Title

Correlating Biological Relationships, Social Inequality, and Population Movement among Prehistoric California Foragers: Ancient Human DNA Analysis from CA-SCL-38 (Yukisma Site)

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Correlating Biological Relationships, Social Inequality, and Population Movement among Prehistoric California Foragers: Ancient Human DNA Analysis from CA-SCL-38 (Yukisma Site).

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Anthropology

by

Cara Rachelle Monroe

Committee in charge:
Professor Michael A. Jochim, Chair
Professor Lynn Gamble
Professor Michael Glassow
Adjunct Professor John R. Johnson

September 2014

The dissertation of Cara Rachelle Monroe is approved.

Lynn H. Gamble

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John R. Johnson

Michael A. Jochim, Committee Chair

September 2014

Correlating Biological Relationships, Social Inequality, and Population Movement among Prehistoric California Foragers: Ancient Human DNA Analysis from CA-SCL-38 (Yukisma Site).

by

Cara Rahelle Monroe

ACKNOWLEDGEMENTS

Completing this dissertation has been an intellectual journey filled with difficulties, but ultimately rewarding in unexpected ways. I am leaving graduate school, albeit later than expected, as a more dedicated and experienced scientist who has adopted a four field anthropological research approach. This was not only the result of the mentorships and the education I received from the University of California-Santa Barbara's Anthropology department, but also from friends and colleagues, who have inspired, encouraged, and taught me along this life's journey called "Grad School".

First, I would like to thank the National Science Foundation for funding my early graduate school career through a Graduate Research Fellowship and the Wenner-Gren Foundation for funding my dissertation project.

Importantly, I must also thank Rosemary Cambra and the Muwekma Ohlone Tribe for their unwavering support for not only this project but also for the use of ancient DNA in further understanding not only their own history but also that of all humans. As a consequence of the Muwekma Tribe's forethought in preserving scientific material and active participation n in anthropological research, the Yukisma site will become one of the most thoroughly studied archaeological sites in California and represents a model for future multidisciplinary research of this kind. It is truly awesome and humbling that I was able to be involved in this project.

My dissertation committee has been immensely helpful in fulfilling my goals. To Dr. Michael Glassow, thank you for your encouragement and patience, but also your sound and frank advice. You expect the best out of people, but you also make it known that it is ultimately achievable. You made me want to do better. I have learned a lot from your classes (in particular your class on subsistence and archaeology) and can only hope to be as respected in California archaeology as you.

To Dr. Lynn Gamble, thank you for agreeing to be on my committee at such a late date and due to sad circumstances. I have left every meeting or conversation with you more inspired, and frankly more knowledgeable. I only wish that you had arrived at UCSB earlier so that I could have learned from you further. Your comments and suggestions have made this dissertation a more sound work, and I look forward to potentially collaborating with you in the future.

To Dr. John Johnson, you have been a wonderful mentor and teacher. I am also privileged to call you a friend. You share my desire to integrate both aDNA and archaeology, as well linguistics and ethnohistory. We both aspire to understand genetics within a defined historical and prehistoric context, which is truly a rarity. I can discuss with you most any topic pertaining to California prehistory and every DNA discovery I encounter, I want to discuss it with you. I look forward to many years of partnership and collaboration in trying to navigate this rather new field of molecular archaeology!

To my advisor Mike Jochim, thank you for so many years of steadfast support. You have always given me the encouragement and freedom to explore my academic goals even when they may shift from your expertise. I came to Santa Barbara wanting to explore the genetics among early European chiefdoms and left exploring the ancient DNA of foragers in California! This is entirely due to your influence and your classes on anthropological and archaeological theory of hunter and gatherers. I had come to graduate school somewhat disillusioned with CRM field work in California, but your teaching inspired me, and really made me love this sub-discipline again. So while I abandoned a regional interest (Central Europe), I regained which would become a shared theoretical focus. I am not only proud, but also lucky to have had you as my advisor. I would not be working at what I love to do without your influence.

To the support staff at UCSB, Daniel Meza and Robin Roe, thank your for keeping me in the loop, and delivering paperwork and retrieving signatures during my absence from Santa Barbara. It is staff like you that allows the academic system to function and thrive.

I must also thank David Glenn Smith, from UC Davis. David, so much of my success with molecular anthropology is due to your confidence in me. I came to work in your lab with no experience and left ready, willing, and able to tackle the the complications involved with ancient DNA research. You took a real chance on me and believed I could succeed in your lab. The environment which you created at UC-Davis is one of real collaboration and sharing, truly I have never since been in a laboratory with such a shared interest in practicing science and understanding the past through biology. Thank you, Thank you.

Ripan Malhi, I appreciate all your help and support over the years. You thought it would be “brilliant” if I joined the Smith Lab even without knowing anything about DNA; it turns out you were right. Thank you also for replicating ancient DNA results on this and so many other projects, as well as writing letters of recommendation and collaboration on various grant applications. You have been a dear friend for many years.

Chris Morgan, you were one of only a few to believe in my abilities when I first came to Davis, California when no one else would and you were the first to take a chance and get me a job doing what I loved, which was archaeology. You were especially supportive of me incorporating ancient DNA into my work. Thank you. As the French would say, Il est bon d'avoir des amis partout!

Alan Leventhal, your guidance and wholehearted participation in this project has been instrumental to its success. Thank you for all your comments and critiques over these many years. In reality, a lot of the research done to date on the Yukisma Mound would not exist without your active encouragement, and this dissertation is the better for it.

Karen Gardner, the data you collected, as well as the compilation of burial records you completed for your thesis was extremely important to my analysis. Thank you for sharing your appendices and tables. Your work laid the foundation for this dissertation! Along this journey, I think we also became friends. In the same vein, Viviana Bellifemine, thank you for sharing the raw data you used in your original spatial analysis of the site.

Jelmer Eerkens and Gary Breschini, thank you for allowing me to analyze and use data from the samples you provided. Gary, I also appreciate the time and consideration it took to review early drafts of this work.

My friends and colleagues at Washington State University (WSU) played a huge role in my ability to finish this dissertation. Patty Brandt, Jess Boyd, Glenn Miller, Ron Lengacher, thank you for your help in managing all of the grant accounts and purchasing supplies, your help was invaluable. Kerry Darnell and Holly Dawkins at University Publishing also provided wonderful editing for this work.

In the Anthropology department at WSU, I would like to thank Andrew Duff, Colin Grier, Courtney Meehan, Luke Premo, and Rob and Marsha Quinlan. Thank you all for your willingness to edit grant proposals, listen to my ideas regarding my dissertation, and offer suggestions and ideas for improvement. Maggie and Marsha, thank you so much for taking care of my infant son while I was in the final stages of writing. It really does take a village.

I would also like to acknowledge and thank all the students, both undergraduate and graduate, who have volunteered their time to collect data from SCL-38 and other regional sites. This includes Misa Winters (research associate extraordinaire), Eric Leci Jr (DNA superstar), Fernando Villanea, Kathleen Judd, Constanza de la Fuente Castro, and Xanthe Dimas. Collecting ancient DNA data on this scale was a huge undertaking and it would not have been possible without your assistance.

To my family, Jim, Mindy, Travis, Nolan, Mark and Erica your encouragement and love has made this possible. To my mother and father in-law Diane and Greg Kemp, you have always made me feel loved and part of the family, and these final months of writing were only made possible with your help caring for Page. Dad, your pride in me completing this degree, was a rally call when I wanted to quit. Mom, you are and have always been my best friend. You have been through every tough challenge, and every happy moment, not just with school but all aspects of my life. I do not know how I could completely acknowledge all you have provided me with except to say I love you and thank you with all my heart.

Brian Kemp, my husband, and partner. We have been through the storm of two dissertations now. Looking back through more than a decade, we made it through four cross country trips, five different universities- with four labs, numerous and sometimes arduous treks doing fieldwork, five cats and finally a baby boy. I initially learned everything I know about ancient DNA from you, and together over the years we have tackled the “vagaries” (as you call them) of ancient DNA together, through discussions, brainstorming and research. Yet, we have also grown academically without sacrificing our own personal identities. Together as a team, we are smarter, more successful, just better. This Ph.D. dissertation would not exist without your support and confidence in me. You are the love of my life and the inspiration for everything I do.

Finally, to my beautiful baby son Page, your arrival into this world jump started the final chapter of this journey and I am so glad it did. It was you, my darling, who made me realize that completing this dissertation was not just a labor of love for me but for you too.

VITA OF CARA R. MONROE

April 2014

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EDUCATION

2005-Present PhC/ABD, Anthropology, University of California, Santa Barbara. Advisor: Dr. Michael Jochim

My research primarily utilizes ancient DNA to investigate hunter-gatherer/forager biological interaction, relatedness of prehistoric populations at the inter- and intra-site level, emergence, and maintenance of sociopolitical complexity and mortuary analyses. My dissertation work analyzed mitochondrial DNA from over 200 burials from the Yukisma cemetery site in Santa Clara County, CA. This Late Period site potentially displayed hierarchical structure according to wealth, status, and biological relatedness. Additional research focuses on forensic DNA methodology, aDNA of animal domesticates, and human populations in American Southwest, Peru, and Western North America, including Southeastern Alaska.

2005	M.A.	Anthropology, University of California, Santa Barbara. Archaeology
1999	B.A.	Anthropology, University of Michigan, Ann Arbor. Archaeology

PROFESSIONAL EXPERIENCE: Molecular Anthropology

2009-2013. **Research Associate.** Department of Anthropology. Washington State University.

Research centered on National Institute of Justice Grants (2008-DN-BX-K008 and 2011-DN-BX-K549) which were conducted in the Molecular Anthropology and Ancient DNA Laboratory at Washington State University under the direction of Dr. Brian M. Kemp. The first grant focused on completing principal research experiments which tackled the three most problematic methodological issues encountered by forensic and ancient DNA researchers: inhibition, contamination, and DNA damage. The second project focused on testing the efficacy of three different “DNA capture” methods for enriching CODIS STR marker DNA in low copy number and degraded samples in order to improve forensic DNA profiling.

Additional obligations included supervising undergraduate and graduate students, day-to-day laboratory operations, and facilitation of research designs and experiments with postdoctoral researcher and laboratory technicians. Side projects included analyzing both faunal and human DNA from various prehistoric sites in California, Baja California, American Southwest, Northwest Coast, Nepal, Peru, and Mesoamerica as well as extant human populations in Southeastern Alaska.

2007-2009. **Research Faculty.** School of Biological Science. Washington State University.

Assisted in the development and maintenance of the Washington State University Molecular Anthropology and Ancient DNA Laboratory. Additionally managed all laboratory business such as professional correspondence, safety inspections, equipment upkeep, chemical and sample inventory, safety training, proper management of bio hazardous material, and training of all undergraduates in procedures and protocols (DNA extraction, PCR, etc.) of the laboratory. Research focused on extraction and analysis of mitochondrial DNA from various prehistoric human remains from Western North America in order to study migration patterns and paleodemography.

2006. **Ancient DNA Contractor.** Trace Genetics, Richmond, CA.

Extracted and analyzed human and pathogenic DNA from ancient skeletal material from North and South America. Supervised by Dr. Ripan S. Malhi and Dr. Jason Eshleman.

2005-2006. **Graduate Student Researcher.** Laboratory of Molecular Anthropology. University of California- Davis, Department of Anthropology.

Research included mitochondrial DNA and Y-chromosomal DNA analysis of extant Native American populations in Southwestern United States and Baja California under the supervision of Dr. David Glenn Smith. Additional research focused on ancient DNA analysis of skeletal material from Peru, England, Jamaica, and various other regions of North America.

2001-2003. **Post-Graduate Researcher/Laboratory Manager.** Laboratory of Molecular Anthropology. University of California-Davis, Department of Anthropology.

Research focused on extraction and analysis of nuclear DNA from multiple species of macaque and baboon for genetic management of primate colonies under the supervision of Dr. David Glenn Smith. Primate research also focused on locating geographic specific short tandem repeat markers (STRs) to determine origin of test subjects. Additional research included extraction and analysis of ancient and modern

DNA from Native American groups to study migration patterns, paleodemography, and gene variation. Techniques applied included silica and phenol-chloroform DNA extraction from bone, teeth, blood, hair, and cheek swabs, PCR, DNA sequencing, and STR and paternity analysis. Duties included managing all laboratory business such as professional correspondence, safety inspections, equipment upkeep, chemical and sample inventory, safety training, proper management of bio hazardous material, and training of all undergraduates in procedures and protocols (DNA extraction, PCR, etc.) of the laboratory.

PROFESSIONAL EXPERIENCE Archaeology

2000-2005 **Archaeological Field Technician.** Pacific Legacy Inc. (Sierra Division).

Performed excavation, survey, cultural monitoring, and site testing throughout California. Duties included report preparation, burial excavation, basic lithic analyses and levels of reduction, and Native American relations (notification of discovery of human remains), contacting and planning of Native American representation for future archaeological projects, liaison for clients and Native American groups.

2000-2001 **Archaeological Field Technician.** Far Western Anthropological Research Group.

Excavated, monitored, and surveyed numerous sites throughout California.

1999-2000 **Archaeological Field Technician.** Tremaine & Associates.

Extensive excavation, cultural monitoring, survey, and site testing throughout California. Duties included basic lithic analysis, artifact curation, accessioning, and cataloging, site record preparation and site record searches, osteological identification of human remains, and site mapping.

ACADEMIC ARCHAEOLOGICAL FIELD PROJECTS

2009 Cueva Santa Rita Archaeological Project, Baja California Sur.

Directed by Dr. Loren Davis, Oregon State University. Excavation of prehistoric cave sites.

2004 Benta Valley Archaeological Project, Szhazhlambatta, Hungary.

Directed by Dr. Timothy Earle, Northwestern University. Survey and site testing of over 30 Bronze Age settlements located in Northwestern Hungary.

2004 Federsee Archaeological Project, Beiberach, Germany.

Directed by Dr. Mike Jochim, University of California Santa Barbara. Excavation of Late Paleolithic and Mesolithic open-air sites.

2001 Beringa Archaeological Project, Arequipa, Peru.
Directed by Dr. Tiffiny Tung, Vanderbilt University. Burial excavation and bioarchaeological analysis of Middle to Late horizon Period Wari cemeteries.

2000 Dos Barbaras Archaeological Project, Orange Walk, Belize. Archaeological Field School.
Directed by Dr. Fred Valdez, University of Texas-Austin. Excavation of Late Classic Maya household sites. Duties included student supervision, excavation, survey, and ceramic reconstruction and analysis.

1999 Dos Barbaras Archaeological Project, Orange Walk, Belize. UCLA Archaeological Field School.
Directed by Dr. Brandon Lewis (Santa Monica College), project directed by Dr. Fred Valdez University of Texas Austin. Excavation of Late Classic Maya household sites. Duties included excavation, survey, and ceramic reconstruction and analysis.

1998 Northern New Mexico, Tewa Sites Archaeological Illustration Field School.
Directed by Dr. Richard Ford, University of Michigan. Surveyed and illustrated petroglyphs sites for the National Forest Service.

1997 Henderson Site, Southeastern New Mexico. Archaeological Field School.
Directed by Dr. John Speth, University of Michigan. Excavated portions of a pueblo that defined various periods of site abandonment. Work focused on ceramic, faunal, and groundstone analyses.

1996 Fort Michilimackinac Archaeological Project.
Directed by Dr. Lynn Morand, Michigan Department of Natural Resources. Site excavation and artifact processing.

PAPERS in Review

In Review. Smith RWA, **Monroe C**, Bolnick D. "Preservation of Cytosine Methylation in Ancient DNA from Five Prehistoric Native American Populations." ***PLoS ONE.***

PAPERS

2014. Barta JL, **Monroe C**, Teisberg JE, Winters M, Flanigan K, and Kemp BM. "One of the Key Characteristics of Ancient DNA, Low Copy Number, May Be a Product of Its Extraction." ***Journal of Archaeological Science 46: 281-289.***

2014. Barta JL, **Monroe C**, Crockford SJ, and Kemp BM. “Mitochondrial DNA Preservation Across 3500 Year Old Northern Fur Seal Ribs is Not Related to Bone Density: Implications for Forensic Investigations.” ***Forensic Science International 239:11-18.***

2014. Kemp BM, **Monroe C**, Judd KG, Reams E, and Grier C. “Evaluation of Methods that Subdue the Effects of Polymerase Chain Reaction Inhibitors in the Study of Ancient and Degraded DNA.” ***Journal of Archaeological Science. 42:373–380.***

2013. **Monroe C**, Kemp BM, Smith DG. “Exploring Southwest Prehistory with Mitochondrial DNA Diversity Exhibited by Yumans and Athapaskans.” ***American Journal of Physical Anthropology 150 (4):618-631.***

2013. **Monroe C**, Grier C, Kemp, BM. “Evaluating the Efficacy of Various Thermo-stable Polymerases against Co-extracted PCR Inhibitors in Ancient DNA Samples.” ***Forensic Science International 228:142–153.***

2013. Barta JL, **Monroe C**, and Kemp BM. “Further Evaluation of the Efficacy of Contamination Removal from Bone Surfaces.” ***Forensic Science International 231:340–348.***

2013. Villanea FA, Bolnick D, **Monroe C**, Worl R, Cambra R, Leventhal A, and Kemp BM. “Evolution of a Specific O Allele (O1vG542A) Supports Unique Ancestry of Native Americans.” ***American Journal of Physical Anthropology 151 (4):649–657.***

2012. Jenkins DL, Davis LG, Stafford TW, Jr., Campos PF, Hockett B, Jones GT, Cummings LS, Yost C, Connolly TJ, Yohe RM, 2nd, Gibbons SC, Raghavan M, Rasmussen M, Paijmans JL, Hofreiter M, Kemp BM, Barta JL, **Monroe C**, Gilbert MT, and Willerslev E. “Clovis Age Western Stemmed Projectile Points and Human Coprolites at the Paisley Caves.” ***Science 337:223-8.***

2012. Johnson JR, Kemp BM, **Monroe C**, Lorenz JG. “A Land of Diversity: Genetic Insights into Ancestral Origins.” In Jones T and Perry JE (eds.) ***Contemporary Issues in California Archaeology 49-72.***

2011. Winters M, Barta JL, **Monroe C**, Kemp BM. “To Clone or Not To Clone: Method Analysis for Retrieving Consensus Sequences In Ancient DNA Samples.” ***PLoS ONE 6 (6).***

2010. Kemp BM, Gonzalez-Oliver A, Malhi RS, **Monroe C**, Schroeder KB, McDonough J, Rhett G, Resendez A, Peñaloza R, Buentello L, Gorodesky C, and

Smith DG. "Mitochondrial DNA and Y-chromosome variation in the Southwest and Mesoamerica: Testing the Farming/Language Dispersal Hypothesis." ***Proceedings of the National Academy of Sciences USA 107(15):6759-64.***

2010. Speller CF, Kemp BM, Wyatt SD, **Monroe C**, Lipe WD, Arndt UM, and Yang DY. "Ancient Mitochondrial DNA Analysis Reveals Complexity of Indigenous North American Turkey Domestication." ***Proceedings of the National Academy of Sciences USA. 107(7): 2807-2812.***

2007. Kemp BM, **Monroe C**, and Smith DG. "Extraction and Analysis of DNA from Archaeological Specimens". In MD Glascock and RJ Speakman (eds.): ***Archaeological Chemistry: Analytical Techniques and Archaeological Interpretation.***

2006. Kemp BM, **Monroe C**, and Smith DG. "Repeat Silica Extraction: A Simple Technique for the Removal of PCR Inhibitors from DNA Extracts." ***Journal of Archaeological Science 33: 1680-1689.***

PRESENTATIONS

2013. Monroe C, Lenci, EL, Leventhal A, Cambra R, Kemp BM. "Ancient human DNA analysis from CA-SCL-38 Burials: Correlating Biological Relationships and Mortuary Behavior." Paper presented at the 78th Annual Meeting of the Society for American Archaeology, Honolulu, HI.

2013. Monroe C, Gardner KS, Lenci EL, Leventhal A, Cambra R, Bartelink EJ, Kemp BM. "Mystery Men of Yukisma: Ancient DNA and Stable Isotope Data used to Deduce the Origin and Relationship of an Unusual Group Burial at CA-SCL-38". Presented at the 47th Annual Meeting of the Society of California Archaeology, Berkeley, CA.

2013. Lenci, EL, **Monroe C**, Villanea F, Leventhal A, Cambra R, Kemp BM. "Ancient human DNA analysis from the San Francisco Bay Area: Interpreting Ohlone History through Genetics." Poster presented at the 78th Annual Meeting of the Society for American Archaeology, Honolulu, HI.

2012. Monroe C. "Ancient Human DNA Analysis from CA-SCL-38 Burials: Correlating Biological Relationships, Mortuary Behavior, and Social Inequality." Invited presentation, November 21, University of Nevada Reno.

2012. Monroe C. "Correlation of Genetic Relationships and Mortuary Behavior: Ancient human DNA (aDNA) Analysis from a San Francisco Bay Area Earth Mound." Invited presentation, November 7, Facultad de Ciencias Sociales, Universidad de Chile, Santiago, Chile.

2012. Barta JL, **Monroe C**, Teisberg J, Winters M, Flanigan K, Kemp BM. "One of the Key Characteristics of Ancient and Forensic DNA, Low Copy Number, May Be a Product of Its Extraction." Poster presented at the National Institute of Justice Conference, Arlington, VA.

2011. **Monroe C**, Barta JL, Kemp BM. "Overcoming PCR Inhibitors of Degraded DNA using Various Thermostable Polymerases." Poster presented at the National Institute of Justice Conference, Arlington, VA.

2011. **Monroe C**, Gonzalez S, Johnson JR, Kruszynski R, Kemp BM. "Ancient DNA Analysis of Prehistoric Burials from the Santa Barbara Channel Region." Paper presented at the 45th Annual Meeting of the Society of California Archaeology, Rohnert Park, CA.

2011. Monroe C, Villanea F, Leventhal A, Cambra R, Kemp BM. "Ancient human DNA analysis from CA-SCL-38 Burials: Correlating Biological Relationships and Mortuary Behavior." Paper presented at the 45th Annual Meeting of the Society of California Archaeology, Rohnert Park, CA.

2011. Monroe C, Villanea F, Leventhal A, Cambra R, Kemp BM. "Ancient human DNA Analysis from CA-SCL-38 Burials: Elucidating Biological Relationships." Paper presented at the 76th Annual Meeting of the Society for American Archaeology, Sacramento, CA.

2011. Villanea FA, **Monroe C**, Runnells S, Leventhal A, Cambra R, Kemp BM. "Sequence variation of O haplotypes in pre-Columbian Native Americans and its Relevance for Native American Evolution." Paper presented at the 80th Annual Meeting of the American Association of Physical Anthropologists. Minneapolis, MN.

2011. Barta JL, **Monroe C**, Kemp BM. "Evaluating the Efficacy of Household Bleach in the Removal of Contamination from Bone Surfaces." Poster presented at the 80th Annual Meeting of the American Association of Physical Anthropologists. Minneapolis, MN.

2011. Kemp BM, Barta JL, **Monroe C**, Teisberg J, Runnells S, Flanigan K. "One of the Key Characteristics of Ancient DNA, Low Copy Number, May Be a Product of Its Extraction." Poster presented at the 80th Annual Meeting of the American Association of Physical Anthropologists. Minneapolis, MN.

2011. Runnells S, **Monroe C**, Barta JL, Kemp BM. "To Clone or Not to Clone: Method Analysis for Retrieving Consensus Sequences in Ancient DNA Samples."

Poster presented at the 80th Annual Meeting of the American Association of Physical Anthropologists. Minneapolis, MN.

2010. Barta JL, **Monroe C**, Kemp BM. “Evaluating the Efficacy of Bleach in the Removal of Contamination from Bone Surfaces.” Poster presented at the National Institute of Justice Conference, Arlington, VA.

2010. Monroe C, Gonzalez S, Johnson JR, Kruszynski R, Kemp BM. “Ancient DNA Analysis of Prehistoric Burials from the Santa Barbara Channel Islands.” Paper presented at the 11th Bi National Meeting of Balances and Perspectives on Anthropology and History of Baja California. Ensenada, Baja California.

2010. **Monroe C**, Gonzalez S, Johnson JR, Kruszynski R, Kemp BM. “Ancient DNA Analysis of Prehistoric Burials from the Santa Barbara Channel Region.” Paper presented at the 75th Annual Meeting of the Society for American Archaeology, St. Louis, MO.

2010. Kemp, BM, **Monroe C**, Geib P, Matson RG, Lipe WD. “Genetic Analysis of Coprolites from Southeastern Utah.” Paper presented at the 75th Annual Meeting of the Society for American Archaeology, St. Louis, MO.

2009. Monroe C, Leventhal A, Cambra R, Kemp BM. “Ancient Human DNA Analysis from CA-SCL-287/CA-SMA-263 Burials: New Insights Regarding California Prehistory.” Paper presented at the 43rd Annual Meeting of the Society of California Archaeology. Modesto, California.

2009. Monroe C, Kemp BM. “The Biological Relationships of Prehistoric Baja California Populations: An Ancient DNA Perspective.” Paper presented at the 9th Bi National Meeting of Balances and Perspectives on Anthropology and History of Baja California. Tecate, Baja California.

2009. Kemp BM, **Monroe C**. “NIJ Project to Enhance Methods for Studying Degraded DNA.” Poster presented at the National Institute of Justice Conference, Arlington, VA.

2009. Kemp BM, **Monroe C**, Lipe WD, Matson RG. “Genetic Analysis of Basketmaker II Coprolites from the Turkey Pen Ruins Site in Southeastern Utah.” Paper presented at the 74th Annual Meeting of the Society for American Archaeology. Atlanta, Georgia.

2008. Monroe C, Kemp BM, Smith DG. “Mitochondrial DNA Analysis Provides Evidence for an Ancient Southwest Population Expansion.” Paper presented at the 73rd Annual Meeting of the Society for American Archaeology. Vancouver, British Columbia.

2008. Monroe C, Kemp BM, Smith DG. “Southern California, Baja California, and Southwest Prehistory: Genetic Evidence for Population Interaction.” Invited Plenary Speaker. Paper presented at the 42nd Annual Meeting of the Society of California Archaeology. Burbank, California.

2006. Monroe C, Kemp BM, Smith DG. “Mitochondrial DNA variation of Yuman Speaking Populations.” Poster presented at the Languages and Genes Conference. UC Santa Barbara.

2006. Monroe C, Kemp BM, Smith DG. “Mitochondrial DNA Evidence Supports Historic Documentation of Yavapai-Apache Interaction.” Poster presented at the 71st Annual Meeting of the Society for American Archaeology. San Juan, Puerto Rico.

2006. Monroe C, Kemp BM, Smith DG. “Mitochondrial DNA Variation of Yuman Speaking Populations.” Poster presented at the 75th annual meeting of the American Association of Physical Anthropologists. Anchorage, AK.

