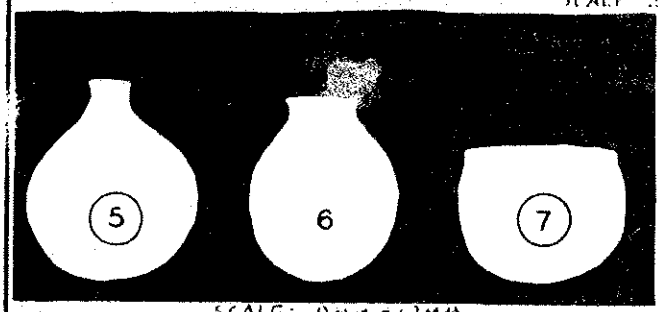


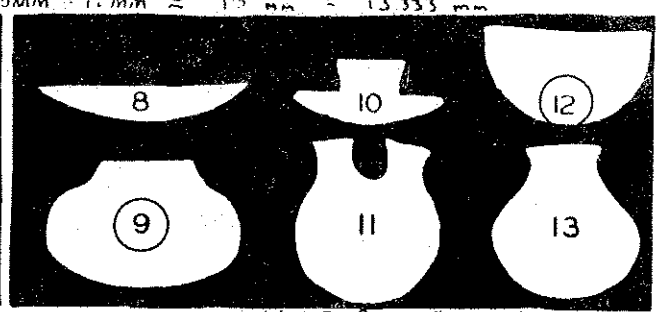
Lip Types

FIGURE 1

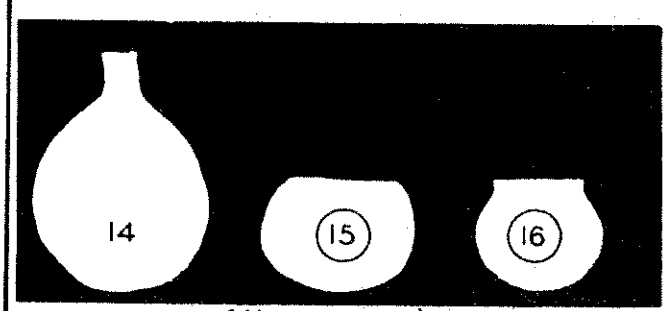


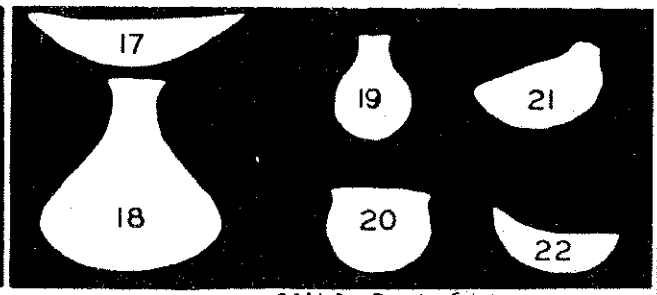
SCALE: .9MM = 12MM ≈ 10 MM = 13.333 MM



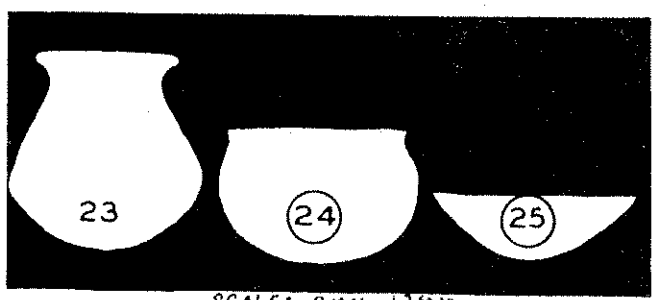


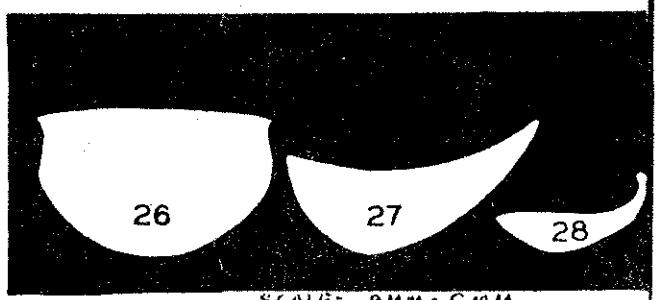
SCALE: .9MM = 12MM — WESTERN GROUPS — SCALE: .9MM = 6MM





SCALE: .9MM = 12MM — DESERT GROUPS — SCALE: .9MM = 6MM





SCALE: .9MM = 12MM — RIVER GROUPS — SCALE: .9MM = 6MM

YUMAN AND SHOSHONEAN POTTERY SHAPES

WESTERN GROUPS

SERI 7, 12
KILIWA 4, 7, 12, 13
S. DIEGUENO 1, 13
N. DIEGUENO 1, 13
LUISENO 4, 6, 7, 12, 13
CUPENO 1, 4, 7, 12.

COLORADO DESERT GROUPS

KAMIA 5, 8, 9, 12, 22, 28
M. CAHUILLA 1, 3, 7, 12, 16.
D. CAHUILLA 1, 3, 8, 12, 16, 17, 20

RIVER GROUPS

YUMA: 8, 11, 15, 17, 20, 22, 25, 28
MARICOPA 8, 12, 13, 16, 17, 23, 28
COCOPA 5, 8, 10, 12, 13, 16, 17, 20, 22, 24-26, 28
MOHAVE 8, 17, 20, 22, 24-25

EASTERN GROUPS

HAVASUPAI 6, 7
WALAPAI 5, 7, 9
YAVAPAI 5, 7, 12

asm	Vessel Types used in Analysis (shown in circled numbers)	FIGURE 2

organic inclusions. In and of itself the results of this test are of little utility; but in conjunction with other results a better picture is gained. The second test cross tabulated mica content by percent temper; in general this test indicated that as the amount of temper increases, so does the relative amount of mica, and vice versa. This would seem to suggest that there is a relationship also between the type of temper and mica content, even though a test of this proposition proved insignificant at the 0.10 level

Proceeding to the final two tests, it was found that a strong relationship exists between temper type and inclusions, and temper type and percent temper. The latter finding was discussed previously, where it was concluded that sand tempered sherds were comprised of less temper than the quartz/feldspar. The cross tabulation of temper by inclusions, shows that a significant association exists such that the sand tempered rims have less inclusions than the quartz/feldspar.

What can be generalized from all of these tests is quite simply that the quartz/feldspar tempered vessels have more inclusions and mica and a greater percentage of temper than the sand tempered. Presumably, the quartz/feldspar tempered rims are made from residual clays, whereas the sand tempered are of some grade of sedimentary clay. The issue of tempering, i.e., whether temper is intentionally introduced into the clay, is one which to this point has been ignored; yet it is important to know this if our results are to be correctly interpreted.

Townsend provides a thorough discussion of this problem in her Jacumba ceramic technology report (1985). Specifically, she was interested in determining if temper was added or was part of the natural clay for both residual and sedimentary sources.

> Shepard states that "there are two classes of paste with nonplastic inclusions that could be original or added constituents. One is fine and silty, the other highly micaceous." Silty pastes from sediment deposits (which mostly include quartz, though often mica, calcite, shell of foraminifers, volcanic dust and other mineral grains) may simply be from coarse sedimentary clays, or silt may have been added as temper. Residual clays derived from a mica granite will contain significant amounts of mica and grains of quartz and "these may be as coarse and abundant as grains in a tempered clay" (Shepard 1956:162).
>
> The available literature is not in agreement about the presence or absence of temper in pottery from the study area. Rogers (1936), Van Camp (1979), and Shipek (1951) all claim that temper was not added to the residual clays which went into forming the mountain wares, but was added to the sedimentary clays. Kroeber (1976), Meighan (1959), and May (1978) all claim the sherds they examined that were comprised of residual clays had temper.

Rogers, on the other hand, is very definite in his statements that the Indians from the areas surrounding Jacumba did not add temper to their residual clays. According to him (Rogers 1936:4), "quartz, mica, and partially altered feldspar crystals constitute 85 percent of the weight" in an average sample of clay. Even after the clays were screened and sorted, the above inclusions still reached almost 79 percent of the weight in the clay used by his informant to make her pottery vessels (Rogers 1936: 7). In his discussion of Luiseno pottery making, Rogers (1936:22) states that if Sparkman's 1908 statements were accurate and the Luiseno did add temper to residual clays in the form "of mineral matter or ground potsherds, it would constitute the only instance of this practice among any group" in San Diego County. Van Camp (1979:48) describes the residual clays as self-tempering and with inclusions of quartz, feldspar and mica (biotite and muscovite). In her appendix II, Van Camp (1979:81-84) includes Rogers' personal descriptions of what he called Western Brownware (i.e., Tizon Brown ware). For each pottery type, Rogers included a description of the natural inclusions and their percentages. Shipek (1951:5) simply notes that "residual clays contain a high proportion of mica, quartz, and feldspar particles, and that sedimentary clays are the clays that require addition of temper."