2006. Kemp BM, **Monroe C**, Smith DG. “Ancient DNA 101: A Guide for Archaeologists.” Poster presented at the 71st Annual Meeting of the Society for American Archaeology. San Juan, Puerto Rico.

2006. Rega E, **Monroe C**. “Human Skeletal Remains from Somerville Cave, Clarendon County, Jamaica.” Paper presented at the 71st Annual Meeting of the Society for American Archaeology. San Juan, Puerto Rico.

2005. Kemp BM, Reséndez A, Malhi RS, **Monroe C**, Rhett G, Smith DG. “Mitochondrial DNA variation among populations of Mesoamerica and the American Southwest: does Uto-Aztecan represent a biological unit?” Paper Presented at the 74th Annual Meeting of the American Association of Physical Anthropologists. Milwaukee, WI.

TEACHING EXPERIENCE

Fall 2013. ***Guest lecturer***, Introduction to Physical Anthropology: Anthropology 260. Washington State University.
Fall 2011. ***Instructor***, Sex, Evolution, and Human Nature: Anthropology 468-01, 468-02. Washington State University.
Fall 2011. ***Guest Lecturer***, Introduction to Osteology: Anthropology 380. Washington State University.
Fall 2009. ***Instructor***, The Americas Before Columbus: Anthropology 331. Washington State University.

Spring 2008. ***Instructor***, Introduction to Physical Anthropology: Anthropology 260. Washington State University.
Spring 2006. ***Guest Lecturer***, Anthropology 101. Sierra College, Rocklin, CA.
Spring 2004. ***Teaching Assistant***, Introduction to African American Literature from 1860's to the Present: Black Studies 38B, UC Santa Barbara.
Winter 2004. ***Teaching Assistant***, Introduction to African American Literature from 1500's to 1860's: Black Studies 38A, UC Santa Barbara.
Fall 2003. ***Teaching Assistant***, Introduction to Cultural Anthropology: Anthropology 2, UC Santa Barbara.

GRANTS, AWARDS, and FELLOWSHIPS

June 2012-June 2013. Wenner-Gren Foundation Dissertation Grant $19,880. Ancient human DNA analysis from CA-SCL-38 Burials: Correlating biological relationships, mortuary behavior, and social inequality. Additional travel funds from the Osmundsen Initiative ($4,980) used to support and train Native American student in ancient DNA techniques.

April 2004-June 2007. National Science Foundation Graduate Research Fellowship Recipient.

PROFESSIONAL MEMBERSHIPS

American Association of Physical Anthropologists
Society for American Archaeology
Society of California Archaeology

JOURNAL REFEREE EXPERIENCE

American Journal of Physical Anthropology
American Antiquity
BMC Evolutionary Biology
Journal of Archaeological Science
PLOS One

ABSTRACT

Correlating Biological Relationships, Social Inequality, and Population Movement among Prehistoric California Foragers: Ancient Human DNA Analysis from Yukisma (CA-SCL-38).

by

Cara Rachelle Monroe

Reconstruction of regional North American prehistory has benefited from the incorporation of ancient DNA evidence. However, few studies focus on intra-site genetic variation, associate these relationships to mortuary assemblages, or link these variables to social ranking. The Late Period (900 BP-250 BP) in the San Francisco Bay area witnessed shifts in settlement patterns that included mortuary treatment distinct from earlier periods. The change in mortuary pattern is interpreted either as a reduction in social inequality, a shift toward corporate group identity based on kinship, or an emergence of a lesser number of differentiated elites with control over high status resources.

Mitochondrial DNA (mtDNA) data was collected from 200 individuals from CA-SCL-38 (Yukisma Mound), hereafter referred to as SCL-38 as well as 102 additional burials from 15 other archaeological sites in the region to test for a relationship between direct maternal kinship (i.e., genetic relatedness as revealed by mtDNA), grave goods, and burial patterns. This was ultimately done to determine whether spatial patterns at SCL-38 are associated with the emergence/maintenance of social differentiation and inferred social inequality. These data were additionally used at the inter-site level to explore the hypothesized spread of Penutian populations and to document genetic continuity in the San Francisco Bay area through time.

Results indicate that maternal relatedness is not correlated to the spatial distribution of burials within the cemetery. Additionally, no associations are noted between particular mtDNA haplotypes and burials with high quantity or diversity of grave goods. Thus, the overall placement of burials at SCL-38 are random with respect to direct maternal relationships. However, regardless of mortuary assembleges, there are some subgroupings within the cemetery of individuals related at the maternal level. The heterogenous distribution of mtDNA lineages across the spatial extent of the site may instead reflect its use as a regional cemetery for select, perhaps wealthy elite, individuals who originated from the surrounding Bay area. It remains possible that patterning along the paternal line or the lack of temporal refinement is confounding other underlying genetic structure. Across the landscape, however, mtDNA lineages are identified that correspond with the hypothesized influx of Proto-Utian (Penutian) speakers into the San Francisco Bay area by the end of the Early Period and beginning of the Middle Period. Additonal haplotypes are also identified that are probably older than 7,000 BP in the region, most likely representing maternal lineages orignally belonging to ancestral Hokan speakers.

Most mtDNA haplotypes discussed represent at least 2,000 years of genetic continuity in the region.

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APPENDICES

I. Introduction

Numerous investigations of mitochondrial DNA (mtDNA) variation have been made over the past decade to supplement archaeological, cultural, and linguistic evidence in order to reconstruct North American population prehistory. Most of these genetic studies, using both ancient and modern DNA from extant populations, have been used to explore the hypothesized spread of major language families across the continent, population migration and genetic continuity through time, and the timing and spread of the initial peopling of the Americas. (While not a complete list, see Barrantes et al. 1990; Bolnick and Smith 2003; Carlyle et al. 2000; Cui et al. 2013; Eshleman 2002; Eshleman et al. 2004; Eshleman and Smith 2007; Hayes 2002; Johnson et al. 2012; Johnson and Lorenz 2006; Kaestle and Smith 2001; Kemp 2010; Kemp et al. 2007; Kemp and Schurr 2010; Kolman and Bermingham 1997; Kolman et al. 1995; Lalueza-Fox 1996; Lalueza-Fox et al. 2003; Lalueza-Fox et al. 2001; Malhi et al. 2004; Malhi et al. 2003; Parr et al. 1996; Potter 2004; Rasmussen et al. 2014; Rasmussen et al. 2010; Saillard et al. 2000; Shields et al. 1993; Smith et al. 2005; Stone and Stoneking 1993; Stone and Stoneking 1999; Tamm et al. 2007; Torroni et al. 1994; Torroni et al. 1992). However, considerably less focus has been placed on studying genetic variation exhibited at the intra-site level. While much has been learned about prehistory through mtDNA evidence, a large number of previous studies have focused on broad scale comparisons of language families, an action that could obscure fine scale genetic differentiation of populations. This is particularly true for ancient Central California populations, who have previously been characterized by small population sample sizes that were lumped together into temporal (Middle Horizon/Period) or regional (Central Valley) units to produce a convenient comparative sampling (Eshleman 2002; Eshleman et al. 2004; Schroeder et al. 2011). This strategy disregards any subdivisions or localized genetic differentiation that may reveal as yet unknown aspects of both local prehistory and past population interactions at the biological level. This is especially problematic as archaeological, ethnographic, and linguistic evidence from Central California and the San Francisco Bay area suggest a complex culture history of dynamic regional interactions and migration, as well as the possible emergence of varying levels of hereditary social stratification. However, the degree of social inequality remains a contentious topic as there are diachronic and sub-regional variations characterized by territorial competition, and overexploitation of resources resulting in periods of site abandonment, aggregation, and social reorganization. A shift in grave good distribution during the Late Period (1000-250) before present (BP), which emphasized a reduced number of total artifacts, but an increase in exotic labor-intensive mortuary goods, has simultaneously been interpreted as an increase, as well as a reduction in overall social inequality. The latter is argued to be a shift toward an egalitarian corporate group identity, one based solely on kinship, which negated ascribed status (Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006; Milliken et al. 2007).

Unraveling the population dynamics of the region is further compounded by the proposed multiple waves of migration of Penutian speakers into the Central Valley and San Francisco Bay area between 4500 BP and 1500 BP (Breschini 1983; Breschini 1997; Levy 1978; Moratto 1984). The level of admixture, if any, that occurred between older Hokan speaking populations and the more recently arrived Penutians into the San Francisco Bay is not yet documented or understood, nor is the extent of genetic continuity or lineage extinction through any given archaeological period. This has additional implications for local prehistory if site abandonment was occurring during any given time period.

This dissertation will address these issues by analyzing ancient DNA (aDNA) from the Late Period cemetery site of CA-SCL-38 ("Yukisma"), hereafter referred to as SCL-38, located in northern Santa Clara Valley of California (South San Francisco Bay area). Previous research hypothesized that the site was spatially structured according to not just age and sex, but status as well (Bellifemine 1997). Collected aDNA data from over 200 burials are tested for correlations between the maternal genetic relatedness of individuals, grave goods, and burial patterns. This will determine if differential, lineage-based prehistoric mortuary practices and ultimately burial patterns associated with the emergence/maintenance of social differentiation existed in Central California at a biological level. Combined, these data, with additional mtDNA haplotype information collected, by the author, from 15 other regional sites (dating 3870-169 BP), will also allow temporally-discrete reconstruction of maternal lineage relationships across the San Francisco Bay area through the calculated minimal dates of coalescent events between lineages. Consequently, it will also help elucidate the timing and geographic spread of Penutian populations throughout Central California during prehistory, providing an inter-site perspective of maternal DNA lineages across the landscape. This represents another step in a long-term project that will collect data on modern and ancient DNA variation throughout all of California, with the intent to utilize genetic data to understand the outcomes of cultural and biological interactions between and among ancient foragers.

A glossary of genetic terms as well as a list of abbreviations used throughout the text is provided in Appendix A and Appendix B.

II. Environment, Culture Patterns, Chronology, and Mortuary Practices

San Francisco Bay Environment

The San Francisco Bay region boasts the largest estuary system in California and includes San Pablo Bay, Carquinez Strait, and Suisan Bay to the north, the entirety of the San Francisco Bay to the south, and all peripheral channels and tidelands. Divided into three sub-regions (North, Central, and South Bay) (Figure 1), the region is composed of approximately 1100 square km of waterways, which was probably closer to 1800 square km prior to the Gold Rush and the subsequent massive silting (Moratto 1984). Situated on a narrow Pliocene-era depression that frequently flooded throughout the Pleistocene interglacials, the San Francisco Bay's most recent inundation occurred between 8,000 BP and 10,000 BP. This drastically altered the coastline and resulted in the destruction or flooding of Paleoindian coastal sites. For example, by 15,000 BP the shoreline was 25 km west of San Francisco Bay's current beaches (Milliken et al. 2007; Moratto 1984).

A heterogeneous mix of microclimates converged in narrow zones and was centered on a complex estuarine system that began to emerge 8000-6000 BP ago when the sea level approached its current height. This mix consisted of freshwater and marine tidal marshes, riparian chaparral corridors along creeks and river systems, and inland hills and coastal shorelines consisting of interspersed plant communities of mixed hardwood and evergreen forests as well as oak and prairie grasslands.

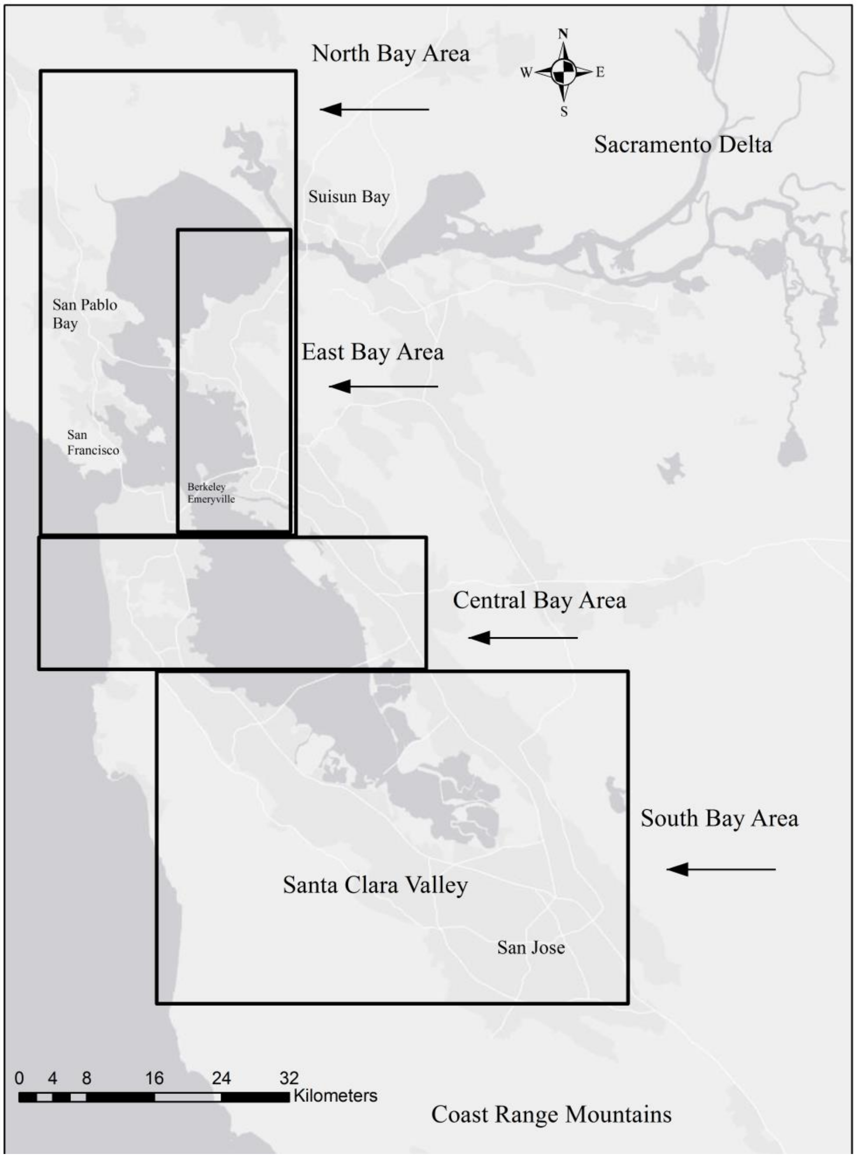

Figure 1. Map of the San Francisco Bay and Regional Subdivisions.

These biotic communities would have changed continuously throughout prehistory, but stable tidal marshes appeared around 6000 BP in the North Bay. However, an established marshland system did not develop for Central Bay until 3000 BP, and not until 2000 BP for the South Bay shoreline (Hylkema 2002; Lightfoot and Luby 2002; Moratto 1984). These environments were extremely productive, being composed of not only a large number of individuals within each species (e.g., mussels) but also high levels of species diversity due to the convergence of ecological zones. The development and fluctuation of these biomes throughout prehistory resulted in a range of possible subsistence strategies, as well as settlement patterns. One such strategy included the advent of storage and exchange systems, which have been hypothesized as the catalysts that increased sociopolitical complexity in the region, culminating in institutionalized leadership roles, corporate kinship groups, and social coalitions that ameliorated periods of poor food productivity and overexploitation of resources (Hylkema 2002).

San Francisco Bay-Area Chronology and Culture History

The current state of understanding for San Francisco Bay prehistory can be seen as a byproduct of early regional archaeological paradigms and the ensuing reactionary stances against these earlier viewpoints, in particular the view that the region was a model for cultural stasis. The result was the production of a cultural chronology heavily influenced by a culture history perspective, and what some might argue is an overemphasized neo-evolutionary framework. Implicit is the assumption of a progression of increasing complexity through time. However, recent work has moved beyond simple site descriptions and narrow evolutionary viewpoints and aims to understand the area at both inter- and intra-site levels. This has further allowed archaeologists to identify meaningful patterns of behavior and adaptations across space and time (Eerkens et al. 2013; Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006; Luby and Gruber 1999).

The first comprehensive investigation of the region was directed by Nels Nelson from 1906 to 1908, during which 425 earth and shell mounds were identified. Ultimately it was these ubiquitous features across the landscape that led Nelson to recognize the San Francisco Bay as a distinct cultural area, albeit one that experienced little economic change through multiple millennia (Nelson 1909). It was argued that the shell mounds were not specialized cemeteries similar to those associated with Mississippian cultures, but rather villages with constituent burials. Contrasting viewpoints existed, however, most notably that of Max Uhle (1907) who suggested that the large shell mound sites, such as Emeryville shell mound (ALA-309), went through diachronic changes in occupation. Within a decade of Uhle and Nelson's initial investigations, a total of 11 sites had been targeted for long term excavation and analysis including West Berkeley (ALA-307), Fernandez (CCO-259), and Stege Mound (CCO-298; -300) complexes (Gifford 1916). All supported the presence of a San Francisco Bay culture that dated to at least 3000-4000 BP, one that was somewhat distinct from what existed in the Sacramento Delta Region. Yet the idea that prehistoric Bay area populations were culturally stagnant was a persistent notion and this idea was perpetuated until the late 1920s by archaeologists such as W.E. Schenck as well as by leading authorities of California culture such as A.L. Kroeber. All future chronologies were either directly or indirectly, positively or negatively, affected by Kroeber's viewpoints (Breschini 1983; Kroeber 1909; Kroeber 1925; Kroeber 1936b; Lightfoot 1997; Moratto 1984). In particular, his concept of "culture area" and "diffusion" placed the apex or "climax" of Central California culture within the Sacramento Delta, followed by outward diffusion toward the San Francisco Bay (Kroeber 1936a). This had significant effects on chronology for the region.

By the late 1930s, the first widely accepted chronological sequence for all of Central California was created and became a precursor to the Central California Taxonomic System (CCTS). Originally proposed by Lillard, Heizer, and Fenenga (1939), the schema was divided into three periods: Early, Transitional (Middle), and Late. Each period was demarcated by differing mortuary patterns (in particular, burial orientations and grave good typologies of shell beads and ornamentation).

As this model gained acceptance it was refined and expanded to include the Bay area and continued to highlight elements of progressive development across both time and space (Beardsley 1948; Beardsley 1954; Heizer 1949; Heizer and Fenenga 1939). The Early Horizon gave rise to the Middle (Transitional) Horizon, which then gave rise to the Late Horizon. However, the Delta Region was still treated as a cultural epicenter with a sphere of influence that spread, with varying levels of success, into other nearby localities. Heizer (1949) argued that Bay-area peoples were both marginal and culturally static (Heizer 1949; Lightfoot 1997). However, it was more likely that these ideas were an extension of Kroeber's rationale that only coastal areas populations experienced cultural change as a direct result of progress in the Delta Region (i.e., through diffusion or migration) (Breschini 1983; Moratto 1984).

Since its inception, the CCTS became the standard Bay- area classification system. Following WWII prominent archaeologists such as Beardsley, Bennyhoff, and Fredrickson continued to apply a culture history approach to their research, primarily refining chronologies by documenting burials, grave goods, and shell beads (Lightfoot and Luby 2002). However, even as early as the 1950s and 1960s, Bay area researchers acknowledged the less-than-perfect fit that their data had to the CCTS classification. This created a longstanding debate regarding the nature of the relationship between the Sacramento Delta and San Francisco Bay area, and the applicability of trying to force a chronological fit to archaeological data (Lightfoot and Luby 2002; Moratto 1984). The model ignored local variation, and its emphasis on culture history largely ignored explanatory processes of culture change pertinent to the emerging processual archaeology movement.

Based on additional discoveries from North and East San Francisco Bay and Sacramento/San Joaquin Delta Region, along with the application of absolute dating technology (radiocarbon and obsidian hydration), multiple adjustments were made to chronologies in the ensuing decades to accommodate observed sub-regional variations (Beardsley 1954; Bennyhoff and Fredrickson 1969; Bennyhoff and Heizer

1958; Bennyhoff and Hughes 1987; Fredrickson 1974; Milliken and Bennyhoff 1993). Further CCTS modifications were made along with the introduction of concepts such as district, pattern, and phase. These contributed to a new regional chronology termed Archaic-Emergent (Bennyhoff and Fredrickson 1994; Frederickson 1994b; Fredrickson 1974). However, all adjustments to the system were still placed within a cultural evolutionary framework that emphasized a progressive development in sociopolitical complexity from Early to Late periods (Lightfoot and Luby 2002).

The most prominent features of Fredrickson's temporal modifications were his observations regarding regional cultural patterns, such as Windmiller, Berkeley, and Augustine Patterns. These, along with Gerow's Early Bay Culture (Gerow with Force 1968) and Bennyhoff and Hughes' (1994) Meganos Intrusion/Aspect, are well defined archaeological traditions and are often used interchangeably with temporal horizons/periods such as Early or Middle Periods (Bennyhoff and Fredrickson 1994; Bennyhoff and Hughes 1987; Frederickson 1994b).

Most Bay area archaeologists now employ a hybrid chronology classification system that combines the tripartite Early, Middle, and Late Period organization of the CCTS (previously used by most South Bay researchers) and the Archaic-Emergent system (mostly used by North Bay and some Central Bay archaeologists). This chronology includes an Early Holocene component and firmly places the Berkeley and Augustine Patterns within the Middle Period and Late Period respectively (Lightfoot 1997; Milliken et al. 2007; Wiberg 1996). The major trends that occur within each of these redefined periods are summarized below. This hybrid chronology is employed for the remainder of this dissertation.

San Francisco Bay Hybrid Chronology:

The Early Holocene (10,000-5500 BP)

The Early Holocene is characterized by mobile foragers who exploited diverse resources such as shellfish, fish, sea mammals, deer, and seed plants from riverine and coastal environments. Artifact assemblages consisted of millingstones, handstones, and wide stemmed leaf-shaped projectile points (Milliken et al. 2007). Local Franciscan chert predominate the lithic assemblages; however, the presence of obsidian projectile points made from Napa Valley and Borax Lake obsidian suggests either high mobility and/or the beginnings of long-distance exchange networks (Milliken et al. 2007). Only a handful of burials have been documented to this period, the oldest of which dates to 8750-7490 BP (from CCO-696). Burials were isolated and grave goods generally absent, although two flexed burials dating to 7400-6900 BP from Santa Clara County were discovered beneath a cairn of millingstones (Milliken et al. 2007).

Early Period (5450-2450 BP)

Early Period sites exhibit cultural transitions in terms of settlement patterns, subsistence practices, and mortuary practices. Prehistoric inhabitants shift from broad-spectrum foragers to semi-sedentary forager/collectors, with a focus on regional trade networks. Mortar and pestles appear in this area after 5500 BP and by 3500 BP are favored over milling slabs and handstones, indicating an increasing reliance on storable resources such as acorns (Lightfoot and Luby 2002; Luby et al. 2006; Milliken et al. 2007). After 4000 BP, the period is defined by resource intensification, increased social stratification, and increased cooperation resulting from population growth (Lightfoot and Luby 2002; Lightfoot 1993; Luby et al. 2006; Milliken et al. 2007).

Early Period Mortuary Patterns

Early Period burials throughout Central California were often associated with red ochre and dorsally and ventrally extended with a westerly orientation. This pattern is affiliated with the Windmiller culture (4950-2450 BP), which was first identified in the Sacramento Valley/San Joaquin Delta, and is generally synonymous with the Early Period (Beardsley 1948; Beardsley 1954; Heizer 1949; Lillard et al. 1939; Meighan 1987; Ragir 1972) and parts of the Middle Period (Bennyhoff and Hughes 1987; Frederickson 1994b; Moratto 1984). Grave goods consisted of quantities of quartz crystals and perforated charmstones, stylized *Olivella* and *Haliotis* shell beads and ornaments, baked clay, larger sized projectile points, and a noticeable presence of millingstones. (Breschini 1983; Lightfoot 1997; Lillard et al. 1939; Moratto 1984). Windmiller burial types originated in the Sacramento Delta and radiated outward across the entirety of the Central Valley and into the San Francisco Bay (Heizer 1949). Interments distinct from the Windmiller style were considered atypical and often disregarded. An early examination of burial position and orientations by Heizer (1949) revealed that between 8.0%-14.8% of burials deviate from this expected pattern, yet the sites were interpreted as exclusively Windmiller (Eerkens et al. 2013). The connection of Windmiller to the Early Period is so prevalent that the absence of this mortuary pattern is equated to the lack of human occupation.

This belief was magnified in the Bay area, where Early Period sites were often inundated. Kroeber's estimation of the region as less progressive and culturally stagnant negatively influenced regional archaeologists such as Beardsley who noted, except for a few traces, the nonexistence of an early hunting and gathering culture in the region. This belief continued despite evidence of burials such as Stanford Man II, which was stratigraphically dated to 3000-4000 BP and later radiocarbon dated to 5130±70 years BP, easily predating the Early Period (Beardsley 1948; Bickel 1978; Breschini 1983; Moratto 1984). Early sites that did exist were often implicitly interpreted from a diffusionist perspective (i.e., as the products of emigration from the Sacramento Delta) (Heizer 1949). Until the 1970s, any Windmiller-style burials outside the immediate Sacramento Delta/San Joaquin Valley region were assumed to be direct cultural ties, while other cultural traditions were dismissed. For example, Heizer refused to consider Gerow's (1968) assertion of a coterminous Early Period culture, termed "Early Bay," despite radiocarbon dates and a well-documented mortuary pattern that lacked Windmiller-style burials (Breschini 1983; Eerkens et al. 2013; Hylkema 2002). Recent data from the Sierra Nevada (Calaveras County) and

Diablo Range (Contra Costa County) suggest that the Windmiller did not necessarily spread outward as previously assumed (Beardsley 1954; Heizer 1958), with some sites (CCO-548, CCO-637, CAL-237, CAL-629/630) being contemporary to or dating even earlier than the first documented site in the Delta (SJO-68) (Eerkens et al. 2013; Rosenthal et al. 2007).

Early Bay

Based on work at the University Village Complex (SMA-77), the Early Bay culture is based on a mortuary complex that contrasts sharply to those traits associated with Windmiller (Gerow with Force 1968). This complex consists of flexed rather than extended burials, no defined burial orientation, and more frequent use of ochre and bone implements. Craniometric analyses define a pattern where coastal populations had lower vaulted crania, while individuals from the interior had larger, higher vaulted crania. Based on these observations, it is argued that the Early Bay culture has more commonalities with groups from the Southern California coast, and represents a population that was both culturally and biologically distinct from that found in the Delta Region. A convergence model was further proposed, where the Early Bay culture was believed to represent Hokan speakers, whereas Windmiller culture was thought to be representative of Penutian speakers. Both cultures coexisted in Central California in the Early Period and, over time, the groups intermixed/intermarried, creating a hybrid population (Gerow with Force 1968).