Given the above evidence, particularly that of Shepard (1965) and Rogers (1936), it seems fair to assume residual clays did not require temper. They appear to be self-tempered, and what Meighan (1959), May (1978), and Kroeber (1976) called tempers were, in fact, natural inclusions.

All of the above authors who discuss sedimentary clays and the resulting pottery (May 1978, Rogers 1936, Shipek 1951, Shepard 1965 and Van Camp 1979), agree that temper was added to sedimentary clays. Rogers (1936:25) claimed that the western desert ware sherds he examined were tempered by either adding crushed quartzose rock or purposely added sand (probably Salton Buff ware). Van Camp (1979:85) includes two of Rogers' desert ware descriptions. She identified the temper of Carrizo Buff I as consisting of 15-40 percent barite. Biotite (mica) was noted as being very low to equal to half of the barite at 40 percent. Carrizo Buff II has the same temper, but less of a percentage and it is more finely ground (1985:14-15).

It would seem then that the residual clays may not have been tempered and the mica, quartz/feldspar and other materials were inherent in the clay. The sedimentary clays were, however, apparently tempered with sand and other inclusions. From this, it can be safely assumed that within the SDi-156 sample those with sand temper were made of sedimentary clays and those with quartz/feldspar residual clays, and that within the Tizon Brown Ware category, the temper attributes explain some aspect of significant variability.

Step 2 consists of the analysis of vessel morphology and style. Variables included for these steps are: vessel form; vessel type; rim curvature type; rim diameter; lip type; and thickness. The investigation into vessel morphology commenced with univariate frequency distribution examinations, and then quickly proceeded to a series of cross tabulations designed to detect any classification mistakes. This consisted of compiling a matrix of attribute states for each of the various vessel types based on preliminary analysis. The vessel type matrix is composed of three variables: vessel form, rim diameter and rim curvature type. Rim curvature type range is estimated from Rogers' illustrations (1936: Plate 9), as modified for this analysis. Rim diameter averages were determined by taking scale measurements from Rogers' drawing and the initial statistical calculations. Vessel type numbers are those used by Rogers.

Vessel Type	Vessel Form	Rim Diameter	Rim Curvature Type
1*	Jar	6.0	01
4	Jar	6.5	02/03
5	Jar	4.8	02/03
7	Pot	15.0	01/02
9*	Pot	11.0	03
12	Bowl	9.5	01
15*	Bowl	7.5	01
16	Pot	8.0	02/03
24	Pot	16.0	03
25	Bowl	20.0	01

* Vessel configuration modified for this study.

Regarding vessel form, it is found that the pots predominate with some 56%, followed by bowls with 29% and then jars at 15%. Not surprisingly, given the large number of pots and bowls, 59% of the rims were direct, while 31% were slightly recurved and 10% were recurved. Of the various vessel types, 24% were type 12 bowls, 18% were type 15 bowls, 15% were type 7 pots, 11% were type 16 pots, type 24 pots and 4 jars each had 8%, 6% were type 25 bowls, 5% type 1 jars, 4% type 9 pots and 1% type 5 jars. Rim diameter statistics show a considerable range of mean diameters, from a small of 5.7 cm for type 1 jars to 20.4 cm for type 25 bowl (the mean for the entire population is 10.58 cm with a standard deviation of 4.96 cm).

The final variable to be analyzed in this step is that of lip type--an attribute presumed to be more stylistic than morphologic in nature, this because any number of lip applications are possible for vessels independent of function. The most frequently occurring type was the rounded variant representing some 31.9% of the entire sample, 26.6% were of the "flattened" variant, 18.3% projecting asymmetrical rounded, 9.5% projecting asymmetrical pointed, 3.6% combination rounded inside/squared, 1.2% sloppy rounded, and 0.6% mushroomed, bevelled, and hooked, respectively. To determine if, in fact, these lip types are associated with specific vessel types, a cross tabulation was run. For this particular analysis, all lip type variants were included except those at 0.6% or less. The chi-square

calculated for this cross tabulation proved to be insignificant at the 0.10 level (29.57 < 33.19 needed to reject the null hypothesis), and hence it can be concluded that vessel type and lip type are unrelated. As a double-check of this conclusion, another test was run for vessel form by lip type, this time only for those variants with five or more members. The results were the same, i.e., insignificant, thus corroborating our conclusion.

In the third and final step of analysis, the results of the paste/temper and vessel morphology/style components are crosstabulated. It will be remembered that in step 1, temper type was determined to be a potential independent variable, while in step 2 it was lip type. Given this, the obvious question is whether there exists any relationship between temper and lip type. If the null hypothesis is accepted in this instance, i.e., that no association exists, then we can conclude that the two variables remain independent (for whatever reason). Conversely, if one rejects the null hypothesis, then an association is assumed and it may be possible to proffer some explanation for the phenomenon.

Table 1 contains the cross tabulation and chi square test of the aforementioned hypothesis. With an X^2 value of 8.59 and 3 degrees of freedom (for a compressed 4 lip type situation) the test is significant at 0.10 level where a value of 6.25 or greater is required for rejection of the null hypothesis. Inspecting the cross tabulation, it is fairly evident what is happening: lip types 8 and 9--asymmetrical rounded and pointed--are significantly underrepresented for vessels made with quartz/feldspar temper. Because under this abbreviated X^2 using only the four largest lip types, it is possible some error could be introduced, all twelve lip variants were recombined in a systematic manner into three related macro-types. Under this scheme, lip types 1, 6, and 11 were classified as macro type A--rounded series; types 2, 3 and 4 macro-type B--flat series; and types 2, 3, and 4 macro type C--asymmetrical projecting series. The X^2 test of this reformulation (Table 2) again resulted in rejection of the null hypothesis (6.00 > 4.61 needed to reject at the 0.10 level).

Now that we are confronted with the empirical evidence, it remains to explain its possible causes. That certain lip types are significantly underrepresented among the quartz/feldspar temper vessels obviously has some import--but what is it? It may be of some assistance to present the quantitative data from Table 2 in a simpler qualitative form. This is done in the matrix below:

---> CROSSTAB (B:BCSHERDS.150 2 \ 3): CROSSTAB OF PRIMARY TEMPER BY LIP TYPE (VAR 14 BY 9

PAGE 1

	COL 1	COL 2	COL 3	COL 4	#ROW TOTS#
ROW 1	31.8 ! 27 ! 61.4	28.2 ! 24 ! 70.6	23.5 ! 20 ! 87.0	16.5 ! 14 ! 93.3	= 100.0 = 85 = 73.3
ROW 2	54.8 ! 17 ! 38.6	32.3 ! 10 ! 29.4	9.7 ! 3 ! 13.0	3.2 ! 1 ! 6.7	= 100.0 = 31 = 26.7
#COL TOTS#	37.9 ! 44 ! 100.0	29.3 ! 34 ! 100.0	19.8 ! 23 ! 100.0	12.9 ! 15 ! 100.0	= 100.0 = 116 = 100.0

---> CONTAB (B:BCSHERDS.152): CONTAB OF PRIMARY TEMPER BY LIP TYPE (VAR 14 BY 9)

PAGE 1

I	J	OBSERVED	EXPECTED	CHI-SQ
1	1	27	32.2414	.852075
1	2	24	24.9138	.0335163
1	3	20	16.8535	.587463
1	4	14	10.9914	.823536
2	1	17	11.7586	2.33633
2	2	10	9.08621	.0918996
2	3	3	6.14655	1.61079
2	4	1	4.00862	2.25808

Chi-Square Statistic for 3 Degrees of Freedom: 8.59369
Pearson's Coefficient of Contingency: .262629

asm

Crosstabluation of Primary Temper by Lip Type

TABLE 1

	Sand	Quartz/ Feldspar	
Macro Type A	38	22	60
Macro Type B	32	13	45
Macro Type C	39	7	46
	109	42	151

--- CONTAB (B:BCSHERDS.201): CONTAB OF PRIMARY TEMPER BY COMBINED LIP TYPE (VAR 14 BY X)
PAGE 1

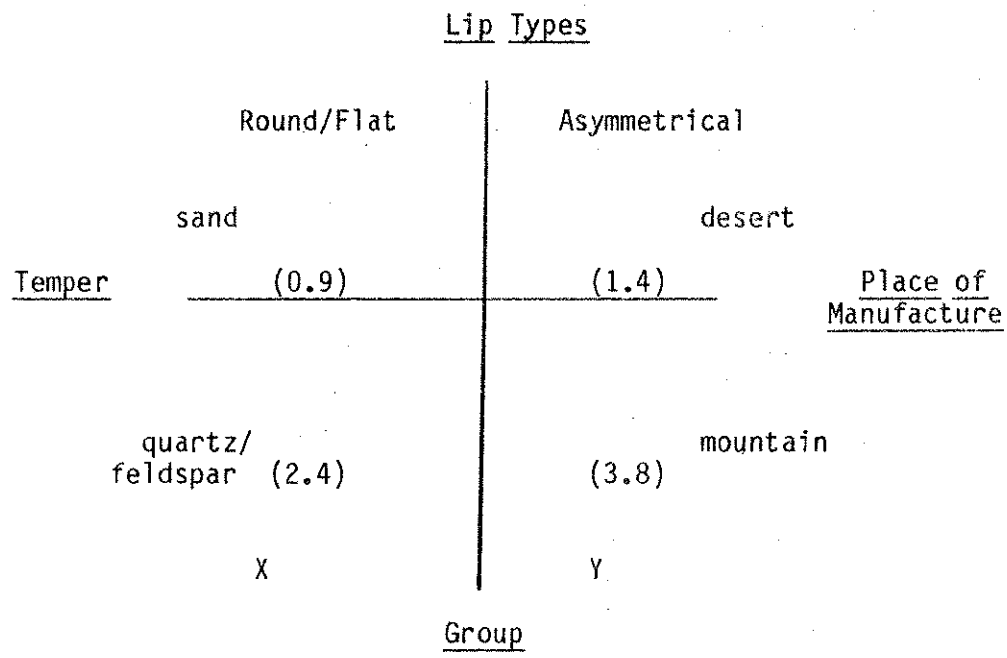
I	J	OBSERVED	EXPECTED	CHI-SQ
1	1	38	43.3113	.65131°
1	2	22	16.6887	1.69033
2	1	32	32.4834	.007195
2	2	13	12.5166	.9186727
3	1	39	33.2053	1.01124
3	2	7	12.7947	2.62441

Chi-Square Statistic for 2 Degrees of Freedom: 6.00317
Pearson's Coefficient of Contingency: .19554

asm

Contabulation of Primary Temper by Combined Lip Type

TABLE 2



The variables used for the test are shown on the left and top sides, divided into their dichotomous attribute states. Implications are shown on the right and bottom sides. For temper, the implication is straightforward: The sand tempered vessels were made in the desert areas to the east, while the quartz/feldspar are locally made with residual clays from the cis-mountane region, probably somewhere in the vicinity of SDi-7156. The implications of lip type are made hypothetical in nature. Here we assume that since lip type is unrelated to vessel form or type, i.e, independent so that any lip type could be found on any vessel type, then the source of the variability is the preference of the potter. Given that manufacture is a learned skill passed from potter to potter, then we can assume that the two different lip types represent two different groups (whether cimul extended family, cimul, or whatever cannot be determined at this point).

Within the matrix are shown "+," "0," and "-" symbols with various values in parentheses below. These indicate whether the given category is statistically overrepresented (+), near expected (0), or underrepresented (-), and by relatively what degree as shown by the relative chi-square value in parentheses. Thus any chi-square less than 1.0 was considered neutral, and any greater than 1.0 positive or negative depending upon the difference between observed and expected frequencies.

Interpreting this matrix, we can now see that not only are the quartz/feldspar asymmetrical projecting lip type underrepresented, but also conversely the quartz/feldspar round and flat lip types are overrepresented as are sand tempered asymmetrical lip types.

REFERENCES CITED

Kroeber, Alfred L.
1962 The Nature of Land-holding Groups in Aboriginal California. Pp. 19-58 in Two Papers on the Aboriginal Ethnography of California. D. H. Hymes and Robert F. Heizer, eds. University of California Archaeological Survey Reports 56. Berkeley.

Laylander, Donald
1983 Ceramic analysis in research designs for the prehistory of southern California. In Casual Papers, CRM Center, San Diego State University.

May, Ronald V.
1978 A Southern California Indigenous Ceramic Typology: A Contribution to Malcolm J. Rogers Research. Journal of the Archaeological Survey Association of Southern California 2(2).

Meighan, Clement W.
1954 A Late Complex in Southern California Prehistory. Southwest Journal of Anthropology, 10(2);250-264.

Rogers, Malcolm J.
1936 Yuman Pottery Making. San Diego Museum Papers 2.

1945 An Outline of Yuman Prehistory. Southwestern Journal of Anthropology 1(2):167-198.

Shepard, Anna O.
1956 Ceramics for the Archaeologist. Carnegie Institutions of Washington Publication 609.

Shipek, Florence
1970 The Autobiography of Delfina Cuero. Malki Museum Press, Banning, California.

Townsend, Jan
1985 Prehistoric Lifeways in Jacumba Valley. Manuscript on file at San Diego Gas and Electric.

Van Camp, Gena R.
1970 Kumeyaay Pottery: Paddle-and-Anvil Techniques of Southern California. Socorro: Ballena Press.

Waters, Michael R.
1982a The Lowland Patayan Ceramics Tradition. In McGuire and Schiffer (1982), pp. 275-297.

1982b The Lowland Patayan Ceramic Typology. In McGuire and Schiffer (1982), Appendix G, pp. 537-570.

1982c Ceramic Data from Lowland Patayan Sites. In McGuire and Schiffer (1982), Appendix H, pp. 571-580.

EARLY MAN AND A CULTURAL CHRONOLOGY

FOR BATIQUITOS LAGOON

Dennis Gallegos
WESTEC SERVICES, Inc.
San Diego, CA

EARLY MAN

Just the thought of Early of Man brings up names such as George Carter, Herb Minshall, Texas Street, Buchannan Canyon, Calico and Richard Leakey. Well, my Early Man is not early as old as Carter's, Minshall's, or Leakey's. The Early Man I am referring to is found in the New World within the Holocene Period.

For the true Early Man advocate, 1985 has not been a good year. The most current book on California archaeology discounts the work of Carter and Minshall as unsubstantiated (Moratto 1985). Calico, suggested to be 200,000 years old, has also had its problems, as the ring of rocks believed to be hearth, has been shown through archaeomagnetics to have never been affected by fire (Keveles 1986). Not to be left out, the scientific scholars for early dates have been shaken by recent findings. Pleistocene dates produced by amino acid and C-14 were found to be in error by the latest radiocarbon dating method, accelerator mass spectrometry (AMS) (Taylor et al. 1985).

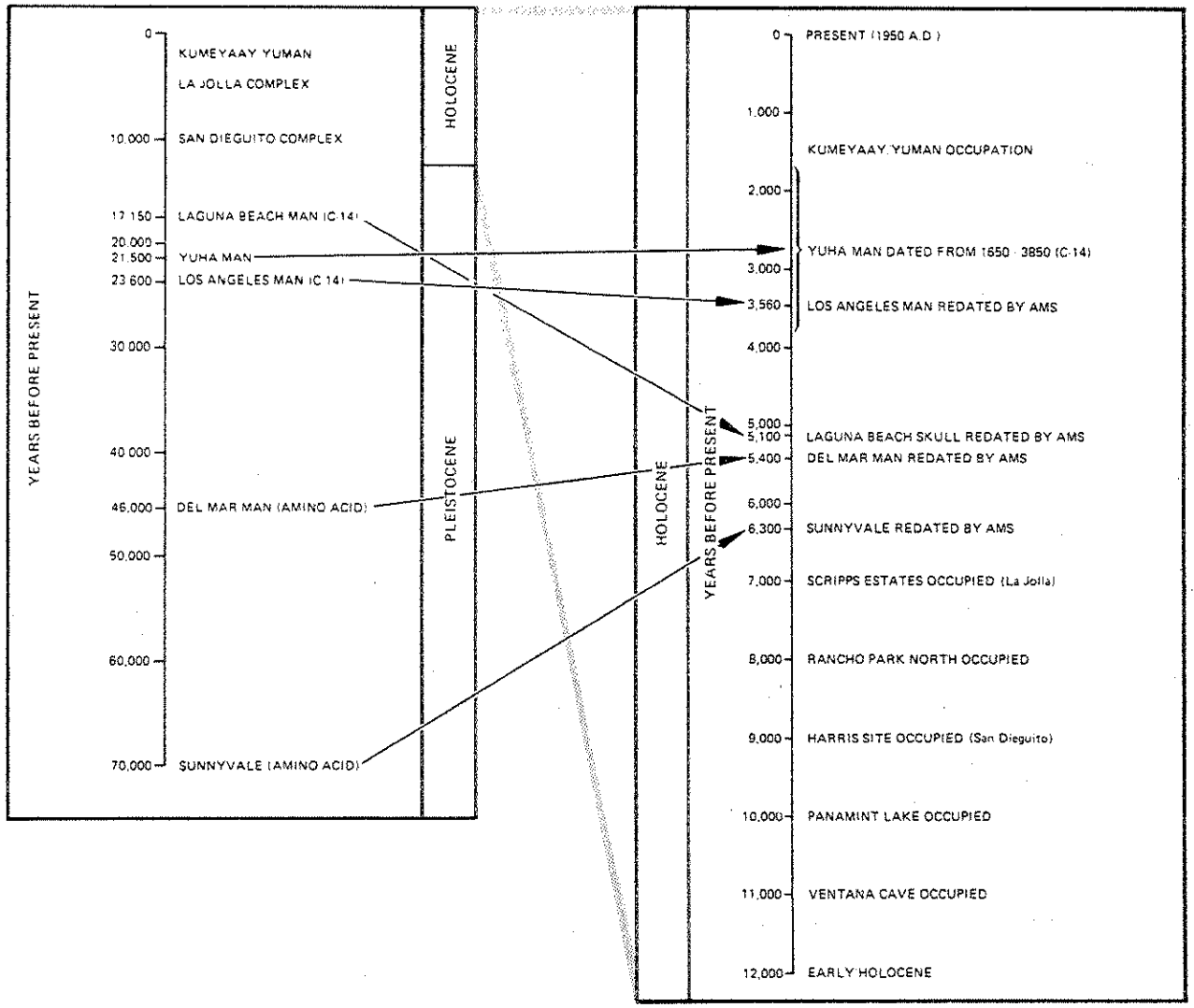
Jeffrey Bada, of Scripps, having calibrated his amino acid dating method on C-14 dated material, revised his Early Man Pleistocene dates to within the Holocene period (Bada 1985) (Figure 1).