Moratto (1984) maintains that the University Village Complex, rather than being a distinct culture of earlier Hokan speakers, actually is the end result of a proto-Costanoan expansion from the Central Valley into the Bay area beginning around 4500 BP. Here, an early manifestation of Berkeley Pattern traits represents Utian speakers (Miwok-Costanoan), and it was the early adoption/merging of these "foreign" traits by local Hokan people that resulted in the Early Bay archaeological pattern. Thus, the Berkeley pattern marks the arrival of Penutians. Furthermore, it represents the beginning of a cultural and, presumably, biological merging with native Hokan speakers (possibly ancestral Esselen) and intrusive Utian speaking populations (Breschini 1983; Breschini and Haversat 2002; Breschini and Haversat 2004; Moratto 1984). This interpretation rests on the assumption that "culture" (i.e., burial style) is a reflection of genetic relatedness.

By the close of the Early Period at around 2500 BP, shell mounds (ubiquitous to the region at the time of European contact) began to appear. Large mounded villages and clusters of smaller mounded villages dotted the Bay region, the largest of which probably functioned as a hub for various socio-political-ceremonial activities including trade, funerary rituals, and feasting, which could be used to reinforce and/or substantiate status of elite individuals. These village mounds co-occurred with shell mounds that functioned solely as ceremonial and ritual cemeteries (Leventhal 1993; Lightfoot and Luby 2002; Luby 2004). Shell mounds ranged in size from dense but small middens of oyster, mussel, and clam to larger mounds that could reach over 200 meters long and 10 meters deep. The largest of these mounds are always associated with burials. (Leventhal 1993; Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006; Luby and Gruber 1999). Given the increased number and depth of deposits at these sites, an increase in population during this period was also likely. Grave goods also increased in frequency and these traits together define the later emerging Berkeley Pattern (Middle Period) (Hylkema 2002).

Lower Middle Period (2450-1520 BP)

The Lower Middle Period follows the trends in subsistence and settlement documented in the Early Period, although additional changes in material culture occur. The Berkeley Pattern is most often associated with the entire Middle Period, but at times is concurrent with some earlier Windmiller and Early Bay Culture burials, with which it shares some traits. The pattern was initially defined in the North Bay region where an intensive coastal subsistence strategy was observed, but it also appears east throughout the Central Valley, south into Santa Clara Valley and Central Coast, and north into Mendocino County. Shared cultural traits with earlier periods diminish with the continued development and appearance of large earth/shell mounded village sites, and by the middle of this period, the number and size of shell mounds reached a peak. Some sites maintained a ritual focus as ceremonial funerary mounds, either with sterile soils or with evidence of localized feasting. Other large mounds showed evidence of long term village occupation, with smaller mounds clustering around larger ones (Leventhal, 1993; Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006; Luby and Gruber 1999; Milliken et al. 2007).

The most salient features of the Berkeley Pattern are based on mortuary customs and grave goods. Burials are flexed with no particular orientation. Interments occurred within shell or earth mound middens with few accompanying artifacts. This is often interpreted as a culture that placed little emphasis on wealth (Hylkema 2002; Lightfoot and Luby 2002). Substantial inter- and intra-regional variation exists, however, as archaeological sites belonging to the Berkley pattern are documented throughout Central California. The extensive geographical spread of the Berkeley Pattern, along with the consideration of linguistic data, led Moratto (1984) to advance the "Utian Radiation Model." According to this model, the Berkeley Pattern represents Utian-speaking Miwok-Costanoan populations and their expansion throughout the Bay and Central Coast regions. Early manifestations of the Berkeley Pattern share commonalities with Windmiller, suggesting a common origin. Utian speakers first settled interior Contra Costa County by 4450-3950 BP, and then migrated westward toward San Francisco Bay. By 3850 BP, Utian groups inhabited West Berkeley Shell Mound (ALA-307) in the East San Francisco Bay. At this point, Utians speakers had become recognizable as ancestral Costanoan speakers and spread southward into South San Francisco Bay by 3450 BP (Moratto 1984). This is followed by a northward movement onto the San Francisco Peninsula, southward into the Santa Clara Valley, and an arrival in Monterey Bay by 2420 BP, as evidenced by occupation at MNT-12. Descending from earlier Utians, ancestral

Western Miwok groups likewise evolved from earlier Utians, moved into the North Bay area, and arrived in Napa Valley by 3450-2950 BP and Clear Lake by 2450 BP (Moratto 1984).

Upper Middle Period (1520-900 BP)

The beginning of this period is characterized by site abandonment and a breakdown of shell-bead trade networks, (Milliken et al. 2007). Non-abandoned sites show a shift from exploitation of pinniped remains to sea otter and terrestrial mammals such as elk and deer (Milliken et al. 2007). Burials were typically flexed with some extended (representative of the Meganos intrusion) and became more elaborate with large quantities of specific objects (mostly shell beads).

The Meganos Intrusion/Aspect appears between 1400 and 1200 BP in the East Bay and Santa Clara Valley. Deviating from the widespread Berkeley Pattern, some Meganos traits are thought to represent Utian-speaking populations from San Joaquin River near Stockton, as observed from burials at ALA-413, ALA-453 (Union City), ALA-343 (Fremont), and SCL-327 (San Jose) (Bennyhoff and Fredrickson 1994; Bennyhoff and Hughes 1994; Hylkema 2002; Moratto 1984). The mortuary pattern itself is a blend of Bay-area mortuary features[1] and Windmiller-style burials. Meganos burials are ventrally or dorsally extended with no preference for orientation. Burials are associated with few to zero artifacts and are not restricted to shell or earth mound village sites, but are also found in separate discrete

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[1] This is a reflection of the influence of the diffusionist school of thought perpetuated by Kroeber where cultural traits generally equate to people.

cemeteries. These co-occur with flexed burials reflecting the more common contemporaneous Berkeley pattern. Bennyhoff and Hughes (1994) viewed the variation in mortuary treatment as representing different lineages, ultimately the result of a mix between Berkeley pattern groups and Windmiller peoples from the Central Valley. That the first appearance of Meganos burials occurred at the geographic boundaries of both culture areas supports this notion.

The Late Period (900-400 BP) and Terminal Late Period (400 BP-Contact)

The Late Period represents increased levels of sedentism and status differentiation. It is during this period that the ethnographic Ohlone culture is thought to have developed and is also associated with the Augustine Pattern, a direct cultural offshoot of the earlier Berkeley Pattern (Frederickson 1994b; Milliken et al. 2007). Settlements increased in size and number, and long distance trade intensified (Milliken et al. 2007). Conversely, during the previous Middle to Late Period transition (1100-750 BP) and later during the Late Period Phase II (600 BP), many villages oriented around shell mounds were abandoned or shifted in function to become primarily cemetery sites (Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006). It is uncertain whether this is due to site sampling, actual depopulation, aggregation of sites, or the post-depositional destruction of the upper portions of the shell mound (Luby 2004). However, this was not a region-wide pattern as some village-associated mound sites, cemetery shell mounds, and ritual burial mounds associated with feasting, such as ALA-329, showed continuous use throughout both periods (Leventhal 1993).

Cemeteries with differential wealth among burials may reflect the emergence of hierarchical social control and differential social ranking (Milliken et al. 2007). Changes in mortuary treatment of the dead, with the reduction of the overall number of “wealthy” high-status graves, occurred along with more conspicuous burials that were “fire affected ” (evidence of burnt clay/faunal remains/artifacts) (Hylkema 2002; Leventhal 1993; Luby 2004; Luby et al. 2006; Milliken et al. 2007). At select sites, mortuary goods shifted from large quantities of specific goods (such as shell beads) to fewer objects that were exotic and labor intensive to create (such as large mortars), or restricted ceremonial objects such as pendants and charmstones (Bellifemine 1997; Leventhal 1993; Milliken et al. 2007). This suggested a presence of emerging elites that were increasingly differentiated from other segments of the community (Bennyhoff 1994a; Frederickson 1994). The appearance of clam disk beads as a form of “currency” reinforces the notion that new levels of social and political complexity developed during this period (Hylkema and Bethard 2007; Hylkema 2002; Lightfoot and Luby 2002; Lightfoot 1993). Faunal remains found among discrete burials included burnt and unburnt elements of various species including eagles, condors, sea lions, dogs, bears, elk, dear, geese, turtles, herons, and pelicans. Additionally, discrete burials of whole wolves, elk, bears, and eagles have been found within late period sites, possibly delineating the burial areas according to moieties, clans, or totems (Bellifemine 1997; Field and Leventhal 2003).

The reduction in the quantity of mortuary goods may superficially indicate the presence of social mechanisms geared toward redistribution of wealth. Milliken and Bennyhoff (1993) documented an increase in mortuary wealth and differentiation throughout the Early (5450-2450 BP) and Middle Periods (2450-900 BP), demonstrated by the concentration of shell beads that increased markedly during the Middle-Late Transition (1100-750 BP), followed by a consistent decline throughout the Late Period. Milliken and Bennyhoff (1993) interpreted this trend as either: 1) the result of shell bead inflation, where previously high-status goods became commonplace, therefore ineffectual as distinction of rank, or 2) a shift from marked displays of wealth within a burial context to conspicuous gift-giving, resulting in affluent individuals redistributing shell beads to the community. Luby (2004) further elaborated that mortuary inequality ceased to be displayed toward specific individuals within mortuary contexts, representing a shift toward a type of corporate group/kinship reciprocity during inter-tribal rituals. These ceremonies would resemble ethnographic potlatches along the Northwest Coast, which focused on redistributing wealth as well as on reinforcing status differentiation. In contrast, the use of shell beads (an accepted measure of wealth) increased dramatically during the Late Period in South San Francisco Bay/Santa Clara Valley sites (Leventhal 1993; Milliken and Bennyhoff 1993), suggesting that Late Period groups had developed a social ranking system.

Still other research claims that Late Period groups had developed social ranking, reinforced through membership in an emerging pan-regional ceremonial system analogous to the ethnographic Kuksu Cult (Leventhal 1993; Bennyhoff 1994b; Frederickson 1994). However, the shift in grave good distribution is also interpreted as representing a reduction in social differentiation, with focus on community identity based on lineal descent (Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006).

The catalyst for the shift in settlement pattern is unknown but may be due to a period of major climatic fluctuation, commonly referred to as the Medieval Climatic Anomaly (MCA) (1150-600 BP), which has been hypothesized to have had significant impacts on San Francisco Bay-area populations, including increased interpersonal violence, increased evidence of disease/nutritional stress, and changes in trade and subsistence patterns due to increasing salinity of bay shore ecosystems (Lightfoot and Luby 2002). The MCA peaked around 740-560 BP (Jones et al. 1999; Jones and Schwitalla 2012) and also coincides with the appearance of the bow and arrow at around 750 BP, which could have exacerbated incidences of trauma and violence seen in cemetery populations.

Bettinger (1999) provided contrasting evidence that underscored the potential effects, if any, of the MCA, emphasizing that resource stress was a common theme throughout California prehistory. This was supported by additional studies (D’Oro 2009) which concludes that Central California groups had diverse and complex cultural adaptations to prolonged periods of drought, thus negating any negative behavioral patterns (i.e., warfare and violence) due to the MCA. However, the level of trauma and disease are still not as prevalent among skeletal remains during other periods. The timing of the MCA is still intriguing, as it correlates to the cultural transformations in mortuary treatment. Nevertheless, the decrease in the overall health and increased violence, as seen by skeletal pathologies, could have potentially been the product of increasing social differentiation unrelated to environmental decline or a combination of both environmental and social mechanisms.

III. Linguistic Prehistory

An understanding of a region's linguistic prehistory is as significant to archaeological interpretation as are environmental and ethnographic data. This is particularly true for California, with its extreme linguistic diversity, which accounts for approximately 20% of the 500 languages spoken north of Mexico prior to European contact. The California culture area boasted 23 language families and language isolates which are further split into at least 90 languages and even more dialects (Moratto 1984). The result was a constantly changing patchwork of languages distributed across the landscape. This directly affected prehistoric culture and left behind traces of past population migrations, fission and fusion of linguistic units, and, by proxy, possible changes in biological communities.

Linguistic categorization includes language families, followed by further subdivisions into more inclusive or regional language families, languages, and dialects. While no single model will fit all possible scenarios, a comprehensive linguistic history will incorporate the spread, transmission, borrowing, and diversification of dialects, languages, and families (Campbell 1997; Moratto 1984). Many linguistic models, as well many archaeological ones, assume a one-to-one correlation between language and biology, or that language exchange or expansion necessarily resulted in gene flow (intermarriage) or population movement. The reality is probably much more complex. Additionally, some languages may have left no linguistic or archaeological trace. Despite these shortcomings, language can provide a unique perspective, allowing for hypothesis testing at multiple levels and across sub-disciplines. As Moratto (1984) noted, geo-linguistic (i.e., diversity and distribution of environmental terms and cognates) and ethnographic diversity can represent repeated population shifts into, out of, and within a region.

Penutian

Central Californian linguistic history has often focused around the timing and diversification of the Penutian macro family and its daughter language families. Yet, the existence of Penutian as a linguistic macro or super family remains somewhat controversial (Campbell 1997; Goddard 1996). While concrete evidence for the legitimacy of a "Penutian" macro family is still needed, extensive research has revealed that the relationships of language families within Penutian are valid and Californian Penutian is clearly established (DeLancey and Golla 1997). There were over 30 Penutian languages in a somewhat contiguous area within Central California, with additional pockets that occurred along the Central Coast, Bay area, and the far Northwest interior (Moratto, 1984) (Figure 2). The term Penutian was first articulated in Dixon and Kroeber's *Linguistic Families of California* (1919) which categorized the genetic relationship of five Central California language families: Costanoan, Miwok, Maiduan, Yokuts, and Wintuan. Sapir (1929) expanded Penutian to five major categories including major language families outside California: 1) California Penutian: Utian (Miwok-Costanoan), Yokuts (Yokutsan)[2],

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[2] Classifications that are more recent have coined the phrase Yok-Utian, referring to a proto language family ancestral to both Utian (which includes Costanoan and Miwok) and Yokuts (Golla 2007; 2011; Delancey and Golla 1997).

Maiduan, Wintuan; 2) Oregon Penutian: Takelma, Coosan, Siuslawan, Alsea, and Kalapuyan; 3) Chinookan; 4) Tsimshian; and 5) Plateau Penutian: Sahaptian, Molala-Cayuse, Klamath-Modoc (DeLancey and Golla 1997) (Figure 3).

Figure 2. Distribution of California Language Families and Proposed Linguistic Macro-Families.

Based on the Handbook of North American Indian: California vol. 8 and Campbell, 1997.

Image created from Wikimedia Commons digital map file. Author is Babbage. Permission is granted to copy, distribute, and/or modify this document under the terms of the GNU Free Documentation License. http://commons.wikimedia.org/wiki/File:California_languages_precontact.svg.

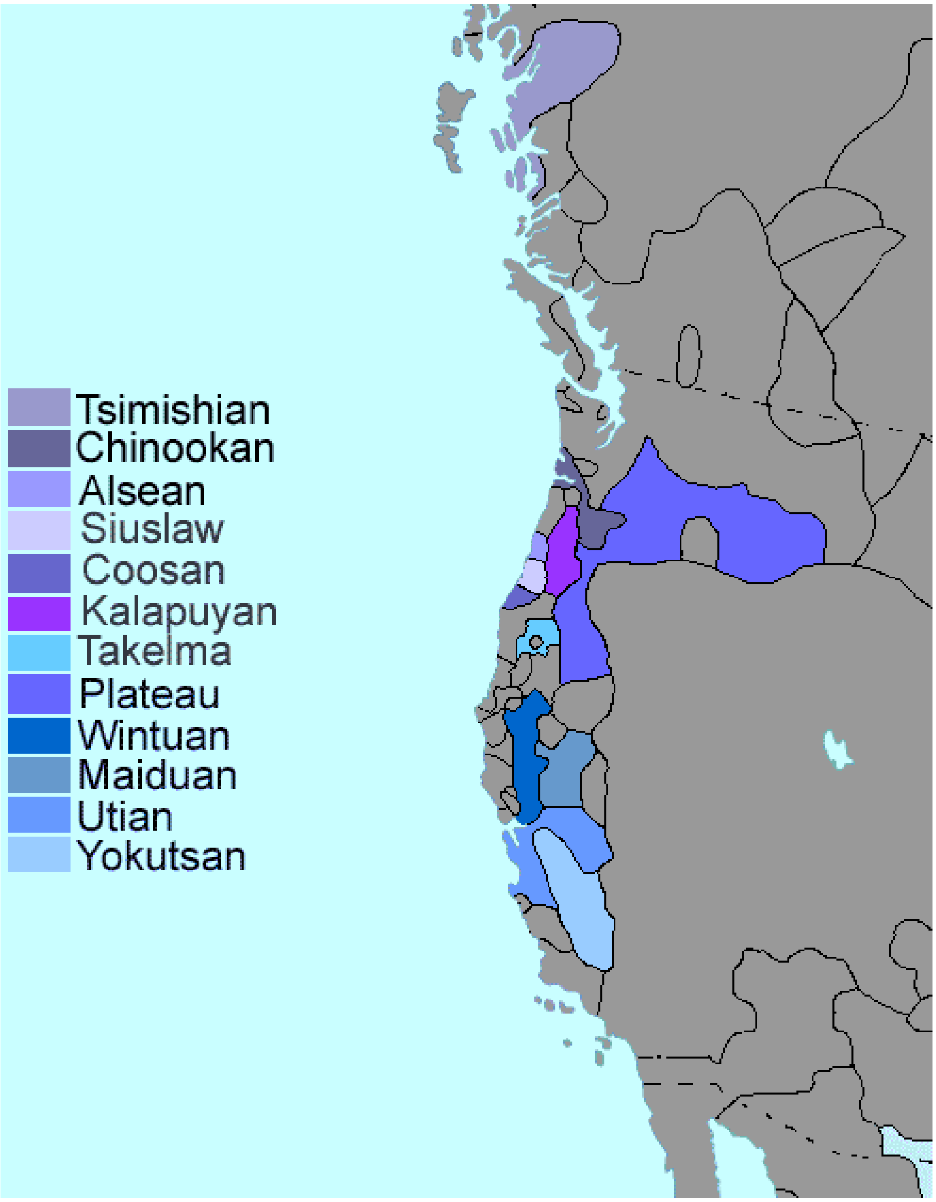

Figure 3. Distribution of Penutian Language Families.

Penutian Prehistory and Hypothesized Homeland

Early linguistic studies focused on identifying the geographic homeland for a hypothetical Penutian proto-language. An in situ expansion from around the confluence of the Sacramento and San Joaquin Rivers east of the San Francisco Bay became a likely location(Dixon and Kroeber 1919; Kroeber 1910; Kroeber 1925). However, an increasing focus was placed on a Penutian origin somewhere in the northwest Great Basin, south central Oregon, or southern Columbia Plateau, followed by a later spread of Penutians into California (DeLancey and Golla 1997). Based on archaeological and linguistic evidence, Whistler (1977) suggested that the entrance of Penutian into California occurred in multiple phases and from different directions. More specifically, he proposed that the four major branches of California Penutian (Utian, Yokuts, Wintuan, and Maiduan) represented four separate migrations from either the northern Great Basin or southern Plateau region. This is supported by recent reclassification which has placed Maiduan as part of Plateau Penutian (Berman 2001). Wintuan also shows a strong association to Plateau Penutian as well as a shared vocabulary with Oregon Penutian (Golla 2007). Moratto (1984) argues for a similar hypothetical situation. The different California Penutian groups shared a geographical origin somewhere in the southern Plateau area. This was followed by a secondary migration into the Great Basin sometime after 4700 BP but concurrent with the pre-Numic Lovelock Culture. Moratto further argued that the Lovelock Culture represented a pre-Californian precursor to Windmiller and that it was a pre-Yok-Utian population occupying northwestern Nevada during this period (Golla 2007; Golla 2011; Moratto 1984).

Yok-Utian

The term “Yok-Utian” has been coined for two distinct sub-clades of Penutian: Utian (which includes Miwok and Costanoan) and Yokuts (also called Yokutsan). This classification is based on recent evidence that indicates a closer linguistic relationship than previously believed (Callaghan 1997; Callaghan 2001). A single Yok-Utian immigration into Central California with a subsequent split into Utian and Yokuts is implied by this connection, and cannot be excluded based on existing archaeological and linguistic data. Despite this, however, the prevailing interpretation saw Utian and Yokuts as the result of two distinct migrations. This is based on the fact that far greater linguistic diversity existed within Utian, suggesting a longer period since the language family split from an ancestral proto-Yok-Utian stock (DeLancey and Golla 1997; Golla 2007; Golla 2011). Additionally, there are numerous ecological terms that place proto-Utian, but not proto-Yokuts, in a California environment, further suggesting that Yokuts are a more recent arrival. However, shared plant and animal vocabulary are consistent with the languages originating in an arid environment outside of California, most likely somewhere in the Great Basin. The most plausible scenario is that the two Yok-Utian sub groups separated prior to Utians migrating across the Sierra Nevada. This was followed by subsequent coastward migrations which would have brought Yokutsan across the

Sierra Nevada at a later time (Callaghan 1997; Callaghan 2001; DeLancey and Golla 1997; Golla 2007; Golla 2011).

Yokuts

The timing of the proto-Yokuts split into the Yokutsan branch is difficult to determine. Small but significant linguistic differences suggest a relatively recent split around 1500-1000 BP somewhere in the San Joaquin Valley. However, there exists a 3,000 year gap (between the proto-Yokuts split and the split of Yok-Utian around 4500 BP) where little is known about this language family (Golla 2007; Golla 2011). Moratto (1984) suggests that the pre-Yokutsan populations arrived in Central California sometime around 3450-2950 BP after proto-Costanoan/Miwok had advanced into the Bay area. Once established in the region, pre-Yokutsan adopted many existing Windmiller traits before expanding southward into San Joaquin Valley and Sierra Nevada foothills around 2950-2450 BP. Interbreeding between Utian and Yokutsan groups may have occurred at this time (Moratto 1984).

Utian, Penutian Intrusion, and the Utian Radiation Model

The Utian split into Miwok and Costanoan occurred between 4500 BP and 4000 BP. Reconstructed wordlists place the origin of proto-Utian around the Sacramento and San Joaquin Delta (Golla 2007) and this correlates well with the proposed connection of Proto-Utian to Windmiller culture and the later Berkeley Pattern (DeLancey and Golla 1997; Golla 2007; Moratto 1984). Although the exact expansion date of Utian is somewhat ambiguous, it most likely happened after

Hokan languages were already firmly established in Central California. The distribution of Hokan languages is not geographically contiguous (i.e., other language families reside between them), suggestive of multiple migrations or an influx of non-Hokan speakers. This was noted by Kroeber (1955) who identified an “explosive disruption” of Hokan languages that occurred 35-40 centuries prior (Moratto 1984). Past migrations and expansions of proto-Utian/Utian populations throughout prehistory likely contributed to the patchy distribution of Hokan speakers across the landscape. The theory of a “Penutian Intrusion” has been extensively discussed in the literature and is generally accepted (Breschini 1983; Breschini and Haversat 1997; Breschini and Haversat 2002; Levy 1978; Moratto 1984). Two remarkably similar but independent “Utian Radiation Models” proposed by Moratto (1984) and Breschini (1983) provide further detail to the exact nature of these expansions.

Utian populations expanded and diversified around 4000 BP in the San Joaquin Valley. These groups, identified as Windmiller, occupied the Sacramento Delta and its associated riparian zones before spreading westward toward East Bay. Linguistics borrowing of ecological cognates (i.e., terms for plants, animal, and ecosystems) indicate an interior origin for Proto-Miwok/Costanoan. Transmissions of lexical terms from Esselen to Costanoan and into Coast Miwok both support at least linguistic and possibly biological interaction. The emergence of the Berkeley Pattern represents a fusion of older Hokan (mostly Esselen) and intrusive Utian cultural elements into the Bay area (Breschini 1983; Breschini and Haversat 1997;

Levy 1978; Levy 1997). Spread of the Berkeley Pattern around San Francisco Bay was characterized by substantial population growth, establishment of large settlements, and appearance of shell/earth mounds. By 3450 BP, Costanoans would have occupied most of East San Francisco Bay, displacing or intermarrying with older Esselen groups. By 2450 BP, the Hokan/Penutian transition had reached as far south as Monterey Bay (Breschini and Haversat 1997) and as far north as Clear Lake (Lake County) (Moratto 1984). The spread of Utian matched the distribution of archaeological sites along marshlands. Thus, it is argued that the success of the Utian Radiation was a result of subsistence specialization to riparian zones, followed by a shift to the intensive harvesting of shellfish and acorns. Social and economic factors, rather than brute force, gave Utians a selective advantage (Breschini 1983; Breschini and Haversat 1997; Moratto 1984). Also, implicit in Moratto’s (1984) model is the presence of increasing sociopolitical complexity and inequality among Utian speakers.

Opposing viewpoints, based on limited linguistic borrowing between Pomo and Costanoan groups, have argued for much later expansion dates of early Costanoan sometime between approximately 1450 BP and 650 BP (Jones 1995; Levy 1978; Levy 1997). This corresponds roughly to Late Period/Augustine cultural patterns. Evidence of this later arrival of Costanoans into the Bay area is not supported by most archaeological and linguistic evidence (Breschini 1983; Breschini 1997; Golla 2007; Milliken et al. 2007; Moratto 1984). Despite this, the hypothesis is often used erroneously in a secular setting.

Costanoan (Ohlone) Dialects

Costanoan or Ohlone languages included eight related languages: languages from north to south: Karkin, Ramaytush, Chochenyo (aka Chocheño), Tamyen, Awaswas, Mutsun, Rumsen, and Chalon (Figure 4). Each has been described as being distinct enough as to be mutually unintelligible and as different from one another as Spanish is from French (Milliken et al. 2007; Milliken 2007). However, recent research has classified most northern languages as a single linguistic unit and refers to it as San Francisco Bay Costanoan.

> Recent publications and encyclopedic websites regarding California Indian ethnography follow the conclusions of Kroeber, Beeler, and Levy to the effect that three separate Costanoan languages—Ramaytush, Tamyen, and Chochenyo—were spoken in adjacent areas around San Francisco Bay at Spanish contact. Over the past few years, however, three linguists actively working on the problem—Catherine Callaghan, Victor Golla, and Juliette Blevins—have concluded that Ramaytush, Tamyen, and Chochenyo are dialects of a single San Francisco Bay Costanoan language. We consider acceptance of that conclusion to be a key tenet of the current report (Milliken et al. 2009:33-37).

Regardless, the distribution of these languages formed a geographic cline from the Monterey Bay north to San Francisco. Ohlone-speaking territory also bordered Miwok groups to the north and east. The number and distribution of the Ohlone languages may be a product of missionization and therefore a historic phenomenon, as each language was associated with the territory of a particular Franciscan Mission. Additional dialects therefore may have also been lost (Milliken 1995).