These revisions include Del Mar Man to 5400 B.P.; Yuha Man to circa 3000 years B.P.; and Laguna Beach Man to 5000 B.P. All of these revisions restrict Early Man to the Holocene Period, a period of time less than 15,000 years ago.

CHRONOLOGY BACKGROUND

Beginning in the 1920's, Rogers' chronology was predicated upon surface archaeological finds and limited excavation. Our earliest radiocarbon dated sites in San Diego County are the Harris site (Warren 1966) and Agua Hedionda (Moriarty 1967), dated circa 9000 years B.P. Both of these early sites are identified to a people we call San Dieguito. Malcolm Rogers believed San Dieguito artifacts to be equal to artifacts found at the lowest levels of Ventana Cave in Arizona (Rogers et al. 1966) and to materials found along the margins of presently dry inland lakes.

The 1960's brought us full-scale excavations at Scripps Estate in La Jolla (Shumway, Hubbs and Moriarty 1961); Batiquitos Lagoon in Carlsbad (Crabtree, Warren and True 1963) and the Harris site, east of Rancho Santa Fe (Warren 1966). The early work by Malcolm Rogers, combined with these



Revised Cultural Chronology

FIGURE 1

excavations, produced the cultural chronology we presently employ. This chronology generally identifies the San Dieguito Complex from 9000 to 7500 years B.P.; the La Jolla Complex from 7500 to 3000 years B.P.; and, Yuman/ Kumeyaay within the past 2000 years.

From the 1970's to the present, over 10,000 new archaeological sites have been recorded and hundreds of sites have been excavated. For the most part, this chronology has held up quite well; but, sites with patinated metavolcanic (felsite) tools and milling tools do not fit well within San Dieguito or La Jolla nomenclature.

Having worked on an 8000 year old site at Agua Hedionda Lagoon and 7000 year old sites near Batiquitos Lagoon, I felt there were problems such as our stereotyping of the San Dieguito as big game hunters, a lack of explanation of why the San Dieguito left and where the La Jolla people came from.

CHRONOLOGY/DISCUSSION

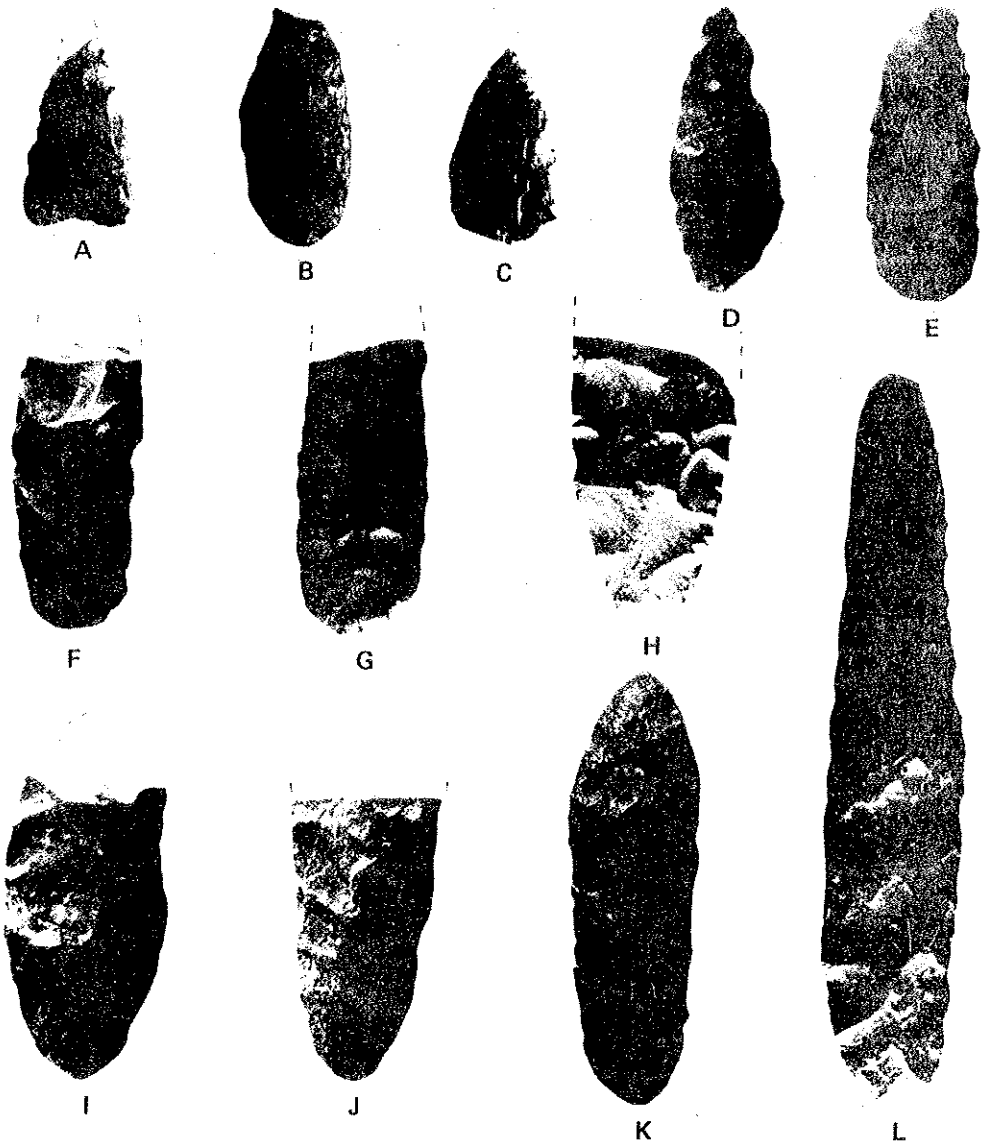
The finding of a Silver Lake point, San Dieguito knives, milling tools, fish, shellfish and small mammal remains at Agua Hedionda Lagoon identified a people who abandoned the drying inland lakes, due to a world-wide warming trend, and resettled along coastal lagoons created by melting ice caps (Gallegos and Carrico 1984).

It is suggested that the San Dieguito never left San Diego County, but rather they adapted to coastal and inland resources and exploited these resources from roughly 9000 years B.P. to at least 3500 years B.P. The San Dieguito and La Jolla Complexes perhaps should be considered one people of San Dieguito stock, who exploited both coastal and inland resources over a very long period of time.

How does this scenario fit with Rogers' San Dieguito chronology and True's Pauma Complex? I feel that Rogers was looking at a much broader time period than Warren's 7500 to 9000 year San Dieguito period. This is demonstrated in the C-14 dating of Rogers' San Dieguito sites near Batiquitos Lagoon from 5000 to 8000 years B.P. (Gallegos 1985); and, Rogers' belief that both Harris Site Locus 1 and Locus 2 were San Dieguito components. These components date from 9000 years B.P. to 4720 years B.P. (Figures 2 and 3).

True (1980) has identified his Pauma Complex primarily on the basis of surface archaeological finds. These finds include crescents, leaf-based knives, milling tools, discoidals, perforated discoidals and a burial. These kinds of artifacts and burial could date from 9000 to 35000 years B.P.

It appears that both Rogers and True were observing a tradition of finely-made tools within inland San Diego County from circa 9000 years B.P. to perhaps 3500 years B.P. and possibly younger.

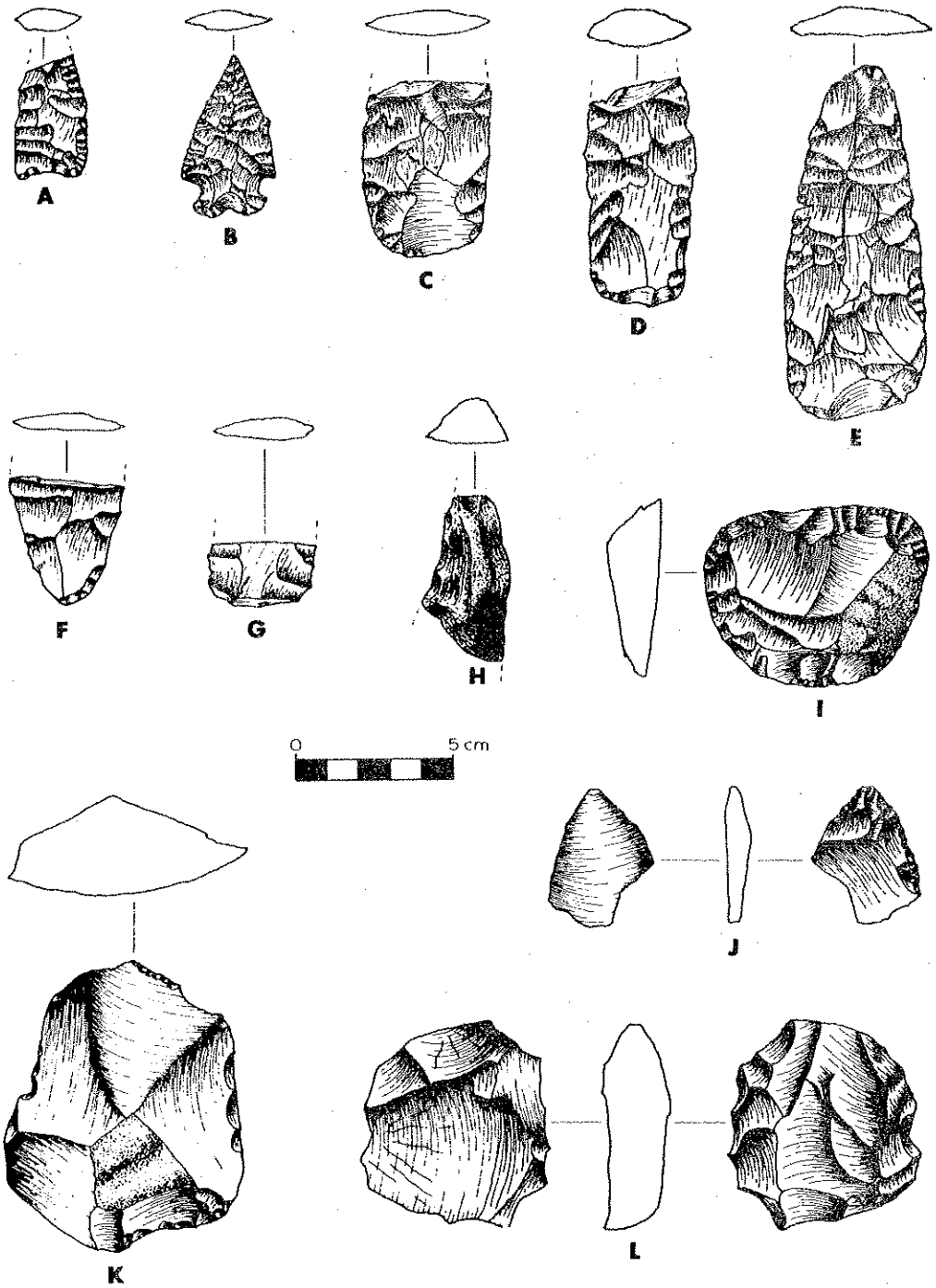


A. Projectile point (type 3).
B - C. Projectile point (type 1).
D - J. L. Knives (types 1 and 2).
K. Knife (type 3).

SOURCE: Warren 1966

Photographs of Projectile Points and Knifes from the Harris Site, Locus I Dated to 9,030 Years B.P.

FIGURE 2



A. Projectile point (type 3).
B. Projectile point (type 4).
C - G. Knives.
H. Side scraper.
I. Ovoid scraper.
J. Pointed side scraper.
K - L. Crude domed scrapers.

SOURCE: Warren 1966

Drawings of Artifacts from the Harris Site, Locus II, Dated to 4720 Years B.P.

FIGURE 3

Harris Site

The Harris Site, dated to 9000 years B.P., has been identified as the Type Site for San Dieguito (Warren 1966). Recent work at Rancho Cielo, a San Dieguito quarry, has led Cook (1985) to believe that the Harris Site is an intermediate specialized site for tool finishing. The Harris Site may be a Type Site for a specialized activity, but not a Type Site for all San Dieguito artifacts or San Dieguito sites.

Early Coastal Sites

The first San Dieguito coastal sites were occupied circa 9000 years B.P. These sites include Agua Hedionda (Moriarty 1967, Gallegos and Carrico 1984), ORA-64 (Newport Bay) in Orange County (Drover et al. 1983) and Diablo Canyon in San Luis Obispo County (Greenwood 1972).

Sites such as Agua Hedionda, ORA-64 and Diablo Canyon demonstrate that the San Dieguito readily adapted to the coastal resources of shellfish, fish, birds and other small game. To support the premise that the San Dieguito left inland lakes, a Silver Lake point was recovered from Agua Hedionda and dated to 8000 years B.P. (Figure 4) (Gallegos and Carrico 1984). After 8000 years B.P., coastal shellfish sites are more common, suggesting a somewhat sedentary lifestyle focused primarily on shellfish and hard seed resources.

Crescents

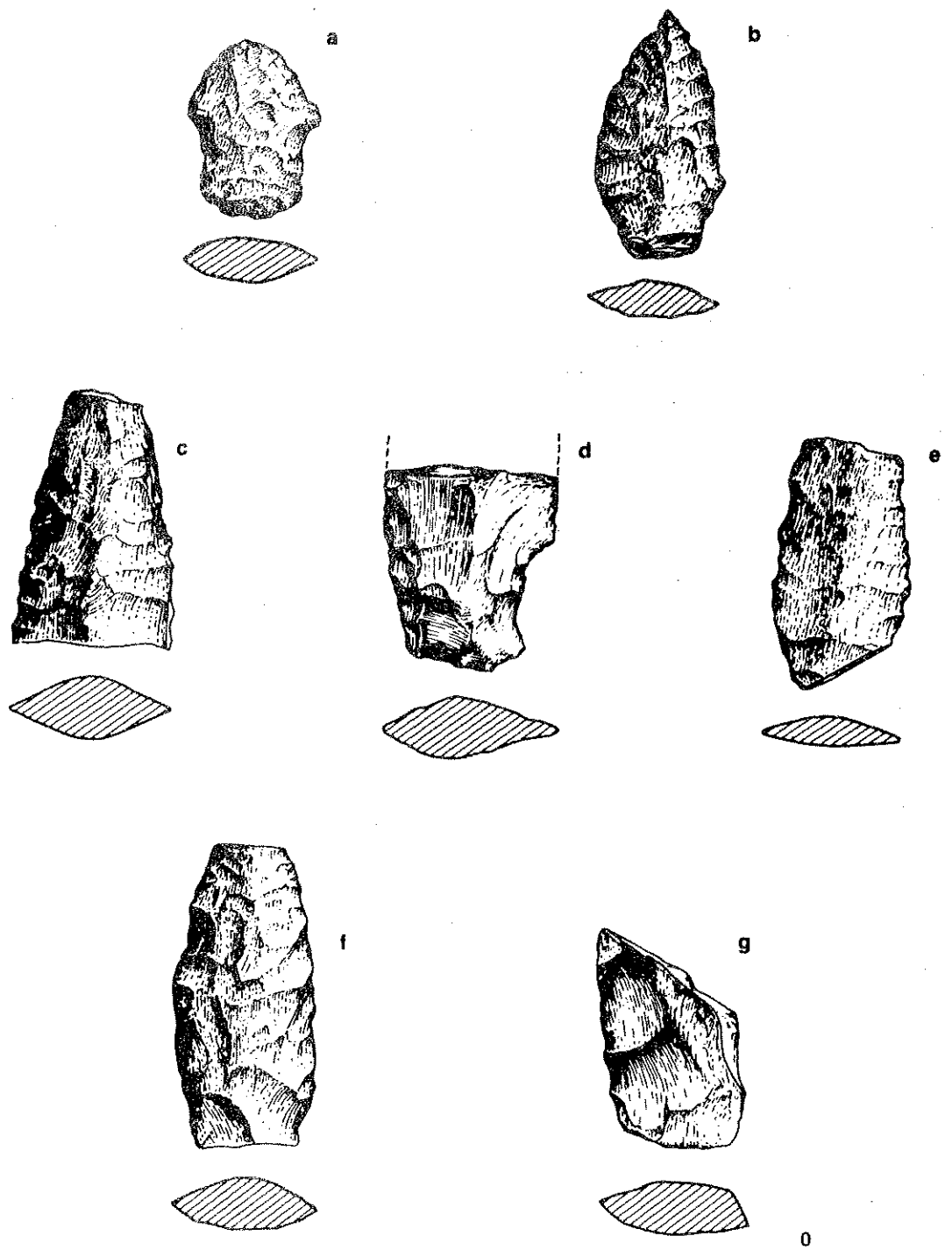
Crescents, a diagnostic artifact attributed to early occupation, has been found near the high shorelines of inland lakes and at coastal and inland sites within San Diego County (Figures 5 and 6). This artifact has been suggested to be a transverse point, a scarification tool, or simply a scraping tool. Combining crescent distribution with recent dates from the last high stand of inland lakes suggests shoreline occupation circa 8000 to 12,000 B.P. (Jertberg 1978; Davis and Panlaqui 1978, Fredrickson 1973, Davis et al. 1969, Warren and Ore 1978).