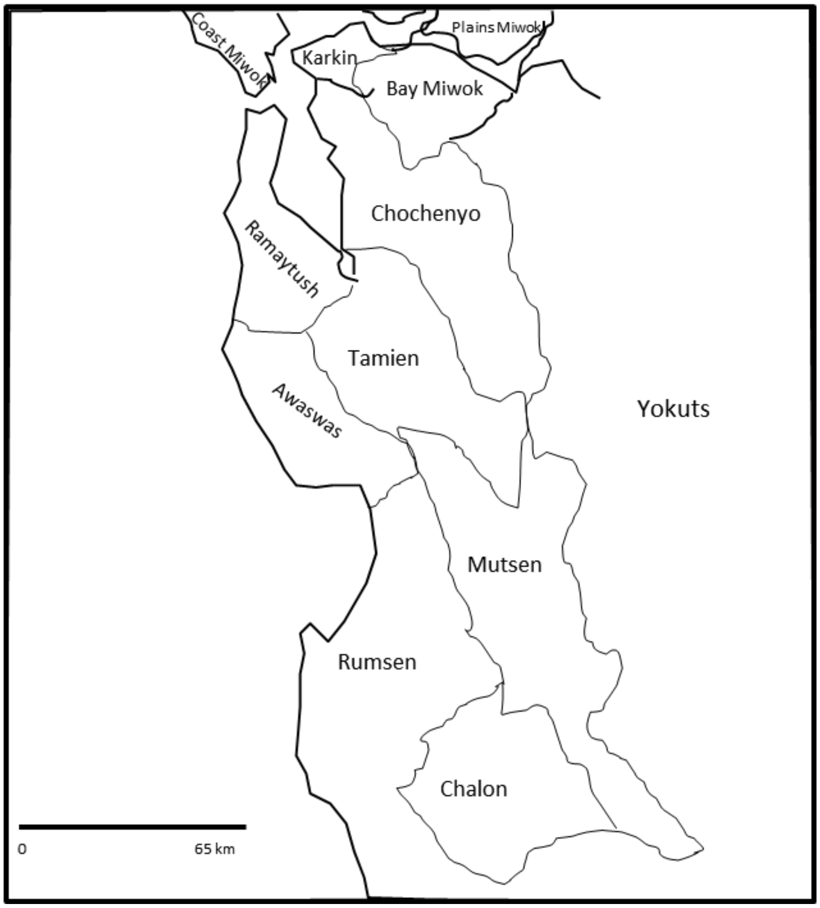

Figure 4. Map of the Ohlone Languages Based on Kroeber (1925).

IV. Ohlone (Costanoan) Ethnography

Population Density/Distribution

The Ohlone consisted of small, politically autonomous tribes or “tribelets” as coined by Kroeber (1925). Tribelets were comprised of seasonally mobile forager/collectors who focused on both marine and terrestrial resources. At the time of Spanish contact during the late 18th century, the Ohlone (Costanoan) people consisted of approximately 45 distinct tribelets that inhabited coastal areas from the northern tip of the San Francisco Peninsula down to Big Sur in the south, and inland to the Diablo Range (Milliken 1995). Each tribal territory was approximately 5-19 km across and villages contained 7-9 houses of intermarried families. Village population size varied in the Santa Clara Valley, but it was estimated at 70-100 persons. Larger village sites with upwards of 200-400 people have been documented; these sites have also been associated with ceremonial houses (Milliken 1995; Milliken 2007). It is unclear how seasonally mobile each tribelet was, or how often village populations aggregated or dispersed. Mission records suggest that the region was quite populous, with local inhabitants being highly mobile and continually moving between seasonal sites. Some larger single village locations were maintained year round, while smaller temporary camps were associated with the harvesting of seasonal resources. Larger permanent villages were maintained in areas with access to multiple habitats (Levy 1978; Milliken 1995; Milliken et al. 2009). Faunal analyses from Bay-area shell mounds also indicate year round occupation (Broughton 1994; Broughton 1999;

Broughton 2002). Despite political divisions, villages and tribelets were closely linked through trade networks, intermarriage, and regional ceremonialism that crossed linguistic boundaries (Leventhal 1993; Hylkema and Bethard 2007; Levy 1978; Milliken 1995; Milliken 2007). Approximations of overall population density at the time of European contact vary dramatically. For lower Santa Clara Valley, Milliken (2007) suggests 4.5 persons per square mile, which is similar to other estimates for the Bay Shore region (Milliken 1995). In the East Bay and along the Pacific Coast, however, analysis of mission records indicates a lower density averaging 2.6-3.5 persons per square mile. For all Ohlone territories combined, total population estimates range from 7,000 to 10,200 persons (Kroeber 1925; Levy 1978).

Sociopolitical Organization

Communities often united into single political units for territorial defense and localized raiding. However, the exact nature of these internal politics, such as how extended family groups were organized, is not known for the Ohlone people (Milliken, 2007). Throughout Central California, tribal authority generally belonged to the eldest members of each descent group, and families were ranked in terms of status and access to power within the tribelets. Descent among the Pomo, to the north/east of San Francisco Bay, most likely consisted of ambilocal corporate kin groups (Kunkel 1976). In the Sacramento Valley, indigenous groups followed patrilineal descent, though ambilineal inheritance would not have been unknown. In the San Francisco peninsula, residence was ambilocal. Mission records suggested that 60% of marriages resulted in the couple living with the husband's family, while 40% resided with the woman's family (Milliken 2007). No contact-period records exist that detail Ohlone descent systems. However, ethnographic evidence postdating the mission period indicate that the Ohlone were primarily exogamous (endogamy was not uncommon) and patrilineal with an ambilocal residence pattern. Polygyny was practiced but was common only among chiefs (Levy 1978).

Families were organized into lineal descent groups, clans (individuals who claimed unilineal descent usually from a very distant common ancestor often referred to as a supernatural being), as well as a moiety system[3]. Descent groups and clans are lineal groups that could demonstrate a common ancestor at some point in the past. These ancestor-descendant relationships would have been further ritualized to the point that the apical ancestor may actually be fictional. Moieties are a further subdivision within a community, generally also claiming lineal descent at a larger scale. Moieties tended to have social and ceremonial obligations to people of an opposing moiety (Field and Leventhal 2003; Harrington 1921-1939; Harrington 1942; Levy 1978). Regardless of lineal organization, each tribelet was large enough

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[3] The existence of a moiety system among the Ohlone is contentious. Harrington's (1941) informants from Mission San Jose indicated that Ohlone peoples did indeed have a moiety system comparable to those of neighboring Miwok groups. However, the relocation of various regional tribes in addition to the Ohlone to Mission San Jose (Yokuts, Coast Miwok, Plains Miwok, Bay Miwok, and Patwin) resulted in not only intermarriage but also cultural admixture and diffusion. Consequently, it has been argued that the social organization documented post-contact does not accurately reflect the precolonial Ohlone (Milliken 1995). As it is, suggesting that the Ohlone did indeed have a moiety system similar to Miwok groups (Kroeber 1925; Gifford 1916) can be useful in hypothesis testing in regards to SCL-38.

to require established social systems that would allow sustained cooperation among unrelated individuals (Milliken 1995; Milliken 2007), and a moiety system would have fulfilled this need. Importantly, this reciprocity involved the obligation of a moiety to bury the deceased of the opposite moiety (Field and Leventhal 2003; Harrington 1942; Kelly 1991; Levy 1978).

Ohlone ethnohistoric records regarding sociopolitical complexity are incomplete and contradictory, so the level of inequality and amount of power and authority held by a leader is unknown. Higher levels of government probably did not exist beyond the headman (capitáns). The role of capitáns was an inherited position passed down patrilineally; however, if no male heir existed, authority could be given to a female relative (Levy 1978). Female leaders who controlled dance houses or who gave ritual speeches have also been noted (Kelly 1991; Milliken 2007). Chiefly power was probably constrained and limited to individual villages or clans. Capitáns acted as the leaders for councils of elders and were responsible for settling disputes, organizing trades and hunts, and providing communal resources. Other positions of authority which may or may not have been held by capitáns included ritual and ceremonial leaders, as well as war chiefs. Spanish explorers documented a large range in the amount of power and authority that leaders wielded. Some noted an egalitarian system with a particular deference to elders and religious leaders (Hylkema and Bethard 2007; Hylkema 2002; Levy 1978; Milliken 1995). In sharp contrast, Commander Pedro Fages in 1775 described “paramount” chiefs who received tribute and treated tribal members as vassals, somewhat negating Kroeber’s tribelet model.

> Besides their chiefs of villages, they have in every district another who commands four or five villages together, the village chiefs being his subordinates. Each of them collects every day in his village the tributes which the Indians pay him in seeds, fruits, game, and fish. ...
>
> The subordinate captain is under obligation to give his commander notice of every item of news or occurrence, and to send him all offenders under proper restraint, that he may reprimand them and hold them responsible for their crimes. ... Everything that is collected as the daily contribution of the villages is turned over to the commanding captain of the district, who goes forth every week or two to visit his territory. The villages receive him ceremoniously, make gifts to him of the best and most valuable things they have, and they assign certain ones to be his followers and accompany him to the place where he resides (Fages 1937:73-74).

Warfare

Low-level intertribal conflict was constant and revolved around territorial disputes and wife-stealing. It is uncertain whether fighting was local infighting among a few families or was true political warfare (Milliken 2007). When altercations escalated, headmen intervened, in some cases sentencing individuals to death. Fighting consisted of ambushes or ritualized group face-offs. Rarely, conflicts evolved into long-standing feuds (Hylkema and Bethard 2007; Leventhal 1993; Milliken 1995).

Ceremonial Systems

Secret society membership throughout Central California was often bestowed on select young people based on both achievement and station of birth. Memberships tended to be inherited ambilineally and may have been used to strengthen intertribal alliances (Bean and Vane 1978). Two different ethnographic pan-regional ceremonial systems are worthy of discussion concerning the prehistory of the Bay area, especially concerning social ranking and regional interactions.

The Kuksu Cult Religion was ubiquitous among Central California natives and has been documented among the Pomo, Miwok, Patwin, Nomlaki, and Yokuts (Kroeber 1923). There is little information pertaining to its presence ethnographically, specifically among the Ohlone, but it has been assumed that it was practiced in the past (Winter 1978; Leventhal 1993). A Coast Miwok informant indicates that the associated dances were learned from the Ohlone community near Mission San Jose (Kelly 1991). Its introduction to the Salinan is also thought to be from Mission San Jose with perhaps Ohlone influence (Hylkema 2002). The River Patwin in California's Central Valley had the most complex system of Kuksu which involved a three tier system, the lowest being open to most male members of the society while the upper tiers were more restricted and required not only access to monetary resources but also participation in potentially dangerous rituals (Gamble 2012). Based on this, Kroeber (1932) argued that the religion probably originated in this region 1000-2000 years ago while Bennyhoff (1961) proposed that Kuksu emerged in the Delta region at approximately 1650 years ago with a subsequent spread to the north and west into the Bay area. Its practice among the Pomo was argued to have been the result of intruding Penutians who brought the religion to the region around 750 BP (Baumhoff, 1980). Regardless of its origin, the Kuksu society was intricately tied to both ritual and political power and authority (Gamble 2012).

This often took the form of regulated ceremonies and displays of hierarchy such as formalized seating and restricted access to ritual spaces (Gamble 2012). Fredrickson (1974) associated the development of social ranking and the Kuksu system with technological advancements such as the introduction of the toggle harpoon and bow and arrow (Gamble 2012).

The distribution of the unique *Haliotis* “banjo” pendants throughout the Bay area and Central Valley correspond with the ethnographic distribution of Kuksu membership (Leventhal 1993; Hylkema 2002). Gifford (1947:21) and Bennyhoff (1977:50) argued that the banjo effigy pendant resemble the deity impersonated during Kuksu “Big Head” performances. The appearance of a new mortuary pattern during the Late Period which included cremation was often found in association with banjo effigy ornamentation and was argued to be a precursor to the ethnographic Kuksu religion (Fredrickson 1974; Bennyhoff 1994; Gamble 2012). Kuksu type artifacts, including banjo pendants and possibly incised bird bone whistles, have potentially been found as far south as SCR-44 near Watsonville. This particular banjo pendent was radiocarbon dated to 460 BP (Breschini and Haversat, 2000). As this artifact was discovered during illegal looting activity, its provenience could be questioned.

The accumulation of shell beads and *Haliotis* banjo pendants, which first appeared in South San Francisco Bay at SCL-690 during the Middle/Late transition, is reminiscent of the ethnographic accounts which describe the attainment of wealth and prestige through Kuksu Cult membership (Hylkema 2002). Banjo pendants have also been found among burials of both sexes, implying that Kuksu Cult participation was not exclusively restricted to males as previously hypothesized by Bennyhoff (1961), at least not prehistorically (Breschini and Haversat, 2000; Fredrickson, 1974).

Recent research by Gamble (2012), argued that the substantial amount of communal labor needed to construct and maintain fishing weirs to catch anadromous fish, such as salmon, would have necessitated authoritative leaders. The ability to also defend fishing lands as well as redistribute the resulting resources gave chiefs tremendous power as well. Additional power and wealth, through the accumulation of shell bead money and ornamentation, were conferred upon leaders. Ideology and ties to the supernatural became not only a way to legitimize power but also a source of power and authority. The Kuksu society, therefore, is thought to have arisen from a need for authoritative leaders who could levy sanctions and would guarantee cooperation (Gamble 2012).

Thus, the banjo pendent, and by proxy the Kuksu religion, probably represent changes in social inequality during the shift from the Berkeley to Augustine Patterns (or Middle to Late Periods). Contrastingly, Fredrickson (1974) maintained that bead wealth, as measured through overall abundance, and membership in Kuksu were more likely a marker of group membership rather than a true symbol of wealth. The entire connection may be contentious, however, as there is no ethnographic evidence of a pendant being used in Kuksu ceremonies (Hylkema 2002; Milliken et al. 2007).

Still, if the association is real, cult membership would probably have carried a certain amount of prestige, if not the power and authority of ascribed status.

The Máien (Coast Miwok) or Mayen (northern Ohlone, Bay and Plains Miwok) was a leadership role associated with prominent women throughout Central California. This may have evolved from the role of Hóypuh kulé (·) yih or "women chiefs" who were leaders of the Acorn and Sunwele Dance and deeply involved in the Bird Cult. Máien were generally head of ceremonies and the position was often held by female chiefs or the wife or female relative of chiefs and shamans (Callaghan 1978; Kroeber 1925). A Máien existed for every major village and was probably an especially powerful position which held influence over all women in the community. They were also responsible for invitations to outside groups, and through time, this role may have evolved into a regional secret society/cult (Kelly 1978; Kelly 1991; Parkman 1981). The geographic distribution of the name supports this notion. Máien was the Miwok variant name for this role and it may have originally been derived from the Cochenyo Ohlone word for coyote (mayan) (Harrington 1921-1939). Among the Hill Patwin, Máien were called "mayin" or "queen." Máien and its other related spellings (*maen, mayen, mayenu, mayin, and meyen*) was also a surname suffix during the mission period and had a frequency of about 30% among North San Francisco Bay women. If the surname spelling of "maye" is considered derivative of "máien" then this would include women from Ohlone groups. Membership tended to run in families and required a prominent status within the community, but it was not strictly inherited or based on moiety. The occurrence of the Máien among Coast, Bay, and Sierra Miwok, as well as Patwin and probably the Ohlone, suggests that the secret society served as way to strengthen regional coalitions (Bean and Vane 1978; Kelly 1978; Kelly 1991; Parkman 1981).

Mortuary Practices

Bay area groups practiced two funerary ceremonies. The first were rituals associated with inhumations, cremations, or partial cremations. The second were annual mourning ceremonies. Bodies were buried or cremated immediately after death (Kroeber 1907; Margolin 1978; Morrow and Naeem 1991) and funerary rites involved the whole community. Tribal members (most likely of the opposite moiety of the deceased) placed the deceased's possessions (clothes, ornaments, etc.) into a grave or upon a funerary pyre (Margolin 1978; Milliken 2007). In some cases, individuals bestowed their own personal possessions. Ohlone taboos regarding the dead included sequestering the widow or widower following the funeral. Funeral preparations, especially animal sacrifices, may have denoted the deceased's moiety and were performed by individuals of the opposing moiety. Great care was taken to avoid touching the deceased and ritual purification followed ceremonies (Harrington 1921-1939; Harrington 1942; Leventhal 1993; Hylkema and Bethard 2007; Milliken 2007). Annual morning ceremonies were common throughout Central California including the Ohlone, Miwok, and Yokuts. These usually were multi-day events which included group mourning followed by feasting, trading, and gambling. Ethnographically this event involved multiple tribal groups that crossed major linguistic lines (Kroeber 1907; Kroeber 1925; Leventhal 1993). Eighteenth century accounts identified indigenous cemeteries near abandoned villages with graves demarcated by slender poles from which objects belonging to the deceased or mourners were hung. This varied from grass hats and skirts to abalone and arrows (Milliken 2007).

Thus, it could be argued that the the study site, SCL-38 (Yukisma), is a large cemetery comprised mostly of Late Period remains of ancestral Ohlone people whom were ceremoniously buried in a dedicated ritual space specifically for the dead. The use of this area over several centuries was part of a funerary process presumably linked to annual mourning ceremonies. The exceptional preservation of these human remains set the stage, in consultation with the Muwekma Ohlone Tribe, to conduct ancient DNA studies. As informative as ethnographic evidence can be, DNA studies of both living and prehistoric indigenous California populations have provided a wealth of new information that cannot be answered by archaeological or historical data alone, and offers new avenues for further scientific inquiries into the region.

V. Mitochondrial DNA Variation in Central California

Mitochondrial DNA has been instrumental to the investigation of relatedness among and between Native American tribal groups (Barrantes et al. 1990; Bolnick and Smith 2003; Eshleman et al. 2004; Kemp 2010; Kemp et al. 2007; Kolman and Bermingham 1997; Kolman et al. 1995; Malhi et al. 2004; Malhi 2001; Malhi et al. 2003; Torroni et al. 1994; Torroni et al. 1992), migrations into the New World (Horai et al. 1993; Lorenz and Smith 1997; Malhi et al. 2002; Merriwether and Ferrell 1996), and ancient DNA (aDNA) in the Americas (Carlyle et al. 2000; Eshleman 2002; González-Oliver et al. 2001; Kaestle and Smith 2001; Lalueza-Fox 1996; Lalueza-Fox et al. 2003; Lalueza-Fox et al. 2001; Malhi 2001; Parr et al. 1996; Schultz et al. 2001; Stone and Stoneking 1996; Stone and Stoneking 1998). Studies of this genetic marker among New World populations reveal that the mtDNA of most Native Americans belong to one of five maternal macro-lineages, or haplogroups A, B, C, D, and X (Brown et al. 1998; Forster et al. 1996; Schurr et al. 1990; Smith et al. 1999). The distribution of haplogroup frequencies across North America is non-random and attributable to geographic distance and/or linguistic boundaries (Lorenz and Smith 1996). These factors contribute to the overall patterns of mtDNA diversity in North America (Malhi et al. 2002). Some of these sub-lineages (haplotypes) have been found to be tribal (Malhi et al. 2002; Torroni et al. 1993) or language family specific (Derbeneva et al. 2002). Therefore, mtDNA can be used to characterize populations and, thus, be used to assess biological relationships. Haplogroup data for populations are often more informative in recognizing regional patterns while haplotype data provides finer resolution to the interaction of particular maternal lineages. Recent review papers provide a more thorough understanding of the use of mtDNA in addressing New World prehistory (Eshleman et al. 2003; Johnson et al. 2012; Kemp and Schurr 2010; Schurr 2004).

MtDNA is an extra-nuclear genome found in the mitochondria of cells. Each mitochondrion contains one or two copies of the genome and each cell contains approximately 1000 mitochondria (resulting in estimates of a 1000-1500 copies of the genome per cell, versus nuclear genes that have only two copies per cell). The high copy number of the mtDNA genome make it especially successful in ancient DNA studies (aDNA), as mtDNA (due to its high copy number) will preferentially stand the test of time and degradation (Kaestle and Horsburgh 2002). The non-coding hypervariable region (HVI and HVII), or control region, is the most often targeted portion of the mtDNA genome. This is primarily because this particular region does not code for any genes, and mutations occur in this region randomly rather than via natural selection, (mtDNA is one molecule, so natural selection will affect the entire mtDNA genome, however, overall it is under less selective pressure than nuclear genomes). As such, this portion of the mtDNA tends to contain variation that is informative at the regional and tribal level. Mutations found outside this region are more conserved and when identified are used to designate larger groups (haplogroups or macrogroups) rather than specific maternal lineages. The major Native American haplogroups A, B, C, D, and X are designated by coding region mutations outside the HVI region. Each haplogroup can be further sub-divided by genetic differences found in the control region of the molecule. Other unique characteristics of the genome further illustrate its utility in studies of biological relationships. Human mtDNA is strictly maternally inherited (Giles et al. 1980), reflecting only female movement/history, and is particularly useful in discerning ancestor-descendant relationships because it does not recombine during meiosis (Merriwether et al. 1991; Schurr et al. 1990). Rapid evolution of the mitochondrial genome (Brown et al. 1979) allows this molecule to be used in studies of populations that share recent common ancestry, such as Native Americans. Additionally, as the mutation rate of mtDNA can be calculated, minimal dates for coalescent events between lineages can be determined, in essence dating language splits and population movements (Henn et al. 2009; Howell et al. 1996; Johnson et al. 2012; Kemp 2010; Kemp et al. 2007; Monroe et al. 2013b; Schroeder et al. 2011). Lastly, the genome has been fully sequenced (Anderson et al. 1981; Andrews et al. 1999) and its variation investigated in world-wide populations, having resulted in a large comparative database.

Haplogroup versus Haplotype

Haplogroup and haplotype are two terms commonly misunderstood by archaeologists and, as such, the terms are here discussed in detail. *Haplogroups* are groups of haplotypes that have shared mutations, denoting a common origin or shared ancestry sometime in the past. The mtDNA nomenclature is often confusing, but haplogroups are usually labeled with letters. For example, A, B, C, D, and X are

Native American haplogroups, but are also found in Asia. These groups are determined (usually but not always) by mutations in the mtDNA coding region. Since these mutations are located outside the HVI region, they are more conserved, and while mutations do accumulate through time, the rate at which they occur is reduced.

Haplotypes are specific lineages within a haplogroup defined by sequence variation beyond that defining the initial group. In this investigation, haplotypes are defined by additional mutations that occur within the HVI region. This area of the genome is particularly informative in studying more recent population prehistory, as there is sufficient time for mutations to accumulate due to an overall high mutation rate, thus allowing finer resolution in distinguishing unique lineages. Consequently, it is possible to differentiate even closely related populations and document the interaction of particular maternal haplotypes (Horai and Hayasaka 1990). However, Native American haplogroups are paraphyletic, as each have a separate evolutionary history both in the Americas and in Asia. Therefore, two different lineages (haplotypes) from two different haplogroups are not directly comparable, even if both are Native American. For example, an individual from Asia who belongs to haplogroup C is more closely related at the mtDNA level to a Native American individual who belongs to haplogroup C than to another Asian individual (even a non-maternal family member) who belongs to another haplogroup.

As mutations are often random, different haplotypes may also share the same mutation due to convergent evolution, which allows that a mutation in the same location can occur by chance. In some cases hypermutable positions in the genome called “hot-spots” occur, causing back mutation to the original state (Meyer et al. 1999). Unfortunately, there is no consensus on why or how this phenomenon occurs (Gilbert et al. 2005; Meyer et al. 1999). On a final note, it is important to understand that mtDNA is only one small part (or marker) of what makes up human genomes, and in no ways equates to a full picture of a person’s cultural or biological heritage. It is, however, very useful as discussed above, especially concerning anthropological studies.

Previous Central California Ancient and Modern DNA Studies

To date only a handful of ancient and modern mtDNA studies have investigated California prehistory, the majority of which only analyzed haplogroup frequencies. Studies that are pertinent to Central Californian prehistory will be here reviewed.

MtDNA haplogroup frequencies of living Penutian populations were analyzed and revealed that the genetic differentiation between Yok-Utian and Plateau groups did not support an origin of Penutian languages from the Columbia Plateau. However, California Penutians and Plateau groups are not as distinct as would be expected by models of genetic and geographic distances (Eshleman and Smith 2007). It is suggested that the high amount of haplogroup D within these populations (which was uncommon among Hokan speakers) represents some distant relationship. It is noted that haplogroup D is also found in high frequency among Great Basin populations (Northern Paiute) (Eshleman 2002; Eshleman et al. 2004;

Eshleman and Smith 2007). Kaestle and Smith (2001), further argue that Great Basin Numic speakers may have intermarried with older Penutian populations when they first entered the region.

Eshleman (2002) analyzed ancient mtDNA of 45 samples from three prehistoric sites (SJO-112, SOL-270, AMA-56) in order to determine if population replacement occurred in the Central Valley between 3600 BP and 1700 BP. Based on haplogroup frequency, he determined that the high frequencies of Haplogroup C and D represented population continuity between the Windmiller culture (Early Period) and Middle Period burials. However, haplogroup frequencies from the Windmiller burial site (SJO-112) are statistically different from living Yokuts and Costanoan populations, providing evidence that Windmiller may have predated the arrival of Penutians in California. Middle period haplogroup frequencies did indicate genetic continuity with modern groups. In particular, individuals from SOL-270 are not statistically different from Yokuts or Costanoans. This suggests that the arrival of proto-Utian occurred during the Middle Period (Eshleman 2002; Eshleman et al. 2004; Eshleman and Smith 2007). The high frequency of haplogroup C among all ancient Californian populations is notable and may represent remnant Hokan lineages, especially considering the high frequencies of haplogroup B and D among modern Yok-Utians (Yokuts, Costanoan, Miwok), Plateau, and Great Basin populations (Johnson et al. 2012; Johnson and Lorenz 2006). Ancient mtDNA haplogroup frequencies from Pyramid Lake and Stillwater Marsh sites in the Great Basin are dissimilar from surviving Great Basin people, but they are statistically similar to Californian Penutians. This observed relationship between ancient Great Basin and living California populations has been used as evidence for a population expansion from the Great Basin sometime in prehistory. However, since haplogroup frequencies of ancient California and ancient Great Basin populations are statistically different, any migration or expansion was argued to have been more limited and later in prehistory (Eshleman 2002; Eshleman et al. 2004; Eshleman and Smith 2007; Kaestle and Smith 2001).

A preliminary study by Breschini and Haversat (2008) analyzed aDNA from six individuals from three archaeological sites from Monterey Bay (MNT-831, MNT 1489, MNT 1931). The results revealed genetic continuity of haplogroup A for more than 5200 years along the California coast and further suggest a deep antiquity for the presence of ancestral Esselen speakers in the region. They also hypothesized that the occurrence of haplogroup D in the later component of one site (MNT-831) was representative of encroaching Costanoan populations (Breschini and Haversat 2008).