Milling Tools

The San Dieguito may have had milling tools when they entered San Diego County; but, the earliest dated site with milling tools is dated to circa 8000 years B.P. (Norwood and Walker 1980). The adaptation to coastal resources, the presence of the Silver Lake point, the production of cobble based tools as well as quarry based tools, and the introduction of milling tools led to the identification of a group well adapted to coastal and inland resources.

Campbell Influence

From 5000 to 3000 years B.P., a stylized Elko-eared point, and mortar pestle were introduced and identified as the Campbell Influence (Figure 7). Site with artifacts representing this influence have been rarely dated. Examples of Campbell tradition sites within San Diego County include



SOURCE: Gallegos And Carrico 1984

NOTE: The undisturbed unit levels for artifacts a and c were radiocarbon dated to 8060 ± 90 (Beta 9128) and 8280 ± 100 (Beta 9129) respectively.

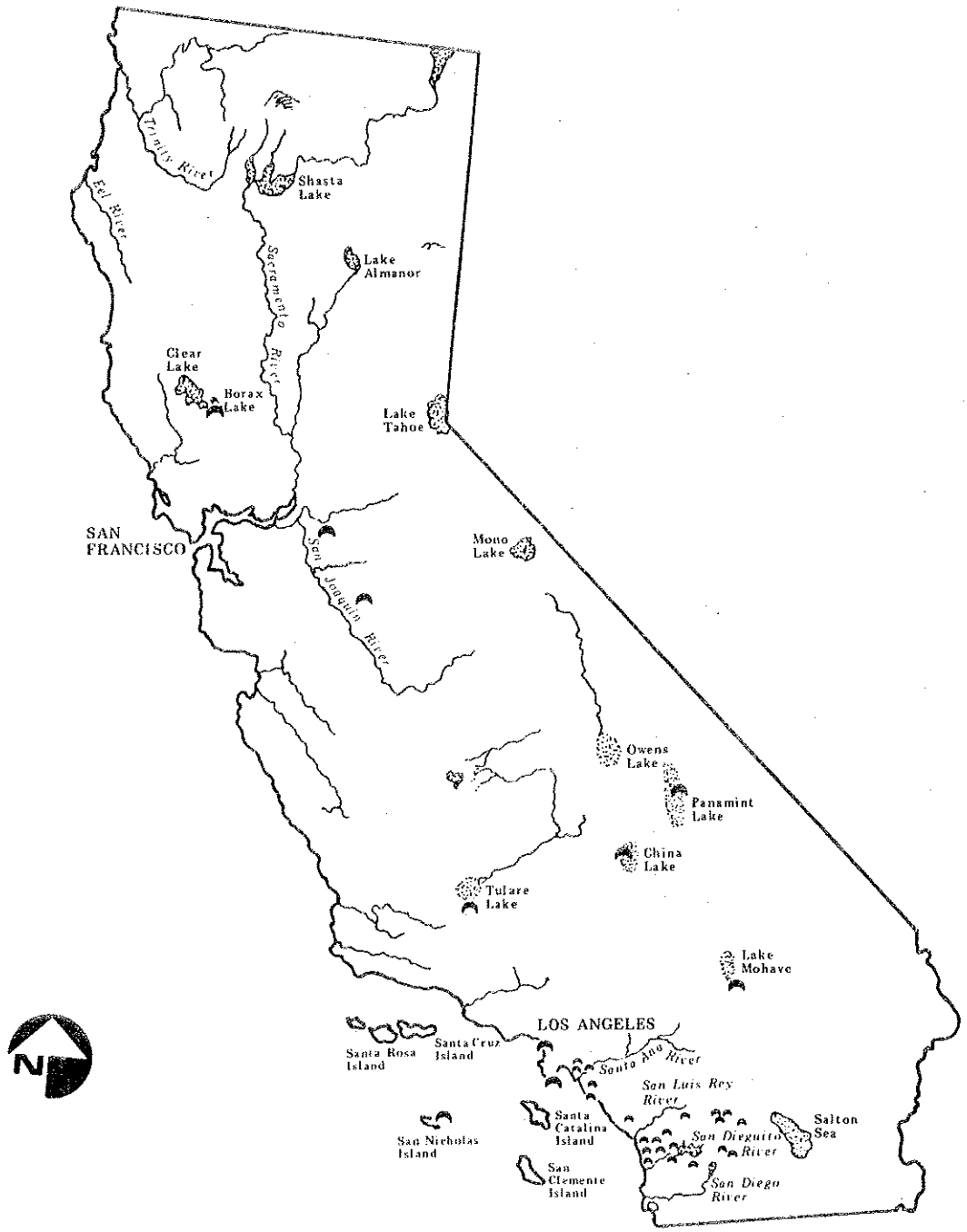
Silver Lake Points and Point/Knife Bases from Site W-131, Agua Hedionda

FIGURE 4

SOURCE: Rogers et al., 1968

Cresents and Eccentric Cresents from Inland Lake and Coastal Locations

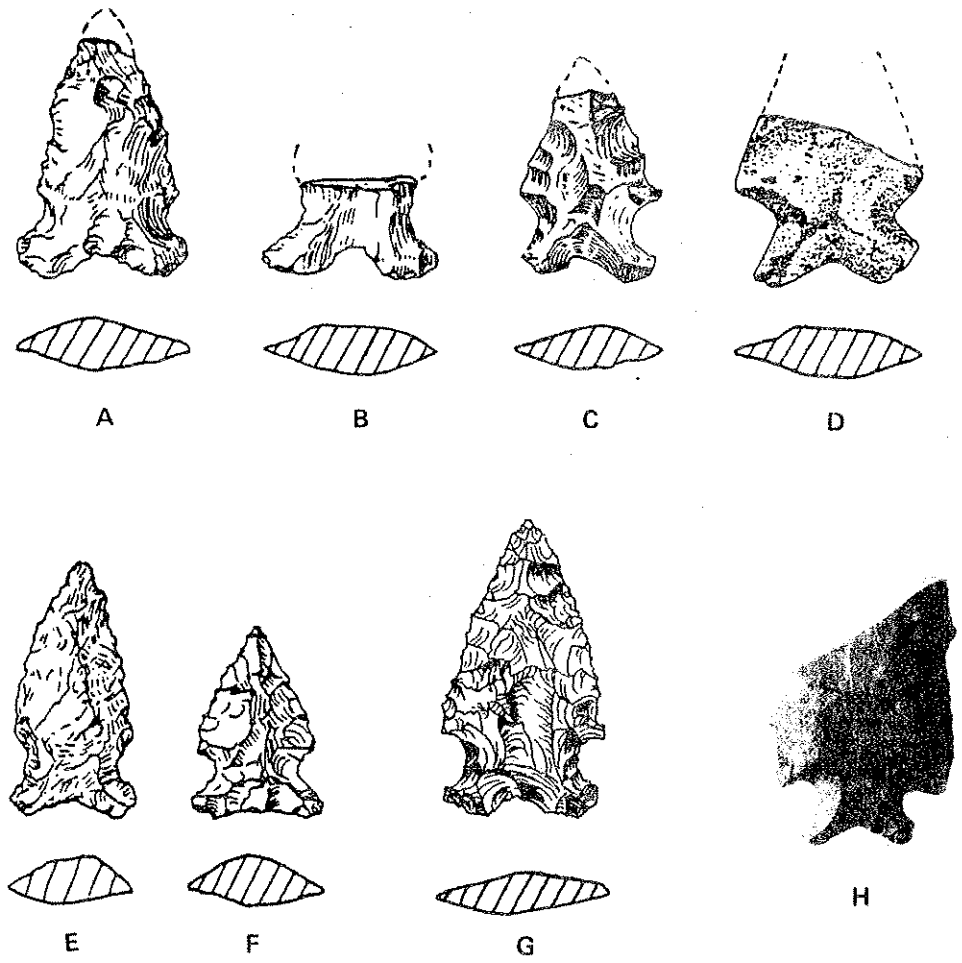
FIGURE 5



ADAPTED FROM: Jertberg, 1978

Distribution of Eccentric Crescent within California

FIGURE 6



SOURCES: A,B,C,D,E, and F - O'Neil, 1982
G - Cardenas and Van Wormer, 1984
H - Greenwood, 1972

Campbell Tradition Points, Also Called Elko Eared, Tri-Notched and Fish Tail Found in San Diego, Santa Barbara and San Luis Obispo Counties Circa 3,000 to 5,000 Years B.P.

FIGURE 7

W-1556, a site on the Palomar Junior College Campus (O'Neil 1982); Avocado Highlands in El Cajon (Cardenas and Van Wormer 1984); the Brown site (Moriarty N.D.); Sabre Springs (Cardenas N.D.); the Harris site (Warren 1966) and a site at Penasquitos Lagoon (Smith and Moriarty 1985).

A recent study (Cardenas and Van Wormer 1984) identifying the distribution of Elko-eared points, demonstrates that the Campbell influence was not of short duration, as suggested by Warren (1968) (Figure 8).

Late Period Influence

Also shown on the cultural chronology for northern San Diego County are obsidian, pottery, burial patterns, points and beads. Obsidian was used during both the Early and Late Periods. Pottery in northern San Diego County is quite late, being introduced circa 500 years ago; and, burials are representative of the Early Period with cremations representative of the Late Period.