Initial work on SCL-38 (Yukisma) site provides mtDNA haplogroup data for 41 individuals. Nuclear DNA was also obtained (n=15) to analyze the frequency of ABO blood groups among pre-contact indigenous populations (Villanea 2010). A Fisher’s exact test based on haplogroup frequency determined that the Yukisma population is indistinguishable from SCL-287/SMA-263 (Early/Middle Period Site]), SOL-270, Sierra Miwok, Yokuts, Sahaptain, and Great Basin groups (Monroe et al. 2009).

Haplogroup data is less informative than haplotype data, providing very little fine scale resolution. So while the patterns above are suggestive they are not definitive. Indeed many of the observed differences in haplogroup frequency discussed above could be explained by genetic drift, isolation, or population bottle necks rather than as evidence for admixture or lack of contact. Thus, the general patterns that are based on only haplogroup frequency may be misleading and erroneous.

Some recent mtDNA studies by Johnson and Lorenz (Johnson et al. 2012; Johnson and Lorenz 2006) have made significant contributions by analyzing haplotypic (lineage) data and applying it to a more detailed anthropological and ethnohistorical context. A particular DNA clade within haplogroup B that is defined by a rare transversion[4] mutation at np 16184 was discovered. The distribution of this lineage was initially thought to be restricted to Yokuts and their immediate neighbors, suggesting a population expansion of that particular group sometime in the past. However, newer data presented by Schroeder et al. (2011) has discovered this mutation among the Eastern Ione Miwok as well as a Windmiller pattern and Middle Period burials (SJO-112) (Eshleman 2002). They hypothesized that as this lineage predated 3000 BP (based on radiocarbon dates of burials) it may represent an earlier Yokuts-Utian split within Penutian around 4500 BP. Molecular dating placed

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[4] A transversion mutation is when a purine (A or G) is replaced by a pyrimidine (C or T) base pair or vice versa. A transition mutation is when a purine is replaced by another purine (C to T or vice versa) or pyrimidine is replaced by another pyrimidine (A to G or vice versa). Transversions are 50 times less likely to occur than transitions and therefore are useful in phylogenetic analysis, as they are less prone to site loss (back-mutation to the ancestral state).

the origin of this clade at 5374 (±1957 BP) indirectly supporting linguistic estimates (Schroeder et al. 2011).

Monroe et al. (2009) analyzed mtDNA lineages from the prehistoric site of SCL-287/SMA-263 (~2220 BP -1200 BP) (Buonasera 2012). Haplotype (lineage) data was obtained from 17 individuals, and direct maternal ties to Penutian speaking groups were found in the Plateau, specifically the Yakama. Additional connections were also found with the Central Valley sites of SJO-112 and SOL-270.

Since conducting the first broad-scale surveys of mtDNA patterning among Native North Americas, molecular anthropologists have continued to focus on using mtDNA evidence from both modern and ancient sources to unravel questions about regional prehistory, such as the genetic relationships between speakers of particular languages and to test for hypothesized ancient human migrations.

VI. Yukisma Mound (SCL-38)

SCL-38 (Yukisma Mound, née Alms House Mound) is located approximately 8 km from the shoreline of San Francisco Bay (Figure 5) in Santa Clara Valley and falls within USGS Milpitas 7.5'minute quadrangle. The site is situated along a riparian corridor (Lower Penetencia Creek) with access to grasslands, freshwaters marshes, estuaries, and temperate rainforests that support diverse floral and faunal species. Its location falls within the historic linguistic boundary of the Alson-Chocheño-speaking and adjacent Tamien-speaking Ohlone (Leventhal et al. 1993; Milliken 1995). The two historic tribal villages of Alson and Santa Ysabel were located approximately 16 km away, and the Muwekma Ohlone Tribe of the San Francisco Bay Area is the most likely descendant for the region (Leventhal et al. 1993).

Yukisma Mound, presently located under Elmwood Correctional Facility, was first recorded by C. W. Meighan in 1952 under the name Alms House Mound. He described it as an extensive habitation site with a low nondescript mound 300 feet in diameter and four feet high (Meighan 1952). The site had initially been disturbed by post-contact farming; however, six inhumations with associated artifacts were recovered from a midden component during initial subsurface excavations. Inhumations consisted of three adult females, two children, and one adult male all buried in a tightly flexed position with no preference for orientation. The relatively shallow depth of the burials indicate that the mound was probably much larger and had been slowly removed post-contact (Meighan 1952).

Typological classification of a bone (tooth) fishhook found with an adult female suggests that this component of the mound dated to the Middle Period.

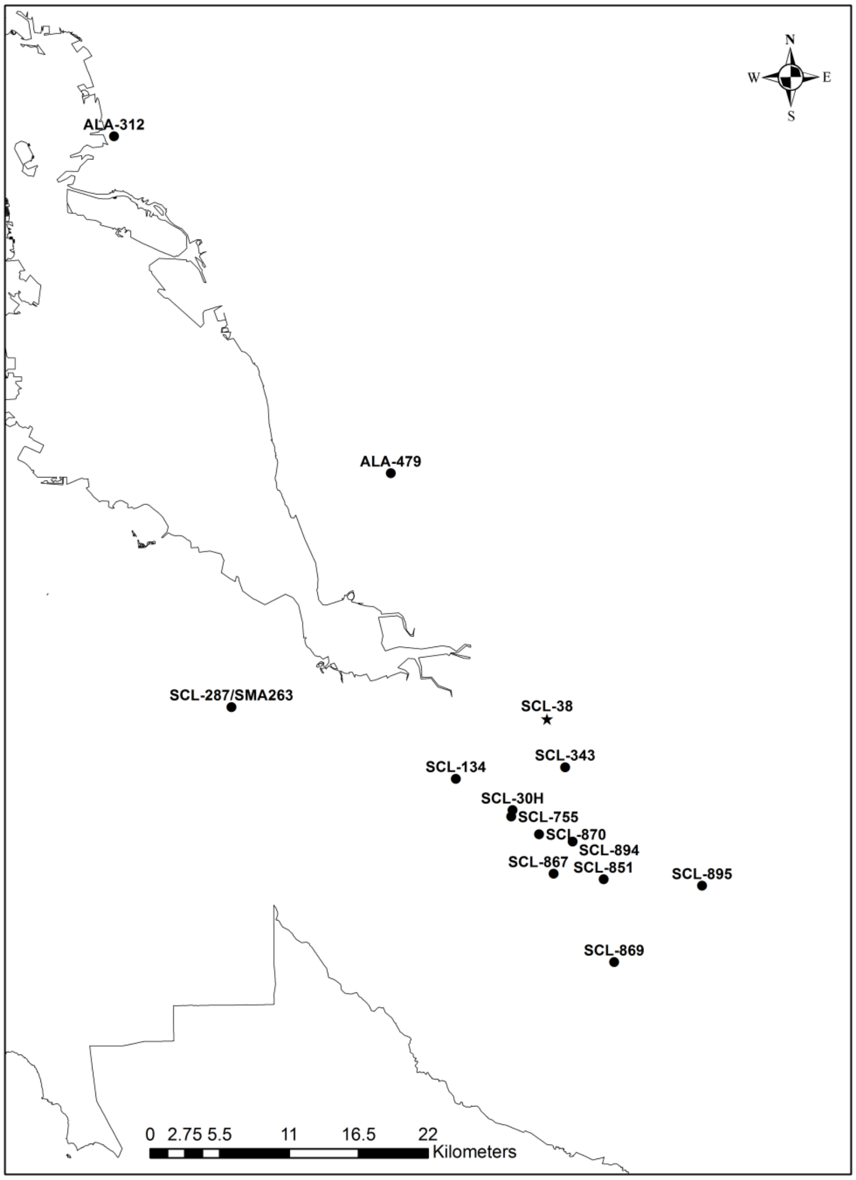

Figure 5. Location of SCL-38 and other Archaeological Sites from this Study.

Other mortuary goods were non-diagnostic, but included a mortar with a separate adult female and a shell covering a child. Additional archived artifacts at the Phoebe Hearst Museum of Anthropology included various faunal remains, mortar and pestle fragments, and bone needles and saws (Gardner 2013). No additional test excavations were performed until Cartier's 1981, 1984, 1985, and 1987 surface surveys during the construction of the Elmwood Correctional Facility (Bellifemine 1997; Leventhal et al. 1993). Test excavations recovered additional burials as well as a notable number of vitrified/baked clay features, ground stone fragments, and lithic fragments (Bellifemine 1997). Very few vertebrate faunal remains were discovered but there was a rich midden laden with California horn snail (*Cerithidea californicus*) and California oyster (*Ostrea lurida*).

An uncorrected radiocarbon date of 500±60 BP placed the site firmly within the Late Period. It was further determined to be a cemetery site with an associated village that may have also been linked to SCL-343, another nearby Late Period site (Leventhal et al. 1993). Other surveys support the classification as a predominately Late Period site with a possible Middle Period component. A thick, well-developed midden was documented along the creek bed and supports the suggestion that the site has had extensive occupation (Gardner 2013). In 1993, a site survey and test excavation was conducted by Ohlone Families Consulting Services (OFCS), a Muwekma tribal cultural resource management company. It is argued that SCL-38 functioned mainly as a mortuary mound with very little evidence for its use as a village site. This conclusion was justified based on the presence and absence of particular archaeological features. Burials predominated and the associated vitrified clay features were convincingly determined to have melted at such high temperatures (1200˚C) as to preclude its use for cooking activities that are often seen at habitation sites. The faunal and artifact assemblages outside of the burials were sparse, and the amount of shell at the site could not have calorically supported even a moderately sized population (Leventhal et al. 1993). This conclusion is in part based on the definitive monograph based on investigation of ALA-329 (Ryan Mound) located 14 km to the north. The Ryan Mound's function is interpreted as being solely a ceremonial center used for funerary purposes (Leventhal 1993). This defied traditional explanations on the usage of shell mounds, which often focused on their function as habitation or mortuary sites (Chartkoff 1984; Gifford 1916). Evidence of domestic activities are considered the result of ritual feasting and probably represented something similar to the ethnographic annual mourning ceremony that was prevalent throughout Central California (Bean and Vane 1978; Blackburn 1976; Leventhal 1993).

It is hard to reconcile the contrasting viewpoints of the functional role of the Yukisma Mound. However, it is safe to assume that the site had been seriously impacted over the past 200 years, which may account for the discrepancies in regards to presence/absence of a midden. It is possible that the 1993-1994 work by OFCS only exposed a small portion of the site with the rest residing beneath Elmwood Correctional Facility barracks. Recent reanalysis of East Bay shell mounds also found that the functional role of shell mounds was often very dynamic, changing dramatically from one period to the next (Lightfoot and Luby 2002). This ranged from use as a discrete cemetery, to use as a cemetery and village, to complete abandonment. Therefore, it is entirely plausible that SCL-38 had multiple uses, and the observations from previous investigations cannot entirely be dismissed. Refined temporal control at the site could help document the existence of any diachronic change.

Further mitigation was performed in 1993-1994 by OFCS who unearthed an additional 243 burial features. All recorded material was then curated at San Jose State University for analysis. At the County's insistence, the human remains and associated artifacts were reburied in 1996 (Bellifemine 1997; Gardner 2013; Leventhal et al. 1993). Prior to repatriation, rib fragments from 208 individuals were selected and reserved for future radiocarbon dating, isotopic, and DNA studies. As a consequence of the Muwekma Tribe's forethought and active participation in anthropological research, the Yukisma site will become one of the most thoroughly studied archaeological sites in California and represents a model for future multidisciplinary research of this kind.

Mortuary Data

Various mortuary features of SCL-38 will be described including paleodemography, mode of interments, cemetery organization, and grave good assemblages. The summation of data for each category as well as frequencies of various grave goods have been extensively discussed and reported multiple times in table format elsewhere (Bellifemine 1997; Gardner 2013). As such, it will not be lengthily reported here. However, all raw data are reported in Appendix C and in Appendix D, which is a revised version of Gardner's substantial database (see Gardner Appendix A and B)[5].

Osteological Analysis

Osteological analysis of SCL-38 burials primarily focused on paleodemographic reconstruction, overall health and disease, and documentation of violence and trauma (Andrushko et al. 2005; Andrushko et al. 2010; Jurmain 2000; Jurmain 2001; Jurmain et al. 2009; Jurmain and Bellifemine 1998; Morley 1997). Unfortunately, no metric or non-metric data were collected in the osteological analysis of the Yukisma burial population prior to reburial. These data would have helped further deduce biological relationships, but their absence further demonstrates the need for genetic analysis. Major inconsistencies also exist between studies, mostly concerning the minimum number of individuals, exact age classification, and sex identification. Gardner's (2013) extensive review of all available data (including individual burial records) reconciled many of the discrepancies, and it is those classifications that will be referenced throughout this dissertation.

A total of 243 discrete grave lots, some with multiple burials, were recovered. Four graves were later determined to be non-human (Burials 2, 22, 199,

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[5] Revisions include splitting of the two appendices, a change in the ranges for age category (additionally, when there was a conflict with this change all ages were rounded up), numerical encoding of interment style, sex, etc., and the addition of DNA haplogroup and haplotype data.

and 200) and 248 burials were human. Two of the graves were complete animal burials. One was an articulated juvenile grizzly bear burial (B22) (*Ursus arctos*) (890±70 BP), located west of the central portion of the site. A second burial (B2) of an immature elk (*Cervus canadensis*) was found in the northeastern periphery, within a vitrified clay pit. A small pestle with traces of ochre and a single charmstone were also found with the remains of this animal. An articulated rack of elk antler was discovered west of the central cluster near and partially beneath three burials (two females and one sub-adult) (Bellifemine 1997). The antlers were placed at a considerable depth (2.4 meters), possibly indicating an earlier interment that demarcated the site for ritual purposes. The only other artifact types associated with this burial were two shell *Haliotis* pendants. A number of other animal species were distributed throughout the burials including mountain lion, coyote, sea otter, goose, black bear, and swan. These were probably the result of animal offerings to the deceased and may correlate with sub-moieties among Penutian speaking groups (Field and Leventhal 2003; Leventhal 1993). Comingling was evident in approximately 86 of the remaining 239 burial lots. This may have been an intentional group burial or the result of site disturbances. There are an estimated 248 individuals that were recovered from the 1993-1994 salvage excavation of SCL-38 (Bellifemine 1997; Gardner 2013).

Isotopic Studies

Carbon (δ13C) and Nitrogen (δ15N) stable isotope and bone apatite δ13C data from SCL-38 indicate a diet that consisted of terrestrial resources supplemented with freshwater and few marine resources. The results placed SCL-38 as intermediate to other East and South Bay populations. Few statistical correlations were found with diet, social inequality, and grave goods, the exception perhaps being individuals who were buried with *Haliotis* pendants. These individuals had higher δ13C levels from bone apatite, but not Carbon (δ13C) and Nitrogen (δ15N) levels from collagen, suggesting an increased consumption of high non-protein C^{13} foods such as seaweed (Gardner 2013). Burials with evidence of pre or post interment burning also had statistically different dietary patterns. Graves with burning had lower δ15N values compared to burials without burning, indicating the intake of foods at lower trophic levels. Similarly, adult men consumed more animal protein than did women and children (Gardner, 2013).

Paleodemography

Paleodemography of the site deviated from a normal life table (Morley 1997). The burial sample consisted of 248 burials with 63 (25.4%) females, 99 (40%) males, and 86 (34.6%) individuals of indeterminate sex (represented by both adults and subadults) (Figure 6). Age categories were reclassified from Gardner (2013) to follow the recommendations of Buikstra and Ubelaker (1994). Infants (0-3 years) and young children (3-5 years old) were underrepresented (~5%, n=10; ~3% n=

~7%). This perhaps is due to differential preservation or incomplete recovery of the entire cemetery (Morley 1997). However, off-site burial (or no interment at all) was not uncommon among many human groups, a practice that may reflect the fact that in some cultures infants and children often were not yet ascribed a social persona (Binford 1971; O'shea 1984; O'Shea 1996). Interestingly, children (6-10 years, n=10) and adolescents/subadults (11-20 years, n=45) were also underrepresented. This may be due to often-seen decreases in mortality of this age group, although it is noteworthy that this age bracket also overlaps with puberty and may represent some social distinction. There was a low mortality of women of child-bearing age (potentially differential treatment) and a high mortality rate for males ages 16-45 (possibly indicative of inter-personal aggression). This mortality pattern is not uncommon and has been found at other sites in the region (Andrushko et al. 2010; Bellifemine 1997; Jones and Schwitalla 2012; Jurmain et al. 2009; Jurmain and Bellifemine 1998). Mortality among men and women reached an equilibrium in the age range of 35-49 (~52% n=43/82; ~43% n=35/82)[6], but with a higher overall male to female sex ratio (1.6:1). A majority of older adults individuals (~77% n=7/9) were female; however, the overrepresentation of adult males has been interpreted as evidence of elite status with preferential treatment over females (Bellifemine 1997; Gardner 2013; Morley 1997).

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[6] The total number of burials for this age bracket is 82; however, four individuals' sex was indeterminate.

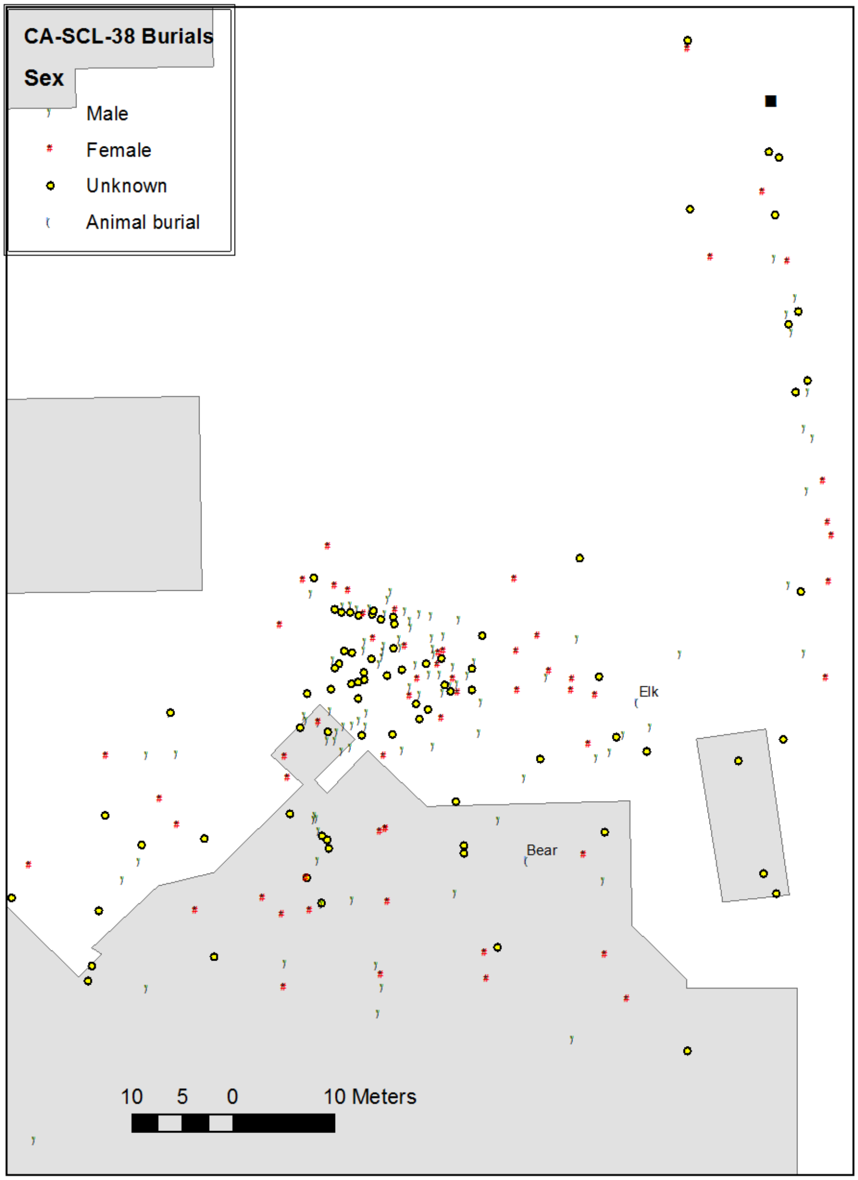

Figure 6. Sex Distribution at SCL-38.

Grave Association/Mortuary Goods

Both the quantity and diversity of artifacts varied significantly across the site (Figure 7 and 8). Only 14 burials had more than four types of artifacts. Half of these were identified as males, four as female, two of indeterminate sex, and one infant/child (Bellifemine 1997; Gardner 2013). Faunal and botanical remains including shell, bone, bulbs, seeds, wood, and fiber were found with most burials (~81%, n=202/248), and represented either midden debris from feasting or intentionally placed grave goods (Bellifemine 1997; Gardner 2013; Leventhal et al. 1993). Fragments of shell and shellfish were present in 75% of the burials, a majority of it being California horn snail (*Cerithidea* sp.), and the California oyster (*Ostrea lurida*). Clam (*Macoma* sp.), mussels (*Mytilus* sp.), abalone (*Haliotis* sp.), crab, fish, and turtle were less common. Unidentifiable faunal bone was discovered with approximately 57% of burials (n=142/248). Avian bone was noted separately and found in 13% of burials (n=31). Only 5% (13/248) of burials contained any plant remains. Adult burials contained the majority of organic material with no overall distinction between male and female (Bellifemine 1997; Gardner 2013).

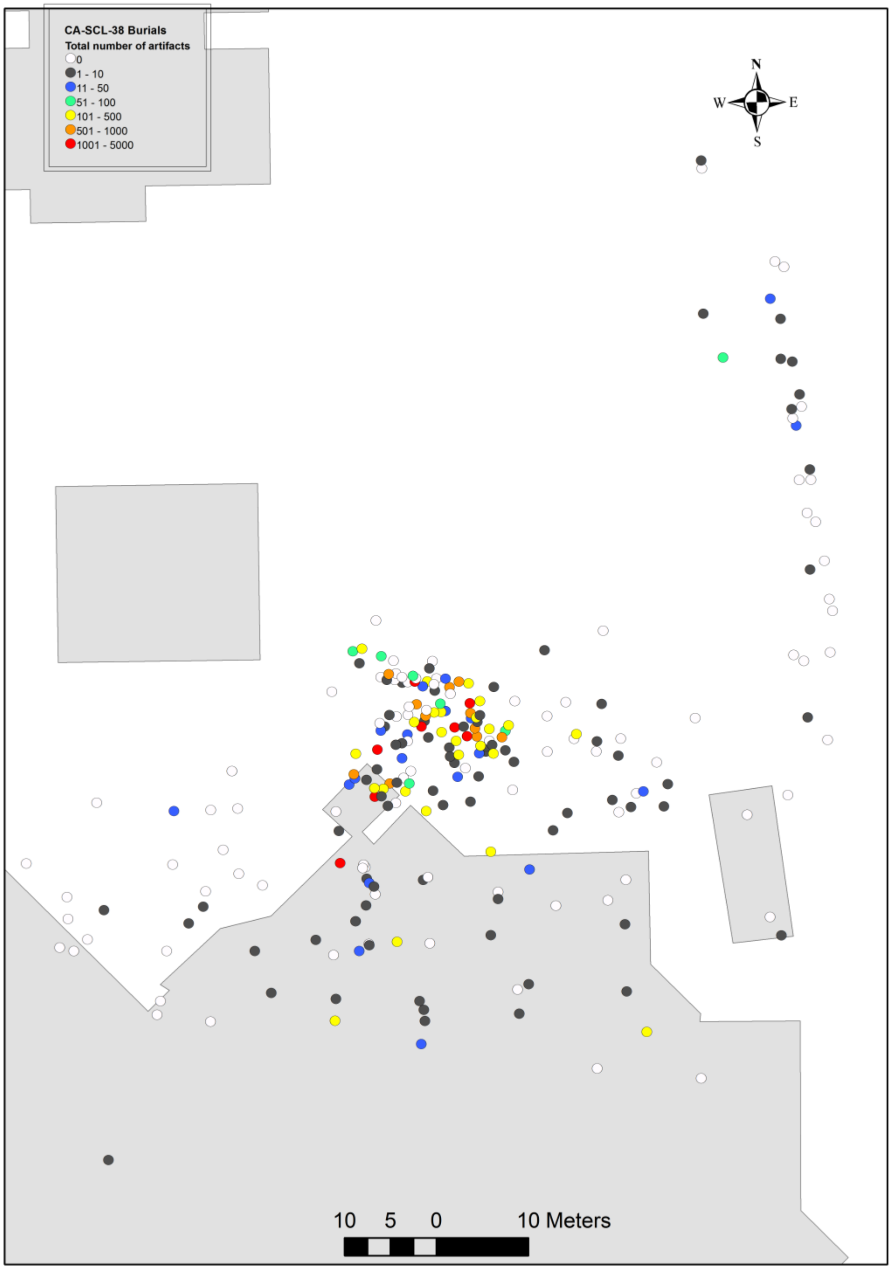

Figure 7. Distribution of Total Number of Artifacts at SCL-38.

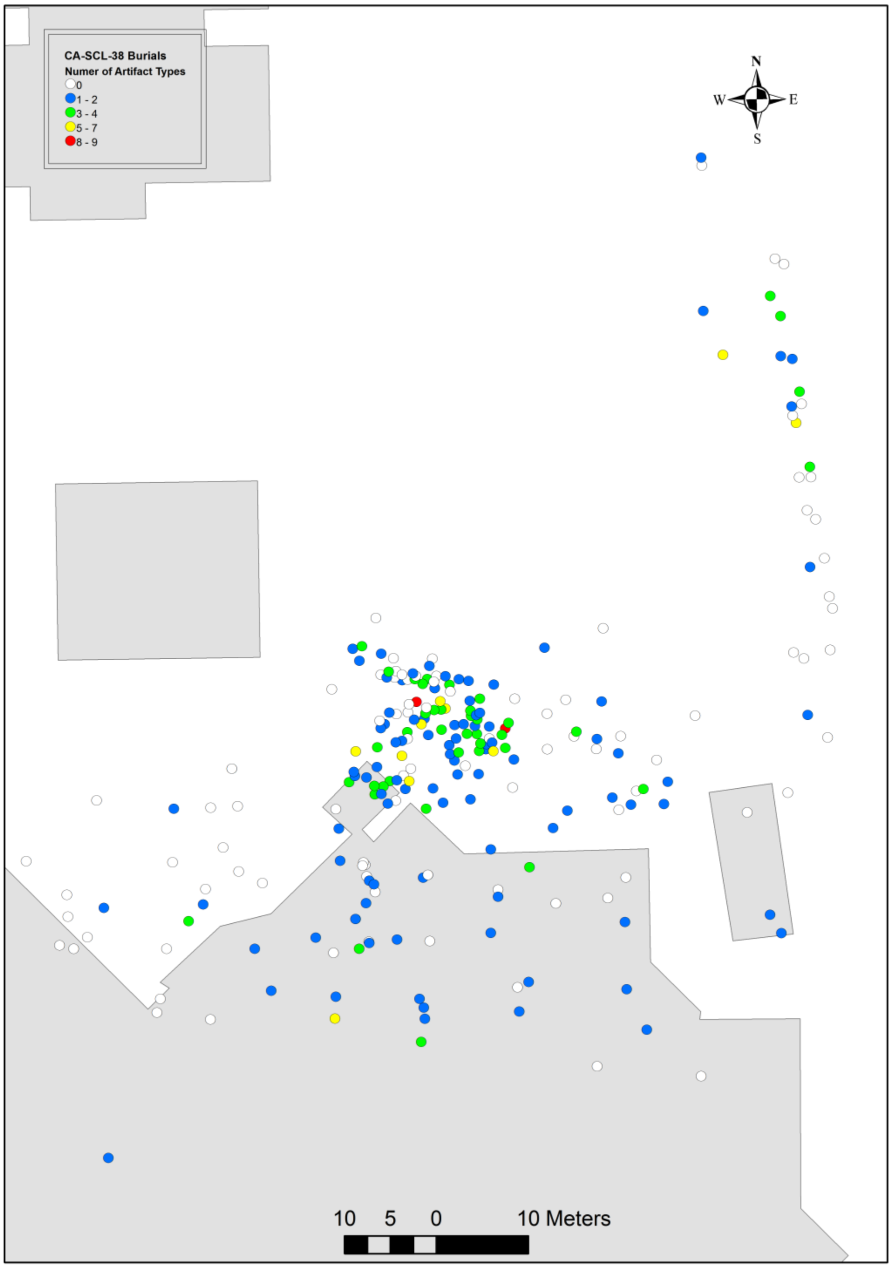

Figure 8. Distribution of Number of Artifact Types at SCL-38.

Bone and Antler Artifacts

Several types of worked bone were described among SCL-38 burials including bone scapulae, strigils, awls, needles, antler wedges, bird bone beads/tubes/whistles, elk rib pendants, elk antler caches, and various other unclassified bone objects (Bellifemine 1997; Gardner 2013). However, there is no correlation with age or sex with this artifact type. Bird bone whistles were the most frequent artifact type after *Olivella* beads and *Haliotis* ornaments. There were over 129 among 16 burials. Some had decorative shell applique and/or traces of asphaltum. B105 had two whistles with asphaltum, one of which had three rows of type M *Olivella* beads (rectangular series). B093 had a whistle with asphaltum and two additional burials (B164 and B166) had asphaltum with cordage impressions. Whistles were more frequent among males and, significantly, they were found more often with adults (Bellifemine 1997; Gardner 2013).

A rare type of elk rib pendants, measuring 20-35 cm in length, were found between two burials of adult females (B063, n=9 and B230, n=6) (Figure 9). An additional pendant was found with an adult of unknown sex. Some of these pendants, due to their darker color, may have been heat treated (B230) (Bellifemine 1997; Gardner 2013). The limited distribution, and the identification of this artifact type as elk, marks this item as a potential symbol of moiety affiliation.

Figure 9. Elk Bone Pendant from SCL-38

(Permission to use photos provided by maker of images Karen Gardner, 2013)

Shell Beads/Ornaments

Shell beads and shell pendant artifacts are classic examples of California mortuary remains that are considered clear markers of wealth and social status. How this wealth and status is related to inherited social inequality and to what degree remains unclear. Additionally, it is difficult to separate various aspects of social identities, as grave goods could have had double meanings that incorporated both status and ideology. The function of such objects as markers of wealth also makes them susceptible to the inconstancy of regional politics and thus stylistic change through time (Bellifemine 1997; Gardner 2013; Hylkema and Bethard 2007; Leventhal 1993; Milliken and Bennyhoff 1993; Milliken et al. 2007).

Four types of *Olivella* beads were found at SCL-38 and included 1) spire lopped (further divided into A1-simple spire lopped, A4-punched spire lopped, A5-applique spire lopped, spire lopped with cut sections); 2) type K1 and K2 callus; 3) type L2 thick rectangle; and 4) type M1/M2 thin rectangle (Bellifemine 1997; Gardner 2013) (Figure 10.).

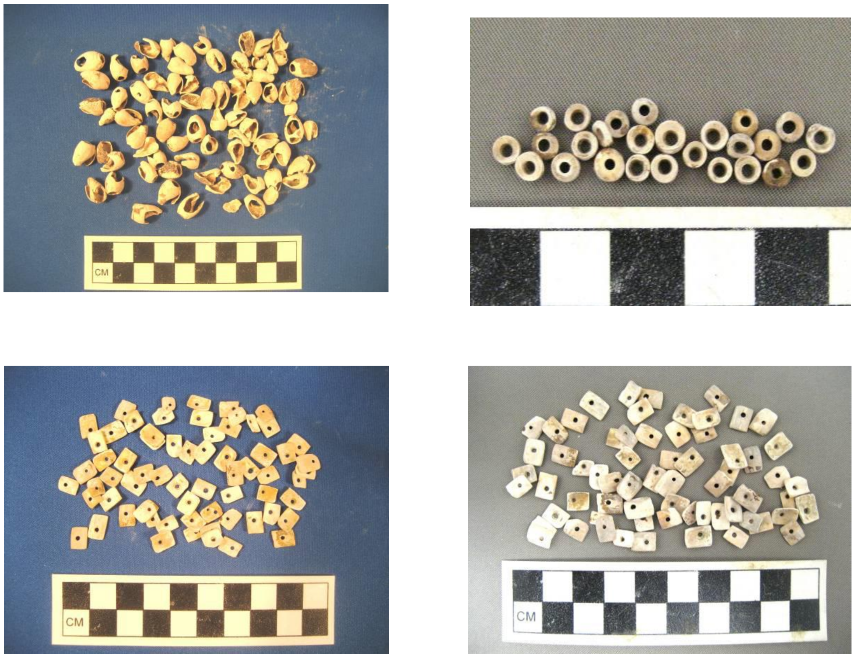

Figure 10. *Olivella* shell beads from SCL-38.

(Top left): Type A4/A5, provenience unknown. (Top right): Type K2 (Bushing) beads with B53. (Bottom left): Type M1 beads, provenience unknown. (Bottom right): Type M1 and M2 beads with B166. (Permission to use photos provided by photographer Karen Gardner, 2013).

More than half the burials (55%) contained no shell beads or ornamentation (Figure 11). However, when they did occur (approximately 23-38% of burials) the distribution differed by age and sex. Approximately 85% (~28,000) out of a total 33,081 beads were recovered from male graves. A majority of these (n=20,602) belonged to only 17 individuals. Most females (~63.5% n=40/63) were buried with no beads and only 19% (n=12/63) had between 1-10 beads. Two female burials stood out (B063 and B093) with over 500 beads each. Beads found with sub-adults were uncommon (~22%), with half of the burials containing fewer than ten beads. Burial 41 (age 10) had 109 beads, and Burials B137 and B178 (age <5 years) had 381 and 299 beads respectively. The variation in bead wealth suggests that different levels of inequality was present at SCL-38 and may have been organized according to age and sex. Whether these social roles were inherited is unknown (Bellifemine 1997; Gardner 2013).

Approximately 14,186 spire lopped *Olivella* shell bead were affiliated with 93 burials (37.5 %) at SCL-38 (Table 1) A large majority (~92%, n=13,049) were classified as A1-simple spire lopped and were found in 81 burials. The second most frequent was A4-punched (n=551) and co-occurred with A1 beads in 44 burials. Spire lopped with cut sections appears to be locally manufactured and were probably blanks for M type beads. A total of 478 beads appeared in 45 burials. A5-applique spire lopped beads are the only temporally diagnostic type recovered dating to the Protohistoric-Historic Period (Bennyhoff and Hughes 1987). Found among four burials, a majority (n=102/108) were found with three burials in the 160s cluster (B162, B163, B164) (Bellifemine 1997; Gardner 2013).

Bead Type	**Number of burials**	**Small (%)**	**Medium (%)**	**Large (%)**	**Total (%)**
Spire Lopped A1	81	3779 (90.3)	8021 (93)	1249 (92)	13049 (92)
Punched Spire Lopped A4	44	217 (5.2)	275 (3.2)	59 (4.3)	551 (4)
Applique Spire Lopped A5	4	0	102 (1.0)	6 (<1)	108 (1)
Spire Lopped Cut section A?	45	188 (4.5)	243 (2.8)	47 (3.5)	478 (35)
Total		4184	8641	1361	14186

Table 1. Distribution of Olivella Shell Beads at SCL-38.

Seven types of abalone pendants (Haliotis sp.) have been identified at SCL-38 and included 1) type S and Z rectangular; 2) type K circular; 3) type AB semi-circular; 4) type Q and AA trapezoidal; 5) type N banjo style (Kuksu); 6) type AP crescent; and 7) type U triangular. These were classified by Bellifemine (1997:215), following the typology of Gibson and Fenenga (1978). Approximately 570 abalone pendants (Haliotis sp.) were found with 56 (23%) burials (Bellifemine 1997; Gardner 2013) (Table 2).

Shell Ornament Type	**Number of burials**	**Total number**
Rectangular: Type S or Z	44	345
Circular: Type K	11	100
Semi-circular: Type AB	1	1
Trapezoidal: Type Q and AA	8	93
Banjo: Type N	7	20
Crecent: Type AP	4	7
Triangular: Type U	4	4
Total		570

Table 2. Distribution of *Haliotis* Shell Ornaments at SCL-38.

The unique banjo or “Big Head” pendants have a tentative distribution from Watsonville north to Calusa County, and east from San Francisco to Sacramento County (Breschini and Haversat 2000). They may have also been related to the ethnographic Kuksu Cult and, consequently, are a possible status marker (Leventhal 1993). At SCL-38, only 20 were recovered from seven burials. All were adult males (B51, B64, B71, B164, and B219) except for one who was an adult female (B189) and one of undetermined sex (B65). Stylistically the pendants date to the middle of the Late Period (Bellifemine 1997; Gardner 2013)

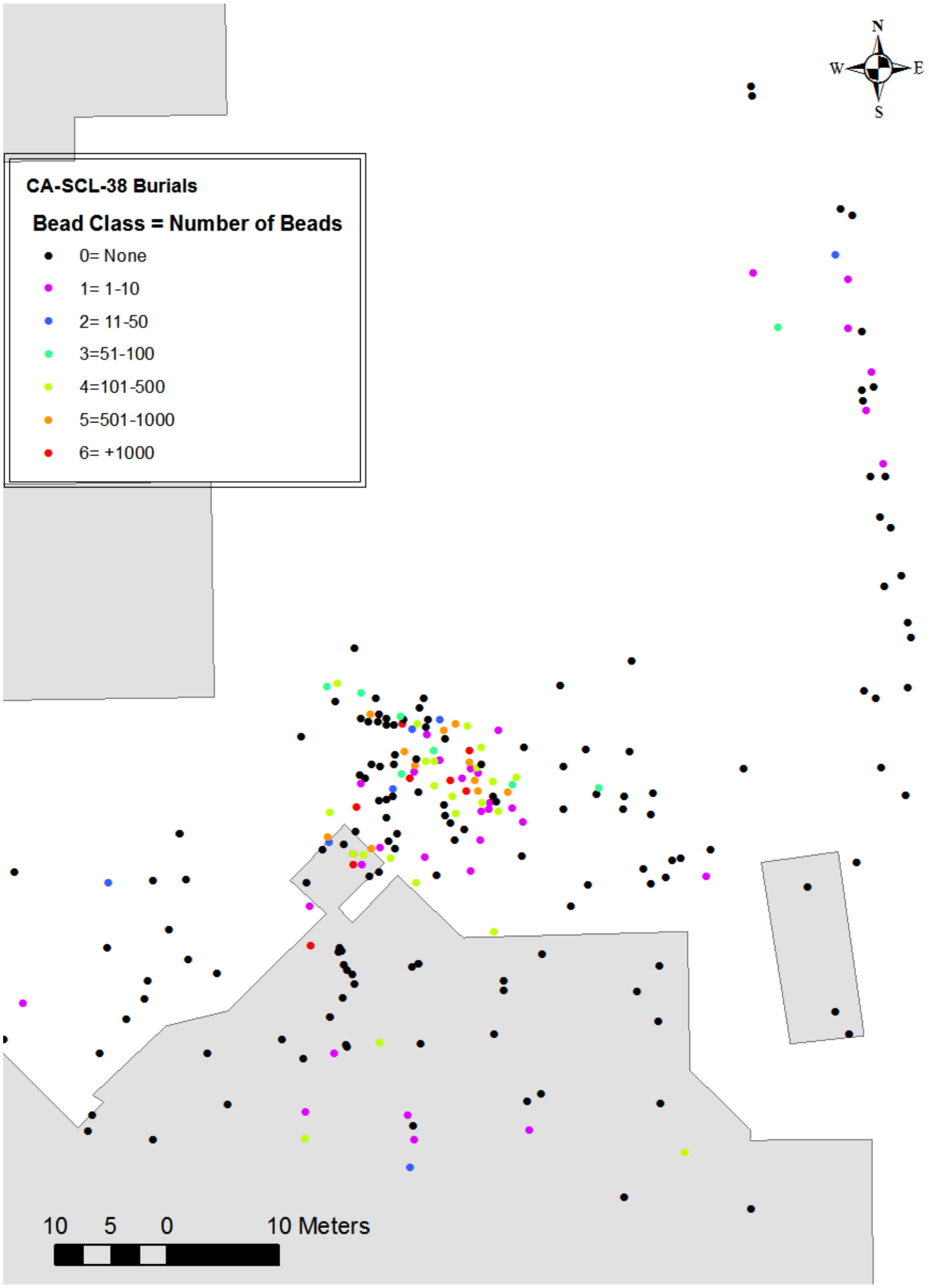

Figure 11. Distribution of Shell Beads at SCL-38.

Lithic/Stone/Groundstone Artifacts

Twenty obsidian projectile points and bifaces were found within burial contexts, with most of them being associated with violence and adult males. Six of these (B91, B140, B142, B143, B161, and B171) were unambiguous as they were imbedded in or lodged between bones (Bellifemine 1997; Gardner 2013).

Twenty-two mortars were found within 21 graves. Groundstone has been argued to have become stylistically more diverse in the late Holocene, possibly representing change in function. This is most apparent with large and heavily decorated mortars (flower-pot) as well as disproportionately long pestles, both of which may have had been associated with ritual feasting and elite status (Leventhal 1993; Buonasera 2012). There was no overall sexual preference for the placement of mortars at SCL-38 with an almost equal number being found among males and females (Bellifemine 1997; Gardner 2013).

At SCL-38, 65 pestle and pestle fragments were recovered. Length varied from 6.5 cm to 64 cm. Twenty-four were isolated surface finds while the remaining 41 pestles were found among 29 burials. Ten of these pestles had been ritually broken (“killed”), the significance of which is unknown. Twenty-nine have moderate wear patterns, while 21 show little to no use, supporting the view that these objects functioned as more than utilitarian objects (Bellifemine 1997; Gardner 2013). Manos (handstones) were particularly uncommon, with only three being identified.

Seven stone beads (6 magnesite, 1 steatite) were recovered from three adult burials (B53, B65, B117), all of whom were also found with *Olivella* and *Haliotis* shell artifacts. Ethnographically, magnesite was a much valued raw material and often associated with higher status individuals. The nearest source of magnesite is Lake County, north of San Francisco Bay (Goldschmidt 1976). Additionally, King (1978a) described steatite and magnesite beads as having a decorative rather than a monetary function which were used to validate the status of elite individuals (Bellifemine 1997; Gardner 2013).

All charmstones (n=39) were unperforated, with one recovered from the articulated elk burial (B2). The remaining 38 charmstones were distributed among 13 burials (~5%), mostly adult males (B13, B71, B73, B97, B130, B140, B148, B160, and B175). The exceptions are two adults of indeterminate sex (B91 and B134), a wealthy female burial (B093), and one child (B178). Styles include squat (n=11), piled (n=31), and plummet piled (n=2). Many (n=18) had asphaltum residue at the proximal ends. There is also a high correlation with age; older individuals were found with higher frequencies of charmstones (Bellifemine 1997; Gardner 2013). The function of charmstones has been speculated but is ultimately unknown. It has been argued to have served as either a utilitarian (net sinker or bolas) or a ritual object, although most researchers tend to accept the latter explanation. In the San Francisco Bay area, most have been found outside a burial context and show wear. Stylistic variance has also been associated with different time periods. Within SCL-38 there exists a contradiction, since charmstones were not only found within burial contexts but more than seven burials had more than one type, suggesting they were in use at the same time and that they had ritual importance (Elsasser and Rhode 1996; Rhode 1996; Van and Wiberg 2011).

Cemetery Organization

Cluster analysis, using the agglomerative hierarchal technique (Bellifemine 1997; O'shea 1984), displayed a high degree of spatial organization among the burials. This consists of a central cluster surrounded by two concentric partial ring sections (two sections in the middle ring and two in the outer) which correlated with both age and sex (Figure 12).

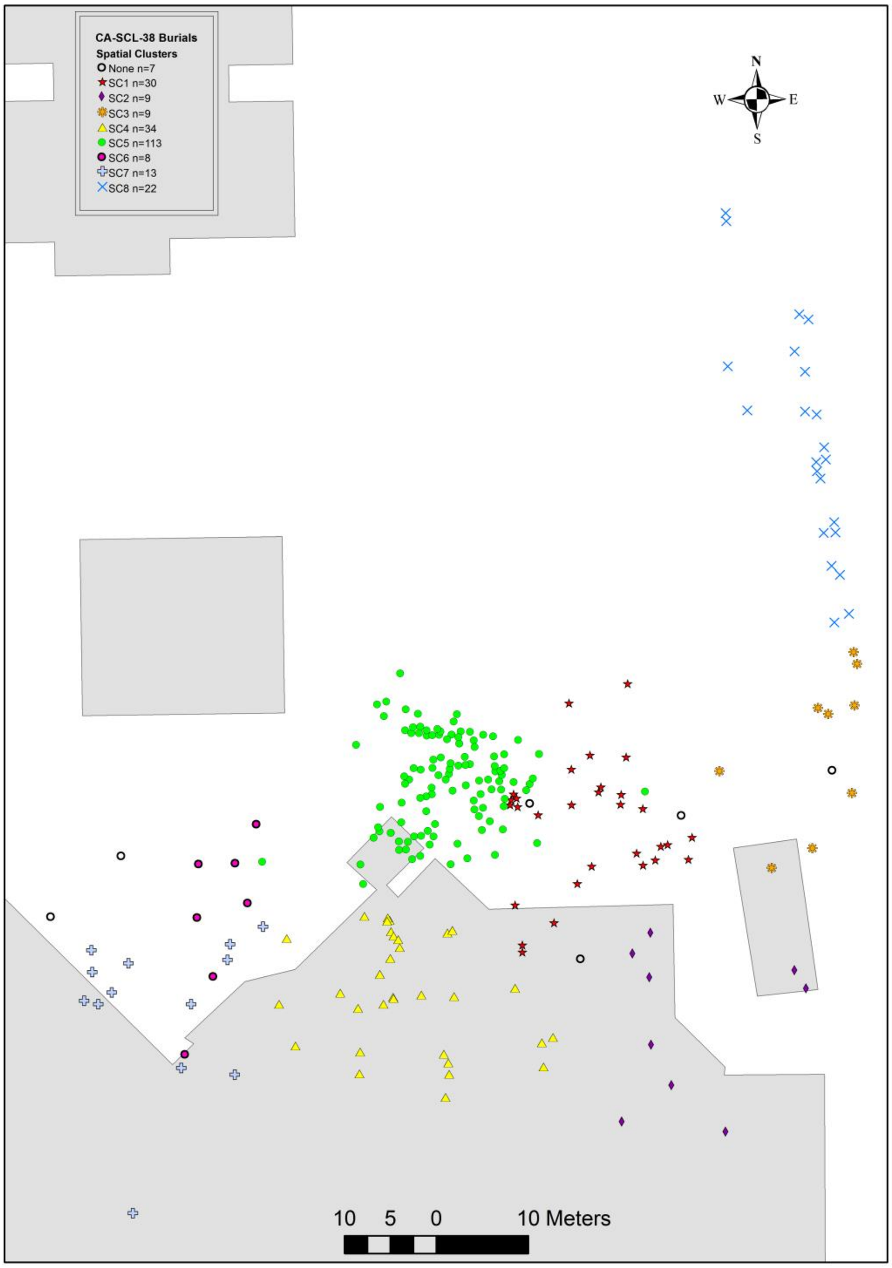

Figure 12. Distribution of Spatial Clusters at SCL-38.

The two outer rings had a balanced sex ratio, with preferential areas for youths, elders, and infants in the intermediate and peripheral areas. Spatial Cluster 1 (SC1) contained 31 individuals. There was an overrepresentation of elderly females and children, but infants were absent. However, the overall sex ratio was relatively equal at 1:1.09 (Bellifemine 1997). Spatial cluster 2 (SC2) contained nine burials and had an overrepresentation of mostly female elders (~40%). The sex ratio was 1.5 females to one male and no children or infants were identified. Most graves contained less than one artifact. Spatial cluster 3 (SC3) deviated the most from a normal sex ratio being 2:1 in favor of female, most of whom were elders. Graves in this sector appeared to be oriented to the cardinal directions. Like SC2, most burials had one or no artifacts (Bellifemine 1997). Spatial cluster 4 (SC4) was comprised of 34 burials just south of SC5. There is an almost balanced sex ratio (1.08:1) with a slight overrepresentation of females (n=6, 67%) and infants (n=13, 20%) and underrepresentation of males and subadults. Grave good density and diversity were intermediary between all other spatial clusters being neither "rich" nor "poor." Based on these data, Bellifemine (1997) hypothesized that this cluster represented lineal descent groups.

The central cluster (spatial cluster 5) had burials (n=114) that necessitated investment in terms of time and energy and displayed the highest quantity and diversity of mortuary wealth (Bellifemine 1997). These burials were almost exclusively adult males and were associated with localized burning (whether it was cremation, partial cremation, interment pit burning, or burning of artifacts) and semi-flexed inhumations. Artifacts restricted to this cluster, and therefore predominately associated with males, included charmstones, type K and M *Olivella* beads, and stone pipes. Two notable exceptions to this pattern were the inhumations of two females aged approximately 25-40 years old and 44-55 years old (B063, B093). Grave wealth, both in quantity and rarity, with these two individuals was unquestionably higher than most within the entire site, and included objects usually restricted to males (Bellifemine 1997).

Spatial cluster 6 (SC6) did not deviate from expected norms. Burials represented a balanced sex ratio and grave wealth was an average between high and low. Spatial cluster 7 (SC7) contained burials that generally had one or no artifacts. Overall, it was similar in composition to SC2 and SC3 with more adults of unknown sex, females, and children. Finally, spatial cluster 8 (SC8) had 22 burials and an equal number of adult males and female (Bellifemine 1997).

Two infant burials and three children, while interred outside the central area, did have a significant amount of grave goods, displaying 74% more mortuary remains than the average burial, indicating some sort of status or wealth. In general, artifacts associated with wealth and status were preferentially interred with males, but with the exceptions discussed above. No other statistically significant correlations with either age or sex were present among all other artifact types including beads, mortars, or pipes. However, factor analysis indicated linked relationships between functional artifacts such as mortars and pestles with symbolic objects such as shell beads. Notably the mortars and pestles showed little evidence of wear and approximately half of them were ritually broken, suggesting that they were not functional objects. This pattern was also seen in a distinction between utilitarian bone tools and bone tubes and whistles (Bellifemine 1997).

The outside clusters could represent lineal groups, clans, or moieties. While not conclusively documented, it has been argued that the Ohlone had lineal descent groups, clans (individuals who claimed unilineal descent, usually from a very distant common ancestor often referred to as a supernatural being), and a moiety system. Miwok groups were represented by two major moieties and various sub-moieties, each with its associated animal totem which includes elk/deer and bear (Field and Leventhal 2003; Jones 2009). The articulated animal burials discussed earlier may be such totem animals and represent spatial subdivisions within the site. If true, this would support the hypothesis that the SCL-38 burials are organized around a clan or moiety subdivision with particular lineages clustering around either the elk or the bear burials. Additionally, individuals often had a “dream helper” linked to a particular animal spirit. While these dream helpers were specific to individuals, they oftentimes mimicked their moiety and sometimes clan totem and tended to be inherited from one generation to the next (Field and Leventhal 2003). Although it is unknown what specific animal represented any given clan among the Ohlone, they may have mirrored the moiety totem.

Modes of Interments

Disposal

Burials consisted of inhumation and partial and full cremation including primary and secondary deposits. A total of 196 (89%) of the burials were recorded as primary inhumation and were evenly distributed across age and sex. Partial or full cremations accounted for approximately 14% of all burials (n=35), while 155 burials (~64%) were "fire affected," which includes evidence of pre-interment burning, post-interment burning, vitrified clay, and cremations. Burning was seen equally between both sexes and across age brackets, although full cremation was slightly more common among adults. Sex in these cases could not be consistently identified; those that were identified showed a bias toward males (10%, n=10 of 99) rather than females (6%, n=4 of 63) (Bellifemine 1997; Gardner 2013).

A flexed position characterized approximately 87% of all burials. Sub-adults were often found in a tightly flexed position while adults were associated with a semi-flexed position. No burials conformed to the "Windmiller" or "Meganos" styles (Bellifemine 1997; Gardner 2013). Cardinal orientation data was documented for 202 burials. No significant pattern was observed by Gardner's (2013) classification; however, Bellifemine (1997) noted a statistically significant excess of elders oriented to the north and adults of both sexes to the east. The discrepancies may be due to inconsistencies in the burial records, especially when individuals were oriented between two cardinal directions. However, both authors agree that there was a trend for burials of subadults to be oriented toward the north and west (Bellifemine 1997; Gardner 2013).

Gardner (2013) reported frequencies of disposition for 196 individuals in which records could be reconciled. More than half the burials were buried on either left or right side (n=93), with slightly higher frequency of individuals being placed on their right side. The second most noted burial placement was dorsal positioning, which might have been more frequent for adults than subadults, who were more typically buried on their side. More rarely, individuals were buried kneeling face forward. Bellifemine (1997) found statistically significant patterns indicating males were more likely to be buried in a dorsal position or ventrally with their head positioned towards the left. Females were most likely to be buried ventrally on their right side or with flexed legs spread to each side. The ventral position was exclusive to adults. Two other unique dispositions were noted. Seven individuals were buried in a seated position and two other individuals were buried head first (B008 adult male; B145 adult female) (Bellifemine 1997; Gardner 2013).