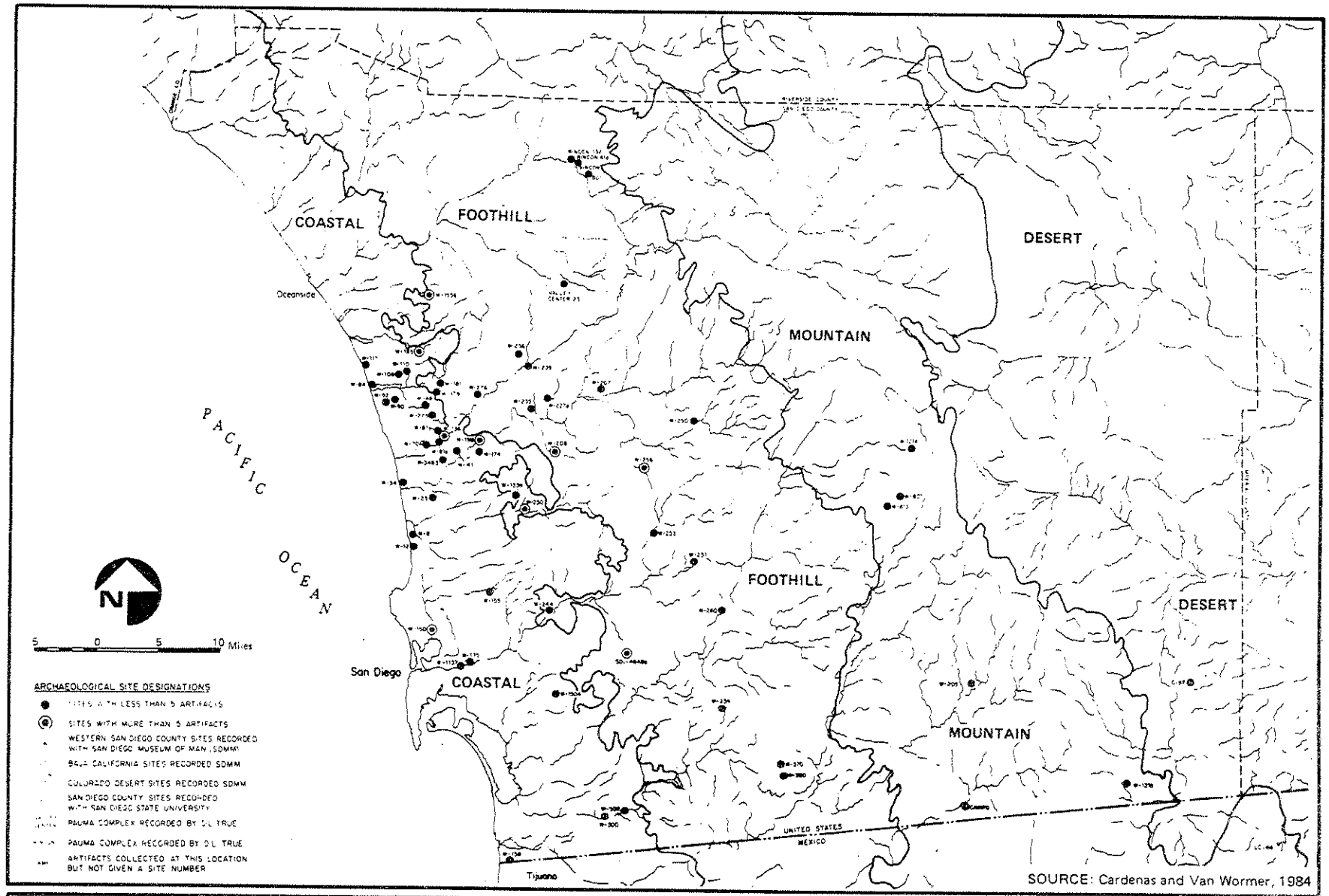
CULTURAL CHRONOLOGY

A cultural chronology for the Batiquitos Lagoon region is based on work conducted near Batiquitos Lagoon and includes both uncorrected C-14 dates, corrected C-14 dates to actual years B.P., regional and localized archaeological studies, material remains by excavation and date, environmental setting for Batiquitos Lagoon, environmental influences and implications (Table 1).

This chronology identifies an Early and Late Prehistoric occupation. The Early occupation in San Diego County begins with the San Dieguito circa 9000 years before present, adapting to coastal resources and bringing with them a tradition of finely worked stone tools. Rogers' description of an Early Playa Industry and Davis et. al's (1969) Western Lithic Co-tradition identifies a predecessor for the San Dieguito occupying the shores of inland lakes, circa 9000 to 12,000 years before present. Around 10,000 years ago, a warming trend reduced inland lakes to dry playas and melted ice caps to fill coastal valleys with water, thereby creating deep coastal lagoons.

SUMMARY

In summary, Early Man in San Diego County dates to the Holocene period, a period from present to roughly 12,000 years ago. Our understanding of the San Dieguito people should include coastal campsites, inland campsites, quarries and specialized sites for tool finishing and resource exploitation from circa 9000 to 3000 years B.P. The San Dieguito are a people who came to exploit the coastal and inland resources of San Diego County. They stayed, adapting their tool kit to better exploit certain resources within a changing environmental setting. The San Dieguito may well represent a continuous occupation culminating in the Kumeyaay people of San Diego County.



SOURCE: Cardenas and Van Wormer, 1984

Location of Campbell Tradition Points within San Diego County

FIGURE 8

TABLE 1

UNCORRECTED C-14 DATES (YEARS B.P.)	CORRECTED C-14 DATES TO ACTUAL YEARS B.P.	CULTURAL CHRONOLOGY		PROJECT TITLE	MATERIAL CULTURE: CRESCENT	POINTS	KNIVES	FLEXED BURIAL	CREMATION	STEATITE PENDANT	QUARTZ CRYSTAL	DISK BEADS	OLIVELLA SPIRE LOPPED	MANO/METATE	PESTLE/MORTAR	DISCOIDAL/STONE BALLS	OBSIDIAN	POTTERY	BATIQUITOS LAGOON SETTING	INFLUENCE	IMPLICATION
PRESENT 0	0																	Colorado Buff (15) Tizon Brownware 1,3,13,19) ? Pottery Absent (2)	Closed/Channelized Drainage		
600 500	537	Kumeyaay/ Yuman	Late Period	1 Fieldstone, Carlsbad		Triangular with Concave Straight and Convex Base (1,2,3,4)				(1)				(1)						Introduction of Pottery	Plant and Animal Resources Exploited Supplemented with Fish and Shellfish (1,2,3,4)
850 1,000	900			2 Rogers Ridge, Carlsbad					(2)		(2)		(2)	(2)			Obsidian Butte, Coso (1,2)		Mudflat/ Shallow Lagoon		
				3 La Costa, Carlsbad										(3)						Kumeyaay/Yuman Occupation of Batiquitos Lagoon Region	
1,500 1,680	1,497			4 Green Valley, Carlsbad										(4)							
2,000	2,242	Abandonment/ Depopulation		Absence of Archaeological Data																Lagoon Reopens	
2,500	2,560																		Closed/Channelized Drainage		Abandonment/Depopulation of Batiquitos Lagoon Region
3,000	3,157																			Lagoon Silted/Channelized	
3,500	3,852			4 Green Valley, Carlsbad										(4)							
3,874 4,000	4,542			5 Little Harbor Site, Santa Catolina Island		Elko Eared (5)															Dependence on Plant and Animal Resources Supplemented with Shellfish (4,10)
4,500	5,165																		Mudflat to Shallow Lagoon		
4,720 4,800				6 Harris Site, Locus II		Elko Eared (6)	Leaf Base (6)													Campbell Influence as Represented by Tri-Notched /Elko Eared/Points and Mortars	
5,000 5,100	5,745			7 W-20, Penasquitos		Elko Eared (7)		(7)					(7)	(8,11)		(7)					
				8 Aerophysics Site, Santa Barbara		Elko Eared (8)		(8)					(26)	(12,13)	(7,8)						
				26 Diablo Canyon, San Luis Obispo		Elko Eared (26)								(26)	(26)		Coso (10)				
5,900	6,205			10 Mantado, Oceanside		Elko Eared (117)															
				11 Los Compadres, Encinitas																	
				12 Scripps Estates, La Jolla				(12)				(10)				(12)					
6,000	6,855	La Jolla		13 Center Hill (W-179)			Leaf Base (13)						(13)			(13)					Shellfish and Plant Foods Supplemented with Animal Resources (8,9,10,12)
				14 SDi 603, Batiquitos Lagoon			Leaf Base (14)	(12)				(14)		(14)		(14)					
6,500	7,405			15a Santa Fe Knoll (W-951)			Leaf Base (12)					(12)	(12)			(12)					
				16 La Costa Site (SDi-4405)			Leaf Base (16)							(16)							
				14 SDi-603, Batiquitos Lagoon			Leaf Base (14)	(14)						(20)		(12)					
7,000	7,815			17 Rogers Ridge (W-182)			Leaf Base (17)	(17)													
				18 Batiquitos Pointe	(207)		Leaf Base (18)	(18)				(18)	(18)	(18)							
				15b Santa Fe Knoll (W-179)										(15b)							
7,500	8,400			12 Scripps Estate			Leaf Base (12)	(12)						(12)							
				19 Reyna Site, Carlsbad			Leaf Base (19)						(19)	(19)							
8,000	8,900		Early Period	20 Rancho Park North			Leaf Base (20)	(20)					(20)	(22)			Coso/ Casa Diablo (21)				Shellfish Primarily Exploited Supplemented with Plant and Animal Resources (20,21)
				21 Windsong, Aqua Hedionda	(21)	Silver Lake (21)	Leaf Base (21)					(20)		(21)					Introduction of Milling Tools		
				22 San Dieguito Estates			Leaf Base (22)														
8,500	9,500																		Sedimentation Increasing		
				23 ORA 64, Newport Bay			Leaf Base (23)														
				24 M-15,Aqua Hedionda			Leaf Base (24)														
9,000	10,000			25 Harris Site			Leaf Base (25)														Transition from Inland Lakes to Coastal Lagoons
9,370				26 Diablo Canyon, SLO		Lake Mojave ? (26)	Leaf Base (26)														
9,500	10,600	San Dieguito		27 Lake Mojave	(27)	Lake Mojave (27)	Leaf Base (27)														
10,000	11,200			28 Panamint Lake	(28)	Lake Mojave Silver Lake (28)	Leaf Base (28)												Open Productive Lagoon	Coastal Intrusion from Inland Lakes	
10,500	11,700																				Inland Lake and Valley Plant and Animal Resources Exploited
11,000	12,200																				
11,290		Clovis		29 Ventana Cave, AZ			Leaf Base (29)										Borax Lake (30)				
11,500	12,700			30 Borax Lake	(30)	Silver Lake (30)														Clovis Fluted Points Near Inland Lakes and Streams	
				31 Tulare Lake	(31)	Lake Mojave (31)															
				32 China Lake	(32)	Fluted Base (30,31,32)															
12,000	13,300																				