Special Treatment

Twenty-five double burials, three group burials, and 176 single interments were dispersed throughout the site and represented both adult with adults, and adults with children, with no other particular distinctions. Twelve individuals, coined the 160s cluster (B161-169; B148; B184), were buried in a rough semicircle (Figure 13).

Figure 13. 160s Burial Cluster (B161-169; B148; B184).

(Courtesy of Ohlone Families Consulting Services, Used with Permission of the Muwekma Ohlone Tribal Council).

While not a “group” burial per se, individuals were so closely interred as to be almost touching (Bellifemine 1997). All burials were male except for an elderly female, one child, and one adult of undetermined sex. Previous cluster analysis placed all these individuals into SC5. One adult male individual was a partial cremation and five other adult males had evidence of burning. Overall, the 160s cluster may have represented a familial group. Nine other graves (3 elders and 6 children) were buried under rock cairns well away from the central portion of the site. Cairns were defined as any quantity of rocks, cobbles, or chunks of vitrified clay that surrounded the remains. While the elders were all male, sex was indeterminate for the sub-adults. All but one individual had evidence of burning and no mortuary goods were found within any grave (Bellifemine 1997; Gardner 2013).

A group burial of three young males, located outside the central portion of the site in SC4, represented the only individuals found in extended positions (Bellifemine 1997). A fourth male was placed face down, haphazardly on top of the other individuals. Christened the “Mystery Men,” (Figure 14) they all had evidence of trauma which included fractures and embedded projectile points indicating that they died violently (inferred soft tissue trauma) (Monroe et al. 2013a). The Mystery Men (B141-B144) were buried in a non-traditional manner, without any formal positioning, and exhibited burial treatment similar to victims of trophy taking (which included group burial, ventral and/or haphazard positioning, young adult males, and perimortem trauma) (Andrushko et al. 2005; Andrushko et al. 2010; Bellifemine 1997; Musladin et al. 1996). However, these individuals lacked cut marks that indicated the dismemberment associated with trophy taking.

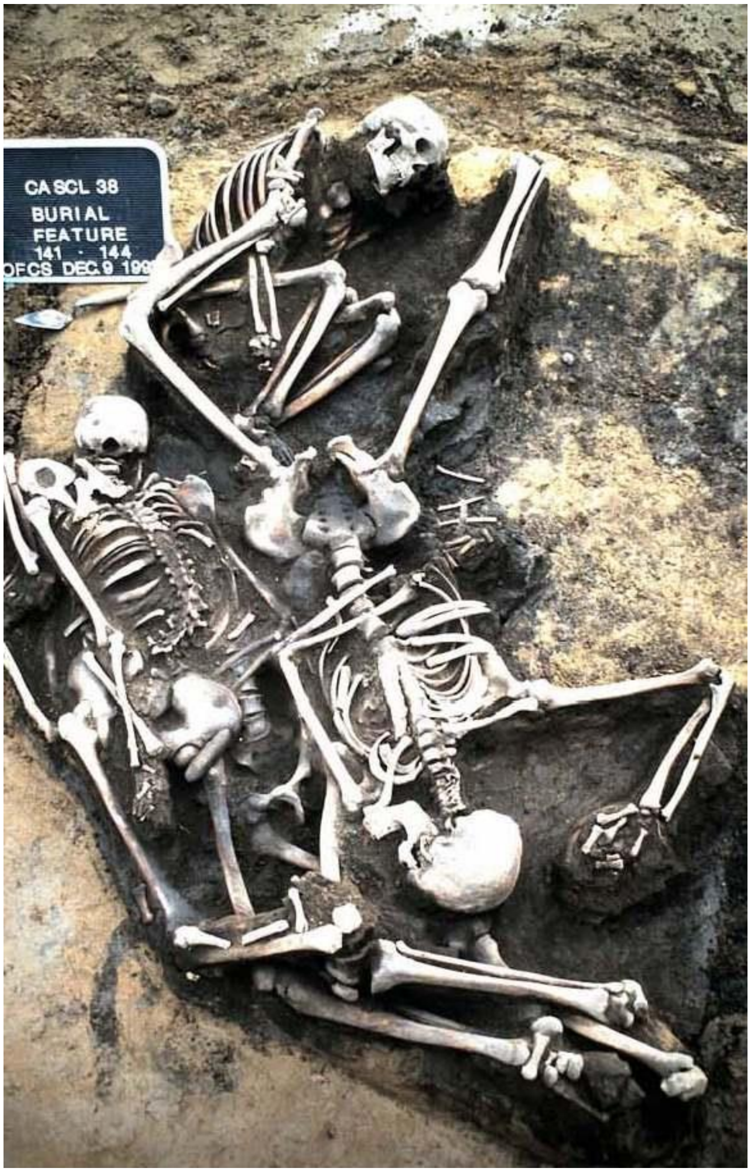

Figure 14. "Mystery Men" Burials (B141-B144).

(Courtesy of Ohlone Families Consulting Services, Used with Permission of the Muwekma Ohlone Tribal Council).

Radiocarbon dating of B144 placed the assemblage within the Late Period, just before the beginning of the Mission Period in California. These young men may have been members of a regional community or outsiders, interred amidst the local population. The inclusion within a structured cemetery would suggest that these men were not enemies but were perhaps allies in conflict and were afforded burial within the cemetery but without any formal funerary ritual. This is supported by burial positions and lack of grave goods (Leventhal Personal Communication).

Stable isotope values of carbon, nitrogen, and sulfur from bone collagen, when considered in totality, fall outside the entire Central Californian region. Based on their low $\delta^{15}N$ values, they consumed lower trophic level foods than Bay-area populations, suggesting a terrestrial diet with little to no input from freshwater fish or marine foods. $\delta^{13}C$ values, in contrast, were most similar to coastal locations, but may also reflect a different combination of foods from terrestrial sources. $\delta^{34}S$ values were similar to those found in the Sacramento Valley; however, carbon and nitrogen values do not fall within expected ranges for that region (Gardner 2013). The placement of these young men within SC4 was intriguing as it provided some evidence against the notion that all individuals in this cluster were close kin; however, this group burial could represent distant kin who provided support during a territorial dispute (Monroe et al. 2013a).

Site Chronology

Multiple sources have been used to develop a cohesive site chronology for SCL-38. This includes radiocarbon dating, obsidian hydration estimations, and *Olivella* and *Haliotis* bead typologies. Data presented here are from Gardner (2013) who compiled all temporal data from presented/previously published data, in addition to reconciling discrepancies. Calibration of AMS dates for marine effects will follow that devised by Gardner (2010) and Bartelink (2006). The approach used in these studies calculated "percent marine" with a linear mixing marine calibration model based on measured $\delta^{13}C_{Collagen}$ values. Endpoints were selected to represent local food values, based on the botanical and faunal isotope studies highlighted in Bartelink's (2006) review of Central California resources. Radiocarbon results were calibrated using the CALIB 6.1.1 program (Stuiver et al. 1993) and the NH Mixed Marine calibration curve was used with a reservoir correction (ΔR) of 365±50 which was recommended for individuals consuming a mixed-marine diet in the San Francisco Bay area (Gardner 2010; Gardner 2013; Gardner et al. 2012; Gardner et al. 2011) (Table 3). Dates range from 2205 BP to 245 BP spanning from the Early Period to contact. Obsidian hydration was performed on 27 samples associated with burials. Analysis was done by Glen Wilson in 1995. An X-ray fluorescence (XRF) study by Craig Skinner (1996) (Northwest Research Obsidian Studies Laboratory in Corvallis, Oregon) identified the source for all samples as coming from Napa Valley except for one which is from Sonoma County-Annadel Source (Table 4) (Bellifemine 1997; Gardner 2013).

Sample ID	Source	14C Age Uncalib	Error	14C Calib	Error	Period
B004	LLNL-2010	365	25	401	53	Late Period 2A
B008	LLNL-2010	405	25	391	41	Late Period 2A
B013	WSU-1996	450	50	465	50	Late Period 2A
B021	WSU-1996	860	150	875	150	Middle/Late Transition
B022	WSU-1996	680	70	890	70	Middle/Late Transition (Grizzly Bear)
B035	LLNL-2010	910	25	711	36	Late Period 1A
B040	WSU-1996	470	200	485	220	Late Period 1C
B051	WSU-1996	440	160	455	160	Late Period 2A
B063	WSU-1996	1160	150	1175	150	Late Middle Period
B064	WSU-1996	440	230	455	230	Late Period 2A
B084	LLNL-2010	830	30	644.5	26.5	Late Period 1B
B090	LLNL-2010	690	25	582.5	29.5	Late Period 1B
B091	WSU-1996	690	220	705	220	Late Period 1B
B093	WSU-1996	620	60	635	60	Late Period 1B
B097	LLNL-2010	815	25	657	24	Late Period 1B
B107	WSU-1996	735	85	750	85	Middle/Late Transition
B117	WSU-1996	1540	180	1555	180	Early Middle Period
B120	LLNL-2010	670	25	613.5	33.5	Late Period 1B
B132	LLNL-2010	790	25	670	23	Late Period 1B
B144	WSU-1996	230	50	245	50	Late Period 2B
B166	LLNL-2010	840	35	647	30	Late Period 1B
B167	WSU-1996	1130	170	1145	170	Late Middle Period
B171	WSU-1996	340	30	355	30	Late Period 2A
B178	WSU-1996	880	280	895	280	Middle/Late Transition
B179	WSU-1996	1710	200	1725	200	Early Middle Period
B182	LLNL-2010	805	25	656.5	23.5	Late Period 1B
B209	LLNL-2010	370	40	366	95	Late Period 2A
B210	LLNL-2010	295	35	296	31	Late Period 2A
B227	LLNL-2010	520	25	509.5	23.5	Late Period 1C
B230	WSU-1996	1210	120	1225	120	Late Middle Period
B240	WSU-1996	2190	170	2205	170	Early/Middle Transition

*WSU-1996Calibrated data from Hylkema 2007

Table 3. Radiocarbon 14 Dates from SCL-38.

Sample ID	Burial	Description	Material	Hydration band (microns)
1-1	1	Biface fragment	Napa	1.9
4-1	4	Biface fragment	Napa	2.3
10-1	10	Biface fragment	Napa	2.3
21-1	21	Serrated proj point	Napa	2.0
21-21	21	Biface fragment	Napa	2.0
42-5	42	Biface fragment	Napa	2.2
58-4	58	Flake	Napa	1.7
72-1	72	Serrated proj point	Napa	1.5
73-14	73	Biface fragment	Annadel	1.7
82-3	82	Serrated lanceolate	Napa	1.8
86-8	86	Stockton serrated proj pt	Napa	2.9
86-9	86	Stockton serrated proj pt	Napa	1.9
92-6	92	Stockton serrated proj pt	Napa	2.1
100-4	100	Flake	Napa	2.0
140-6	140	Stemmed proj pt	Napa	1.9/2.2
144-4	144	Serrated proj point	Napa	2.0
144-10	144	Flake	Napa	1.5
149-1	149	Serrated proj point	Napa	1.8
150-1	150	Serrated proj point	Napa	1.8
152-3	152	Serrated proj point	Napa	1.7-1.8
171-7/21	171	Biface fragment	Napa	1.8-1.9
218-1	218	Serrated proj point	Napa	1.6
225-6/14	225	Proj pt fragment	Napa	1.9-2.3

Table 4. Obsidian Hydration Dates from SCL-3.

The bead typology was based on the presence of three bead classes at SCL-38 for which a temporal association could be made: Class A5 (applique spire-lopped), Class K (callus or bushing beads), and Class M (thin rectangles) (Bellifemine 1997; Bennyhoff and Hughes 1987). *Haliotis* pendants, specifically the banjo type, were identified by Bellifemine and dated using the guidelines of (Gibson and Fenenga 1978). Across all methods, the bulk of the beads belonged to the Late Period. A few burials were associated with the Middle-Late Transition. However, the seven burials radiocarbon dated to the Middle Period or earlier may be in error, as they conflicted with other temporal assignments and in general did not fit the overall chronology of the site (Gardner 2013). While the chronological data amassed for SCL-38 strongly suggests a predominately Late Period occupation, there are still inconsistencies which limit interpretation of how the site was utilized through time (specifically through multiple periods). Radiocarbon dates conducted in 1996 from Washington State University which indicate an earlier occupation (i.e., for more than 2,000 years), are concerning and this is compounded by the larger error range for these dates. Other dating techniques and the overall temporal patterning found at the site do not support occupation prior to 780 BP (Bellifemine 1997; Morley 1997), and is consistent with site intensification throughout the Middle/Late Period Transition and into the Late Period (Gardner 2013).

VII. Theoretical Background

Explaining the development of emergent social differentiation, as well as understanding its variation, is a primary objective in archaeology. However, the ability to identify the presence and degree of social inequality in the archaeological record remains somewhat elusive (Chapman 2003, Ames, 2007). Mortuary studies, while criticized for being overly deterministic, is still one of the best lines of evidence to understand social differentiation (Gamble et al., 2001; Ames 2007; Milliken et al. 2007). As social differentiation and inequality exist along a spectrum, it is also important to understand how concepts of sociopolitical complexity are defined and how the history of mortuary theory influences these ideas, especially in the San Francisco Bay region.

Sociopolitical Complexity

Classic research on the rise and evolution of sociopolitical complexity among forager societies generally rely on trait-based approaches, namely through identification and analysis of archaeological correlates of complexity, such as monuments, levels of social exchange (e.g., long distance trade and/or appearance of exotic goods), evidence of storage (i.e., indicative of surplus resources), territoriality, sedentism, and high population density (Barnard and Woodburn 1988; Brown 1995; Hayden et al. 1995; Price and Brown 1985). Others have focused on identifying the proximate and ultimate causes of complex social organization, determining whether and how 1) leadership (by proxy of wealth and status) was inherited; 2) labor was controlled; and 3) specific ecological conditions that were catalysts for the emergence of cultural complexity, be it environmental stress (as in the case of the Chumash) or abundance (Columbia Plateau), which led to dramatic economic shifts and changes in modes of production (Arnold 1995; Arnold 1996; Arnold and Ebrary 2001; Hayden 1996; Hayden et al. 1995; Hayden and Schulting 1997). While the above approaches appear relatively straightforward, some cases of hunter-gatherer social complexity are more nuanced and less clear-cut, such as is the case in the Kodiak Islands, Central California, and Florida (Fitzhugh 2003; Luby 2004; Luby et al. 2006; Sassaman 2004). The trait list approach has been criticized since researchers were potentially ignoring variants to this schema (i.e., nonegalitarian groups missing some traits while egalitarian groups incorporated these cultural actions into their daily lives) (Sassaman 2004). Separately categorizing cultural characteristics also “muddied the theoretical water,” as some variables are invariably linked (i.e., sedentism and storage, or sedentism and territoriality) and are cultural processes that fluctuate, change, and vary in levels of intensity through time, while still maintaining actual social inequality (Ames 2007; Fitzhugh 2003; Kelly 1995; Sassaman 2004). The latter approaches, while making remarkable advances in theoretical application, have been critiqued for trying to discover an overarching set of conditions that would be applicable to all cases of hunter-gatherer complexity. However, no single anthropological theory explains every case of permanent social inequality (Diehl 2000; Lightfoot 1993; Sassaman 2004).

Fundamental to the discussion is the meaning, definition, and use of the term complexity, and its relationship to concepts of inequality, rank, and stratification. Current archaeological theory accepts that the development of cultural or sociopolitical complexity is not a process of leaping from “simple” hunter-gatherers to more “advanced” hunter-gatherers who are designated as tribes or chiefdoms. Rather, all groups have the potential for non-egalitarian behavior and the term complexity is a relative measure of differentiation with inequality falling along a continuum (Fitzhugh 2003; Sassaman 2004). Thus, Ames (2007) defined inequality within each society as a range from highest to lowest (both vertical and horizontal), with each individual’s rank contingent upon every other member. On a broader scale, populations are ranked relative to other groups (Ames 2007). The vertical and horizontal component of this definition allows for more than one avenue of differentiation in a group and, consequently, multiple sources of power (i.e., economic, military, and ideological power) (Earle 1997). However, distinctions of permanent inequality can be made. Foraging groups are not truly “ranked” unless there exists differential or limited access to not only positions of power, prestige, and authority but also to basic resources necessary for survival (Ames 2007). Along the same vein, Fitzhugh (2003) described hunter-gatherers as complex (which he equated as rank or stratification) only when inequality was institutionalized and where family units were incorporated into new sociopolitical units (i.e., inherited). In California, these sociopolitical transformations are often cited as a consequence of ecological conditions that resulted in population pressure and social circumscription (Beaton 1991; Bettinger 1991; Lightfoot 1993).

Mortuary analysis offers an opportunity to study the diversity of material remains associated with different social or biological groups as well as exploring the meanings behind the practices performed during interment (Binford 1971). Studies of mortuary behavior have addressed the issue of social complexity by associating mortuary remains and burial treatment as an indirect reflection of rank, social differentiation, and territoriality (Brown 1971a; Brown 1995; Brown 1971b; Goldstein 1980; O'shea 1984; Saxe 1970; Shennan 1975; Tainter 1978). This approach has been criticized for arbitrarily applying a direct correlation between mortuary behavior to social roles that were part of daily life, which may or may not be a valid interpretation (Brumfiel 2006; Clayton 2011; Hodder 1982; Hodder 1995; Pader 1982; Pearson 1982; Pearson 1993; Pearson 1999). Still, mortuary studies, specifically from a bioarchaeological perspective, are indispensable in understanding social inequality (Ames 2007; Gamble et al. 2001; Milliken et al. 2007).

Mortuary Studies in Historical Perspective

Current archaeological approaches to mortuary behavior developed out of Kroeber’s (1927) critique of the belief that mortuary practices held social meaning. Through cross-cultural comparison of California groups, Kroeber concluded that the disposal of the dead did not correlate to other aspects of society. Mortuary behavior, and therefore the practices that are visible in the archaeological record, reflect very little of a society as a whole. It was not until the 1960s that a series of independent anthropological works by Hertz, Gennep, and Bloch and Goody began to reconsider the role and meaning of mortuary ritual (Rakita et al. 2005).

Saxe (1970) conducted a cross-cultural ethnographic study in conjunction with formal hypothesis testing. The primary goal was to establish whether social roles of the deceased, as well as the level of social complexity of the society as a whole, have an impact on mortuary practices. Formal cemeteries were observed to be linked to territoriality and the control of resources. Maintenance of cemeteries further sanctioned ownership by legitimizing ties to ancestors. Shortly thereafter, the seminal work *Approaches to the Social Dimensions of Mortuary Practices* (1971b), edited by James Brown, was published. The major themes of this volume focused explicitly on understanding mortuary practices within a social context and how to use such data to make interpretations about past societies. Ethnographic analogy is considered essential in explaining past social structure, especially social ranking, through the analysis of mortuary goods. Quantitative analysis of both osteological and cultural data is highlighted as a means to interpret the past (Chapman 2003). In particular, Brown's (1971a) chapter on Mississippian Spiro Mound was influenced by Saxe's approach. His study used more formal analysis techniques which aimed to find a correspondence between grave goods and social stratification. The most influential chapter in this volume, however, is Binford's (1971) *Mortuary Practices: Their Study and Potential*. Divided into two parts, the first was a critique of the diffusionist paradigm, which emphasized culture change through the movement of people and ideas. In the second half, cross-cultural ethnographic data from 40 indigenous societies was presented, which refuted Kroeber's stance and emphasized social context as a way to explain variation in mortuary behavior. Subsistence strategy was used as a proxy for sociopolitical complexity. As groups moved away from hunter-gatherer subsistence patterns, mortuary rituals become increasingly elaborate. Furthermore, it was maintained that in order to understand mortuary practices one must also consider the social persona of the deceased, which included age, sex, social rank, cultural affiliation, and cause and location of death. As the number of social roles a person held increased so too would the material symbols of those roles. These would then be visible in the archaeological record. Symbols of status would be displayed through grave goods and modes of interment (Binford 1971; Brown 1995; Morris 1991; Rakita et al. 2005).

The presence of high quality and quantities of grave goods, as well as the amount of energy expended for burials, became a signifier for elite status. Cemetery analysis also emphasized quantitative methods, such as cluster analysis and principal components analysis in order to identify archaeological markers of social inequality (O'Shea 1984; Shennan 1975). These "correlations" soon became assumptions and a common theme for future mortuary studies. Grounded in the processual or "New Archaeology" movement, this theoretical foundation became known as the Saxe-Binford approach and is still the dominant framework for American mortuary studies, although refinement and reevaluation became a consistent theme in the ensuing decades (Beck 1995; Brown 1995; Charles and Buikstra 1983; Goldstein

1980; Goldstein 1981; O'Shea 1981; Peebles and Kus 1977; Tainter 1978; Whittlesey and Reid 2001). Reappraisal of the Saxe-Binford model as well as the presentation of new methodologies appeared in *The Archaeology of Death* (Chapman et al. 1981). Goldstein’s contribution to this volume reassessed Saxe’s (1970) correlation of cemetery use and territoriality. She argued that not all corporate groups maintained discrete cemeteries; however, if discrete cemeteries did exist they were organized according to lineal descent. This concept was later expanded by Charles and Buikstra’s (1983) work among Mississippian sites and reconfirmed by Morris (1991). Scholars cautioned that it is necessary to make a distinction between rituals which confer rights to living descendants and behavior associated with funerals and the deceased (Morris 1991). However, these two distinctions are not necessarily exclusive and it is unclear how such distinctions could be made with many artifact assemblages. This mirrored Brown’s (1981) approach, which highlighted the need to consider the entire process of funerary ceremonialism; thereby acknowledging that archaeological assemblages represented only a small part of the whole.

O’Shea’s (1984) comprehensive analysis of proto-historic Arikara cemeteries attempted to reconcile these discrepancies as he noted that no one comprehensive theoretical approach exists that did not rely on ad hoc assumptions. Of importance was determining if social mechanisms constrained variation in mortuary data and if so how any social variability would be displayed within a mortuary context. Using quantitative techniques and the classification of grave goods, he concluded that individuals were ranked vertically through both ascribed and achieved statuses. However, markers of "horizontal" differences, such as clan affiliation, which were documented historically, are not visible archaeologically. Thus, the applicability of archeological data needs to be considered before interpreting it through ethnographic analogy (Chapman 2003; Chapman et al. 1981). Couched within the post-processual movement, reappraisal of the Saxe-Binford program soon turned to substantial criticism (Braun 1981; Brown 1995; Hodder 1982; Hodder 1995; Pearson 1982; Pearson 1999).

Post-Processual Critique

The quantitative focus of many mortuary studies required artifact categorization and ranking. This was argued to be highly subjective and ignored mortuary behavior that is qualitative, such as a burial site's placement within a larger landscape (Chapman 2007; Chapman 2005; Charles 1995; Charles 2005; Rakita et al. 2005). Post-processualists stress the view that mortuary behavior is heavily influenced by the actions and desires of the living, thus negating the one-to-one correlation of grave goods to status and ownership. The aim of identifying only vertical social structure within a mortuary complex was thought to be too narrow and ignored significant variation within horizontal divisions, such as gender. Cross-cultural ethnographic analogies were also considered misleading when applied to archaeological data. Past social systems could only be indirectly reconstructed within specific historical contexts (Braun 1981; Brown 1995; Hodder 1982; Hodder 1995; Pader 1982;

Pearson 1982; Pearson 1993; Pearson 1999). However, these criticisms were rarely addressed beyond historic investigations with written resources.

Following the post-processual movement there was continuing effort to advance and rectify the problems associated with the Saxe-Binford model (Beck 1995; Brown 1995; Carr 1995; Kamp 1998). This was most apparent in an increasing application of landscape archaeology, which places an emphasis on understanding mortuary ritual at the inter-site level (Ashmore and Knapp 1999; Chapman 2007; Chapman 2005; Charles 1995; Charles 2005; Rakita et al. 2005). Other studies have focused on the identity (e.g., gender) of the dead and the agency of the living (ancestor-descendant approach), suggesting that mortuary behavior is a chance for an individual to make a social or political statement (Brumfiel 2006; Clayton 2011; Crown and Fish 1996; Meskell 2002). These studies have increasingly relied on using bioarchaeological methods and techniques (Buikstra and Beck 2006; Gamble et al. 2001; Knudson and Stojanowski 2008; Tung 2008; Tung and Cook 2006), but few have utilized ancient DNA (Kemp et al. 2009; Keyser-Tracqui et al. 2003; Stone and Stoneking 1999).

A review of studies between 1995 and 2000 revealed that research focuses had shifted away from studying social ranking. Rather than improving methods to address this topic of mortuary analysis, it was discarded in favor of other topics (Goldstein 2006). These studies also relied on fundamental assumptions that mortuary ritual reflects social organization; cemeteries are symbols of territoriality, and energy expenditure equals status (Chapman 1995; Charles 1995). This is particularly true of mortuary studies in the San Francisco Bay area.

San Francisco Bay Mortuary Studies

The range of mortuary behavior among foragers is an underexplored and little understood topic (Luby 2004). In particular, Central California has had an unprecedented number of burials and cemetery sites excavated, but very few comprehensive mortuary studies have attempted to place their analyses into a broader scheme of mortuary theory, beyond an attempt to identify social inequality and stratification using a Saxe-Binford approach (Jones and Schwitalla 2012; Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006). Most other mortuary analyses concentrated on identifying chronologies (in particular shell bead typologies) and applying local ethnographic analogy to archaeological data (Bennyhoff 1994b; Bennyhoff and Fredrickson 1994; King 1974; Milliken and Bennyhoff 1993). While developing a sound culture history is an extremely important endeavor for any regional archaeology, only very recently have mortuary studies in the San Francisco Bay moved beyond this limited range. Based on the number and variety of grave goods, most mortuary studies have argued that the San Francisco Bay area experienced increasing social stratification over time, with very elaborate burials in the Middle Period (Berkeley Pattern), followed by marked increase in “wealthy” graves during the Late Period (Augustine Pattern). A few of the more important studies will be discussed below (Bartelink 2006; Bellifemine

1997; Eerkens et al. 2013; Fredrickson 1974; Hylkema and Bethard 2007; Hylkema 2002; King 1970; King 1974; King 1978b; Leventhal 1993; Lightfoot and Luby 2002; Luby 1992; Luby 2004; Luby et al. 2006; Luby and Gruber 1999; Milliken et al. 2007; Wiberg 1988).