REFERENCES CITED

Bada, Jeffrey L.
1985 Aspartic Acid Racemization Ages of California Paleo Indian Skeletons, American Antiquity, Vol. 50, No. 3, pp. 645-647.

Cardenas, Sean and Stephen R. Van Wormer
1984 Archaeological Investigations of SDi-4648 and SDM-W-348. Report prepared by and on file with RBR and Associates, San Diego, CA.

Cook, John
1985 An Investigation of the San Dieguito Quarries and Workshops near Rancho Santa Fe, California, prepared and on file with Mooney-Lettieri and Associates, San Diego, CA.

Crabtree, Robert H., Claude N. Warren, and D. L. True
1963 Archaeological Investigations at Batiquitos Lagoon, San Diego County, California. Reported prepared for the California Division of Beaches and Parks and the Division of Highways.

Davis, Emma Lou, C. W. Brott and D. L. Weide
The Western Lithic Co-Tradition. San Diego Museum Papers, No. 6. Published by the San Diego Museum of Man, San Diego, CA.

Davis, Emma Lou and C. Panlaqui
1978 Chapters 1-5 in E. L. Davis ed., The Ancient Californians: Rancho La Brean Hunters of the Mojave Lakes Country. Los Angeles: National History Museum of Los Angeles County, Science Series 29:4-152.

Drover, Christopher E., Henry C. Koerper and Paul Langenwalter
1983 Early Holocene Human Adaptation on the Southern California Coast: A Summary Report of Investigations at the Irvine Site CA-ORA-64, Newport Bay, Orange County, California. Pacific Coast Archaeological Society Quarterly, Vol. 19, Numbers 3 and 4, July and October.

Ezell, Paul H.
1985 The Harris Site - An Atypical San Dieguito Site or Am I Beating a Dead Horse? A paper presented to the Society of California Archaeology, San Diego, CA. Unpublished paper on file with the author.

Frederickson, D. A.
1973 Early Cultures of the North Coast Ranges, California, Ph.D. disseration. Davis: Department of Anthropology, University of California.

Gallegos, Dennis R.
1985a Batiquitos Lagoon Revisited. In Casual Papers, edited by Chris White, Vol. 2, No. 1. Cultural Resource Management Center, Department of Anthropology, San Diego State University, San Diego, CA.

Gallegos, Dennis R. (continued)
1985b "A Review and Synthesis of Environmental and Cultural Material for the Batiquitos Lagoon Region." A paper presented to the Society of California Archaeology, San Diego, CA. Unpublished paper on file with author.

Gallegos, Dennis R. and Richard L. Carrico
1984 Windsong Shores Data Recovery Program for Site W-131, Carlsbad, California. Report prepared by and on file with WESTEC Services, Inc., San Diego, CA.

Greenwood, Roberta S.
1972 9000 Years of Prehistory at Diablo Canyon, San Luis Obispo County, California. San Luis Obispo: San Luis Obispo County Archaeological Society Occasional Papers.

Hubbs, Carl L., George S. Bien and Hans E. Suess
1962 La Jolla Natural Radiocarbon Measurements II, American Journal of Science, Radiocarbon Supplement, Vol. 4, pp. 204-238, New Haven.

Jertberg, Patricia M.
1978 A Qualitative and Quantitative Analysis of Relationships of the Eccentric Crescent and Its Value as an Indicator of Culture Change. M. S. Thesis on file at California State University, Fullerton.

Kaldenberg, Russell
1982 Rancho Park North, A San Dieguito Shellfish Processing Site in Coastal Southern California. Occasional Paper No. 6, I.V.C. Museum Society, El Centro, CA.

Kevles, Betty ann
1986 Calico: Colling the Fires of Speculation, Los Angeles Times, Scientific View, January 31, Los Angeles, CA.

Miller, Jacqueline
1966 The Present and Past Molluscan Faunas and Environments of Four Southern California Coastal Lagoons. M.S. Thesis, University of California, San Diego.

Moriarty, James R.
1967 Transitional Pre-Desert Phase in San Diego County. Science 155 (3762):553-555.

Moratto, Michael J.
1985 California Archaeology, Academic Press, Inc., Orlando, FL.

Norwood, Richard and Carol Walker
1980 The Cultural Resources of San Dieguito Estates. Report prepared by and on file with RECON, San Diego, CA.

O'Neil, Dennis H.
1982 Archaeological Excavation of W-1556, a Campbell Tradition and Late Prehistoric Hunting and Gathering Camp in San Marcos, California. Report prepared by and on file with Palomar Junior College, San Marcos, CA.

Rogers, Malcolm
1966 Ancient Hunters of the Far West, Richard F. Pourade, editor. The Union-Tribune Publishing Company, San Diego, CA.

n.d. Field Notes (site record forms) for Batiquitos Lagoon sites. Notes on file at the San Diego Museum of Man.

Shumway, George, Carl L. Hubbs and James R. Moriarty
1961 Scripps Estate Site, San Diego, California: a La Jolla Site Dated 5460 to 7370 Years Before the Present. Annals of the New York Academy of Science, Vol. 93, Art. 3, pp. 37-132.

Taylor, R. E., L. A. Payne, Ca. A. Prior, P. J. Slota, R. Gillespie, J.A.J. Gowlett, R. H. Hedges, A. J. T. Tull, T. H. Zabel, D. J. Donahue, and R. Berger
1985 Major Revisions in the Pleistocene Age Assignment for North American Human Skeletons by C-14 Accelerator Mass Spectrometry; None Older than 11,000 C-14 Years B.P., American Antiquity 50: 136-140.

True, D. L.
1980 The Pauma Complex in Northern San Diego County: 1978. Journal of New World Archaeology, Vol. III, No. 4, September 1980. Institute of Archaeology, University of California, Los Angeles.

Warren, Claude
1966 The San Dieguito Type Site: M. J. Rogers' 1938 Excavation Site on the San Dieguito River, San Diego Museum Papers, No. 5.

Warren, Claude N. and H. T., Ore
1978 Approach and Process of Dating Lake Mojave Artifacts. The Journal of California Anthropology.

Warren, Claude N., D. L. True and Ardith A. Eudey
1961 Early Gathering Complexes of Western San Diego County. University of California, Los Angeles Archaeological Survey Annual Report, 1960-61, pp. 24-25, Los Angeles, CA.

CRM CENTER NOTES

In Memoriam

Fred W. Kidder, age 36, Casual Papers, Volume 1 Publications Coordinator and Assistant Editor, died from a stroke at the end of June. He will be sorely missed by all his friends and associates.

Yumiko Joins Geography Department

After 22 years as the Anthropology Department Secretary, Yumiko Tsuneyoshi has assumed the secretarial responsibilities of the Geography Department. The Casual Papers staff cannot adequately express their appreciation for Yumiko's persistent and patient efforts, without which not even a single issue could have been produced. We wish Yumiko the best.

CASUAL PAPERS STAFF

CRM Director	Larry L. Leach
Editor	Chris White
Assistant Editor	Kaye Miller
Production Coordinator	Yumiko Tsuneyoshi