The analysis of Tiburon Cemetery (MRN-27) represents one of the first comprehensive mortuary studies in the San Francisco Bay area. Built upon Saxe-Binford schema, King (1970; 1974) found the cemetery to be organized according to status. Elite cremations with socio-technic artifacts were located in the central portion of the site and surrounded by two outer rings of inhumations with few to no artifacts. These outer rings were attributed to the presence of kin-groups/family lineages. This was one of the first attempts to differentiate a hunter/gatherer/collector group vertically. Fredrickson's (1968; 1974) investigation of three burial populations in the interior Bay area used the direct historical approach to document not only regional chronology, but also to identify the ritual meaning of specific grave objects and the spread of ideological culture systems through elaborate trade networks. Both of these studies are important conceptual breakthroughs in Central Californian mortuary analysis as they moved beyond general temporal classification.

Luby (1992) conducted cluster analysis on ALA-328 (Patterson Mound) on 74 burial attributes and concluded that rank was present at the site. Recent studies of inequality argued for a shift from a discrete cemetery to a less structured burial ground. The degree of inequality was considered reduced as measured by number and diversity of grave goods (Lightfoot and Luby 2002; Luby 1992; Luby and

Gruber 1999). Data from ALA-413 (Santa Rita Village Complex) revealed some evidence of social differentiation based on achieved status; a majority of grave goods were found with adult males (Wiberg 1988). Similar finds were reported at Tamien Station (SCL-690), which had an increase in funerary artifacts through time, especially the number of beads per individual, with over 76% having *Olivella* beads. However, the number of beads was not age or sex specific and there was no evidence for ascribed status as bead "wealth" was shared among many individuals (Hylkema and Bethard 2007; Hylkema 2002).

The Ryan Mound (ALA-329) was unique for the region as it was "occupied" through all periods and had no associated village site, and therefore was a dedicated cemetery. A large proportion of the inhabitants were buried with grave goods, and the quantity suggested that the individuals represented a relatively wealthy population who enjoyed elite status. Interestingly, female burials were on average buried with grave goods more often than males, and over 60% of subadults had some associated artifacts (this pattern was also found at SCL-732 a Middle Period site). Midden and faunal analysis suggested that the site was used for periodic feasting and that the mound itself was purposefully built across many generations (Leventhal 1993).

The above studies contribute significantly to our understanding of Bay area prehistory. However, they all applied Binford's (1971; 1962) tripartite classification of grave goods (technomic, socio-technic, ideo-technic) when trying to identify inequality and social hierarchy. This also included all analyses at SCL-38 (Yukisma

Mound) (Bellifemine 1997; Gardner 2013). While such groupings may be legitimate, they could be misleading and problematic in understanding the subtlety of, and the degree of, social inequality due to inherent researcher bias. An example is the classification of perforated grizzly bear fibula at SCL-354 (an Early Bay Period site) as only ideo-technic (i.e., ideological and ritual based). Such objects are extremely rare, and while they could be ideo-technic, they could just as easily be identified as socio-technic (i.e., marker of social status), or both. Regardless, it was concluded that the Early Period component of the site when compared to later periods, lacked emblems which reflected special social positions and great wealth (Hylkema 2002). Therefore, for this study, only the overall quantity and diversity of artifacts are considered without further sub-divisions.

Additionally, there has been a tendency to generalize interpretations of sociopolitical complexity from a few sites across lengthy periods of time and large geographic areas. Indeed, the Ryan Mound (ALA-329) study stands out as an anomaly in that its occupational history deviated from the norm (Leventhal 1993). Regional analyses of shell mound sites in San Francisco Bay have noted the heterogeneity in form and function of mortuary sites across time and space (Lightfoot and Luby 2002; Luby 2004; Luby et al. 2006). This included variation in the continuous use versus abandonment of sites through different periods. Such works have indicated that social systems, social inequality, and rank in the San Francisco Bay were extremely dynamic, constantly changing, and varied site to site. Recent cemetery analyses have highlighted this variability. Application of high-resolution radiocarbon dating of burials, as advanced by Chapman (2003; 2007), has revealed just how rapidly mortuary patterns can change stylistically, temporally, and spatially. Some burial attributes at CCO-548 (Marsh Creek), such as burial position, changed little through multiple periods while others, such as orientation, shifted completely in less than a few generations. The latter was argued to represent clan or religious affiliation (Eerkens et al. 2013). Isotopic data suggest that females were often non-local, possibly the product of a patrilocal system (Jorgenson et al. 2009). Overall data from Marsh Creek indicates that change and variation in Central California was more prevalent than previously thought. Thus, while social inequality and sociopolitical differentiation was assumed to have existed in the San Francisco Bay area, to what degree and how it changed through time is unclear. Thus, it cannot be assumed that SCL-38 necessarily fits into any preconceived concept of a ranked cemetery site.

Skeletal data on age and sex, and analysis of non-metric traits, are an integral part of most mortuary studies, but few have fully exploited the potential of analyzing the association of grave goods to a more accurate determination of genetic relationships of individuals within burial populations, especially those left by foragers (Gamble et al. 2001; Howell and Kintigh 1996; Stojanowski and Schillaci 2006). Identifying the genetic relationship of burials is crucial to understanding various facets of society such as kinship, age, and gender roles, as well as the rise and evolution of status and emerging sociopolitical complexity. The determination of genetic relations could further clarify whether wealth and power are indeed inherited, or if other social processes such as pronounced kin or corporate identity led to socioeconomic inequalities and complexity (Stojanowski and Schillaci 2006).

Due to advancements in aDNA extraction techniques, the large scale analysis of mtDNA lineages is now possible. This allows investigations to go beyond analyzing only non-metric traits. Consequently, aDNA can identify maternal relationships and, thus, the presence or absence of ascribed social differentiation. Kinship and aspects of unequal social ranking can be inferred and correlated with the presence/absence and frequency of specific burial goods, especially markers of wealth or status. This is especially important for the analysis of sub-adults and fragmentary remains, which are more problematic when identifying traditional osteological traits.

By combining molecular data with archaeological and ethnographic data, multiple lines of evidence have been generated from SCL-38 to deduce a clearer picture of mortuary behavior and, by proxy, the nature, and degree of social relations and complexity in prehistoric hunter-gatherer societies. Collected data was additionally used at the inter-site level to explore the spread of people speaking Penutian languages and document whether genetic continuity of Hokan-related lineages occurred in the San Francisco Bay area throughout prehistory.

Hypotheses and Test Implications

The biological and temporal relationships of individuals both within and between previously identified spatial clusters of burials at SCL-38 are unknown, which limits the ability to test specific hypotheses about the nature of the ritual and sociopolitical dynamics that occurred during this period of prehistory. The genetic evidence will provide a biological baseline to measure how patterns of inequality were structured relative only to biological relationships, not social ones (e.g., fictive kin). SCL-38 is particularly suited to answer these questions as most of the site has been dated within a ~650 year timeframe (~22-32 generations), therefore reducing the effects of potential population replacement (although not entirely). However, genetic signatures may reveal population admixture, extinction, or replacement of maternal lineages which has particular significance in light of the Penutian (Yok-Utian) migrations into central and coastal California. Specific hypotheses to be tested are as follows:

Hypothesis 1

High status burials— those displaying mortuary wealth (based on diversity and abundance)—are genetically related at the mtDNA level. Inherited status would indicate social ranking and be revealed if the individuals found with prestige artifacts, regardless of age and sex, share mtDNA haplotypes, reflecting maternal relationships. The null hypothesis would detect no spatial patterning according to maternal relatedness across the site. This would indicate relationships between wealthier graves that go beyond close kin, consistent with a system of achieved status or patrinlineal/bilateral descent.

Implications of Hypothesis 1

If genetic patterning occurred according to mtDNA lineages among individuals of both sexes, a matrilineal/matrilocal system may be in place based on direct kinship, clan, or moiety. Similarity of mtDNA lineages among females with a large amount of mortuary goods would indicate some sort of inherited status based on female kinship. As the central portion of the cemetery consists of primarily male individuals, the absence of shared mtDNA lineages could indicate inherited status through the patrilineal line.

Hypothesis 2

Previously defined spatial clusters within the site contain burials of individuals who are genetically correlated and represent familial groups or clans. Individuals will display a maternal (mtDNA) genetic relationship within each cluster if they were matrilineally related. The null hypothesis is that filial relationships are random among all clusters.

Implications of Hypothesis 2

According to this hypothesis, individuals previously assigned to spatial clusters should be maternally related. It is possible that these clusters represent familial groups or membership within lineal descent groups or clans. The degree of relationship within these spatial clusters are tested against the null expectations that relationships are random amongst all clusters, indicating that the sub-divisions defined by cluster analysis are not valid and no site structure existed according to maternal relatedness. DNA evidence may reveal that the central cluster, with its interments associated with high-status grave goods, may not consist of maternally related individuals, which would indicate achieved status, whereas all other clusters are distributed according to kinship. Burials based on matrilineal kinship would be demonstrated if group internments and spatial patterning reveal shared mtDNA lineages.

Hypothesis 3

Ancient DNA data from SCL-38 as well as an additional data collected by the author from 15 sites around San Francisco Bay ranging from 3850 to 169 BP will identify maternal lineages which can be linked specifically to the migration of Penutian speakers into the San Francisco Bay region, as well as lineages that represented remnant Hokan populations. Specific mtDNA lineages or related lineages belonging to haplogroup D or to the 16184A clade (Johnson et al. 2012; Johnson and Lorenz 2006; Schroeder et al. 2011) will be present from the later part of the Early Period onward in this region, as presented by the archaeological models of the Penutian Intrusion (Breschini 1983; Breschini and Haversat 1997; Moratto 1984). Hokan lineages will be represented by individuals belonging to haplogroup A and C, respectively, as discussed by Breschini and Haversat (2008) and Eshleman and Smith (2007).

Implication of Hypothesis 3

Based on linguistic evidence and previous mtDNA studies, lineages within haplogroup B with a mutation at np 16184A are expected, in addition to multiple as-yet-unidentified lineages belonging to haplogroup D. The lineages belonging to haplogroup D may or may not be linked to specific geographical areas, such as the Colombia Plateau and the Great Basin. Haplotypes will also be present that can be identified as descendants of earlier Hokan speakers. Based on previous mtDNA studies that analyzed haplogroup data, these haplotypic lineages are expected to belong to haplogroup C, which may or may not be related to lineages previously identified in aDNA studies. Some lineages will have associated radiocarbon dates as well as a place of origin (i.e., location of death). From this and a measure of nucleotide diversity, a minimal date of coalescence between lineages may be determined, in essence providing not only a place but also a calibrated date for when lineages split.

VIII. Methods

DNA Methods

Samples

A total of 208[7] samples from SCL-38 were sent to Washington State University's Molecular Anthropology and Ancient DNA Lab (MAAD) for aDNA analysis. An additional 99 samples from 13 other regional sites dating from 1954 BP to 245 BP were provided by Muwekma Ohlone Tribe and Ohlone Families Consulting Services Inc. (OFCS). Two additional samples from ALA-312 dating to ~3670 BP were provided by Jelmer Eerkens of UC Davis. A single sample was also provided by Gary Breschini from MNT-1256 (920-770 BP) (Table 5).

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[7] There is a discrepancy in total sample size (n=4) with this study (n=208) and that done by Gardner (2013) who reported a total of 204 samples. Burial B50 was reported as not available for study, but it was for this study. Commingled individuals combined by Jurmain (2000), Morley (1997), and/or Bellifemine (1997) included burials B104 (part of B102), and B117 (part of B130). These were counted as separate individuals for this study. Additionally, per Jurmain (2000), fragmentary burial B114 was considered to not be a unique individual and be part of B112. For this study it was also considered a unique individual.

Geographic Area	**Dates (cal BP) or Period of Use**	**Total samples haplogrouped**	**DNA data source**
San Francisco Bay Area			
ALA-312	3670 BP	2	This Study
ALA-479	1257-1194 BP	2	This Study
SCL-30H-Mission Santa Clara	Historic 169-183 BP	6	This Study (Lenci et al. 2013)
SCL-38, Yukisma	245-2205 BP	200	This Study
SCL-134	2500 BP	20	This Study
SCL-287/SMA-263, Sandhill Road	1176-2220 BP	23	This Study ;(Monroe et al. 2009)
SCL-343	Middle Period	1	This Study
SCL-755, Santa Clara University	~1301-1203 BP	1	This Study
SCL-775	2400-1200 BP	10	(Kaestle 2004; Skowronek 2006; Wu 2006)
SCL-851	1061-240 BP	10	This Study
SCL-867	NA	1	This Study
SCL-869	1610 - 1770 BP	1	This Study
SCL-870 Schiele Ave	1231-1242 BP	2	This Study
SCL-894 Fox Theater	~1630 BP	1	This Study
SCL-895 Blauer Ranch	~1680 BP	1	This Study
SOL-270, Cook	ca. 2000 BP	23	(Eshleman 2002)
Totals		**304**	
Central Valley/Foothills			
AMA-56, Applegate	1735-2090 BP	6	(Eshleman 2002)
Fish Slough Cave	700-2000 BP	7	(Kemp et al. 2006)
SJO-112, Cecil	2727-3826 BP	16	(Eshleman 2002)
Totals		**29**	
Central Coast			

MNT-391	733 – 567 BP	1	This study
MNT-831 (Early)	5440-4947 BP	1	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-831 (Middle)	1994-1717 BP	2	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-831 (Late)	290-0BP	1	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-1256	920-770 BP	1	This study
MNT-1489	Late Period	1	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-1931 (MNT-1482)	Late Period	1	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
Totals		**8**	

Table 5. Archaeological Samples Analyzed along with Comparative Data from Published Literature.

Contamination Control

As DNA extracted from ancient remains tends to be in low copy number and highly degraded (Lindahl 1993; Pääbo 1990), aDNA extractions are highly susceptible to contamination originating from modern sources. Modern contaminating DNA can be higher in copy number and less degraded than the endogenous aDNA and, thus, can compete with aDNA during polymerase chain reaction (PCR) amplification. Ancient DNA extractions can become contaminated via two sources: surface contamination of the bone or tooth from handling the material or later in the DNA laboratory or during DNA extraction and analysis.

The former source of contamination can originate at any step of an aDNA study from the time of excavation of the remains to the time of DNA extraction and amplification. Modern contamination of the bone or tooth surface can arise from anyone who has had direct contact with the material, including the archaeologist that excavated the remains, any archaeological researchers that analyzed (e.g., cataloging, measuring) the remains, DNA laboratory personnel, and from laboratory supplies and reagents. Since a skeletal or tooth surface can become contaminated, it is particularly important to remove the contamination before DNA extraction begins. To accomplish this goal remains were treated with a bleach solution to remove surface contamination (Barta et al. 2013; Kemp and Smith 2005). Additional procedures were also utilized to reduce contamination, such as the use of DNA-free lab-ware and reagents and the processing of ancient materials in a laboratory physically separated from one in which modern DNA is examined. Negative controls in both DNA extractions and amplifications were also performed to monitor contamination (Cooper and Poinar 2000; Kelman and Kelman 1999).

DNA Extraction

All samples were extracted at least two times for replication purposes.[8] Each extraction used 0.1-0.2 g of bone, removed from rib fragments. Extractions were done in batches of seven in addition to a negative control to which no sample was added. Samples were submerged in 6% w/v sodium hypochlorite (Clorox bleach) for 15 minutes to remove contaminating DNA from the surfaces of the samples (Barta et al. 2013; Kemp and Smith 2005). The samples were then rinsed twice with DNA-free ddH$_2$O. DNA was extracted according to a modified protocol of Kemp et al. (2007), changed specifically in the silica extraction portion of the method as follows: 1) following the isopropanol precipitation, 750 µL of 2% celite in 6M guanidine HCL[9] and 250 µL of 6M guanidine HCL were added to samples and vortexed several times over a 2 minute period; 2) 3 mL of DNA-free ddH$_2$O was pulled across the syringe and Promega Wizard® Minicolumns to wash them before pulling the samples across the columns; 3) the DNA bound silica was rinsed with 3 mL of 80% isopropanol (versus 2 mL recommended by the manufacturer); and 4) 100 µL of

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[8] Most samples were extracted three times.

[9] This solution is intended to mimic the Wizard® PCR Preps DNA Purification Resin, as best could be ascertained from the Material Safety Data Sheet (MSDS). To make this solution, add DNA-free ddH$_2$O to 1.25 mg of Celite® Analytical Filter Aid II (CAFA II, Sigma) up to 25mL, vortex and let incubate at room temperature overnight. Pour off the water carefully so as to not pour off the celite and add DNA-free ddH$_2$O to 5mL and 6M guanidine HCl (Teknova) to 50mL.

65ºC DNA-free ddH_2O was added to the column and left for 3 minutes prior to centrifugation. This step was repeated resulting in 200 µL of extracted DNA. Samples were then stored at -20ºC.

Testing for PCR Inhibitors

It is important to know whether a sample contains DNA or has been co-extracted with PCR inhibitors that preclude DNA amplification. Following DNA extraction, samples that did not initially amplify were tested for the presence of PCR inhibitors. To do so, a PCR reaction was set-up to which the sample DNA had been added. The reaction was then spiked with a "positive ancient control" (an ancient DNA sample that has been documented to have DNA, in this case an ancient goose sample). If the positive ancient control failed to amplify, the sample was considered inhibited. If the positive ancient control amplified, then the sample in question most likely contains no DNA. This procedure should be performed with a positive ancient control, not a positive modern control, as an inhibited sample may allow a positive modern control to amplify while not allowing a positive ancient control to amplify. This is probably due to some as-yet unknown DNA concentration to inhibitor threshold. If PCR inhibitors were present in a sample, the following remedies were employed. First, the samples were diluted 1:10 and Bovine Serum Albumin (BSA) was added to the PCR reaction. If this failed to overcome PCR inhibition, the samples were "repeat silica extracted" following Kemp et al. (2006). Silica extractions were repeated until the sample no longer showed signs of inhibition.

PCR Amplification and Genetic Screening

After extraction, samples were screened for the polymorphisms (mutations) that define the major haplogroups in the Americas (A, B, C, D, and X). To accomplish this screening, PCR was used to amplify small regions of the mtDNA genome that contain the known polymorphisms that define the haplogroups (Forster et al. 1996; Schurr et al. 1990). PCR amplification reactions contained 8.76 μL of DNA-free dH_2O (Invitrogen), 2.4 μL of 2 mM dNTPs, 1.5 μL of 10X PCR Buffer, 0.45 μL $MgCl_2$ (50mM), 0.18 μL of each primer (20 μM), 0.06 μL of Platinum *Taq* (Invitrogen), and 1.5 μL DNA template. Negative controls (PCR reactions to which no DNA template were added) accompanied every set of PCR reactions to monitor the presence of contaminating DNA. PCR conditions were as follows: 94ºC for 3 minutes, 60 cycles of 15 second holds at 94ºC, 55ºC, and 72ºC, followed by a final 3 minute extension period at 74ºC. The amplicon was electrophoresed on a 6% polyacrylamide gel using 4ul of PCR product. The gel was stained with ethidium bromide and visualized under UV light, either confirming the successful amplification of the amplicon, for later restriction enzyme analysis, or to score the presence or absence of the 9-bp deletion.

PCR and Sequencing Hypervariable Region I

Nucleotide positions (nps) 16011-16383 of the mitochondrial genome, encompassing the hypervariable 1 (HVI) region, were amplified and sequenced in four small overlapping fragments that were less than 200 bp in length. The sequencing PCR reactions were identical to that used to amplify the regions containing the haplogroup-defining polymorphisms except for different primers. These primers and PCR cycling conditions are listed in Table 6. Each sample was sequenced and replicated two times (two separate PCR reactions) in both directions for each extraction. About 3-4 μL of the amplicons were run on 6% polyacrylamide gels, stained with ethidium bromide, and visualized with UV, as described above, to confirm success in amplification. The PCR product was purified prior to DNA sequencing with an *ExoI*/Fast*AP* digestion. Per every 5μL of PCR product, 0.5 μL of *ExoI* enzyme and 1μL of Fast*AP* were added. The reaction was then incubated at 37ºC for 90 minutes and then at 80ºC for 20 minutes to denature the *ExoI*. The product was then sent for direct sequencing at Elim Biopharm Inc., Hayward, California. Sequencing was performed in both directions to preclude sequencing errors. Sequences were aligned to the Cambridge Reference Sequence (Anderson et al. 1981; Andrews et al. 1999) in Sequencher (v. 4.8)

Target Region	Primer	Coordinates*	Annealing Temperature	Citation
A	611F	00591-00611	55 °C	(Stone and Stoneking 1993)
	743R	00765-00743		
B	8215F	08195-08215	55 °C	(Wrischnik, et al. 1987)
	8297R	08316-08297		
C	13256F	13237-13256	55 °C	(Parr, et al. 1996)
	13397R	13419-13397		
D	5120F	05099-05120	55 °C	(Parr, et al. 1996)
	5190F	05190-05211		
X	14440F	14421-14440	49 °C	(Kaestle 2000)
	14591R	14591-14612		
HVI-1	15986F	15986-16010	62 °C #	John McDonough, UC Davis
	16153R	16132-16153		
HVI-2	16106F	16106-16126	62 °C #	John McDonough, UC Davis
	16251R	16230-16251		
HVI-3	16190F	16190-16209	58 °C #	John McDonough, UC Davis
	16355R	16331-16355		
HVI-4	16232F	16232-16249	58 °C #	John McDonough, UC Davis
	16404R	16383-16404		

Table 6. Restriction Length Fragment Polymorphisms (RFLP) PCR Conditions.*

Location of polymorphisms for Native American Haplogroup affiliation, along with enzyme used for restriction length fragment polymorphisms (RFLP)* Coordinates, or numbered according to the Cambridge Reference Sequence (Anderson, et al. 1981; Andrews, et al. 1999) # Touch-down PCR used, decreasing the annealing temperature 0.1° C after each cycle.

Haplotype Analysis

Median-joining haplotype networks were constructed separately for haplogroups B, C, and D in Network (v. 4.1.1.2) (Bandelt et al. 1999). No network was constructed for haplogroup A, as it was represented by only two haplotypes in this study, or haplogroup X, which was absent in all samples studied. Mutational hotspots were down weighted in order to resolve reticulation and were relative to the mutation rates as estimated by Meyer et al. (1999). Nucleotide diversity (π) and standard error within sub-haplogroups was estimated in Mega 4.0 (Kumar et al. 2004), with 10,000 bootstraps of the data in order to determine clade coalescence. A mutation rate of 47.5%/site/myr[10] (99.5% CI: 26.5-78.5%/site/myr[11]) was calculated in Microsoft Excel.

Spatial Analysis

The geographic distances between all individuals were estimated in GenAlEx (Peakall and Smouse 2006), using UTM coordinates for each burial. Results were than plotted in ArcMap 10.2. All additional maps which showed haplotype or artifact distribution were also completed in ArcMap 10.2. Two types of spatial analysis were

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[10] A rate or measure of molecular evolution for mtDNA. This particular rate estimates that 47.5% of all nucleotide positions in the mtDNA will differ from its original state after one million years.

[11] Note that while 99.5% confidence intervals are not necessarily common to the field and may seem overly precise, Henn et al. (2009) and Howell et al. (2003) did use such specificity to calculate a divergence rate of 0.95. This equates to a mutation rate of 47.5%/site/myr (99.5% CI: 26.5–78.5%/site/myr). As the rate of 47.5%/site/myr does not fall exactly center in the CI range, it would indicate a somewhat non-normal distribution. Therefore, it is not in this author's capability to calculate the 95% CI for these data without having the raw data from previous publications.

performed, spatial autocorrelation and landscape interpolation. To determine whether the SCL-38 site was structured genetically, spatial autocorrelation was performed in GenAlEX 6.1 (Peakall and Smouse 2007; Peakall and Smouse 2006). Multiple distance classes, as well as multiple numbers of distance classes, were evaluated. These ranged from 0.5 to 10 for class intervals. A distance of one meter was used for class size. Between 15 and 60, classes were utilized to encompass the entire expanse of SCL-38. Alleles in Space (AIS) (Miller 2005) correlated mtDNA genetic data across the spatial extent of the site. A landscape interpolation technique was used to visualize genetic relationships across the site.

IX. Results

DNA was extracted from rib fragments for 208 individuals that were retained by the Muwekma Ohlone Tribe prior to repatriation. Ninety-six percent (n=200) of these individuals have been typed for Native American mtDNA haplogroup A, B, C, D, or X (Table 7, 8; Figure 15). This was an exceptional proportion of successful haplogroup identification for an aDNA project, indicating excellent DNA preservation. MtDNA haplotype lineages were completed for 189 individuals, with the remaining 11 individuals having incomplete sequences.

	SCL-38 Burials	**(n=)**
Not Received for Analysis	B007,B017,B020,B021,B030,B036,B040, B041,B059,B089,B094,B101,B106,B124, B126,B133,B139,B147B,149,150,151,154, B158,B181,B187,B189,B204,B208,B239, B240,B242,B243	32
No DNA	B099,B117,B127,B162,B174,B176,B194a,B216	8
Samples without complete haplotype	B006,B012,B012,B098,B102,B113,B194, B155,B230,B236,B027,B193	11

Table 7. Samples not Received, with no DNA, or Incomplete Analysis.

To date this is the largest sample size of mtDNA data generated from any prehistoric or historic site in the Americas; the second largest dataset belongs to a protohistoric Oneida population at Norris Farms (Stone and Stoneking 1998; Stone and Stoneking 1999). Currently, 36 mtDNA haplotypic lineages belonging to Native American haplogroup A, B, C, or D have been identified at SCL-38 and are labeled L1-L36 (Table 9, Figure 16).

Haplogroup	**CA-SCL-38 Burials**	**Frequency (n=200)**
A	B001,B016,B025,B043,B071,B072,B108,B115,B141,B143,B182	5.5% (n=11)
B	B003,B006,B012,B013,B023,B028,B034,B039,B047,B053,B057,B061,B063,B075,B078,B085,B098,B102,B103,B105,B105a,B111,B114,B113,B116,B119,B120,B123,B130,B148,B164,B165,B172,B173,B185,B188,B195,B196,B201,B203,B206,B210,B215,B229	22% (n=44)
C	B004,B005,B031,B032,B035,B042,B046,B051,B052,B054,B062,B064,B065,B069,B077,B079,B082,B086,B088,B092,B095,B096,B100,B104,B110,B118,B129,B132,B138,B140,B144,B153,B155,B156,B163,B178,B179,B180,B183,B190,B192,B194b,B202,B207,B209,B211,B213,B214,B218,B222,B224,B228,B230,B232,B233,B234,B235,B236,B237	29.5% (n=59)
D	B008,B009,B010,B011,B014,B015,B018,B019,B024,B026,B027,B029,B033,B037,B038,B044,B045,B048,B049,B050,B055,B056,B058,B060,B066,B067,B068,B070,B073,B074,B076,B080,B081,B083,B084,B087,B090,B091,B093,B097,B107,B109,B112,B122,B125,B128,B131,B134,B135,B136,B137,B142,B145,B146,B152,B157,B159,B160,B161,B166,B167,B168,B169,B170,B171,B175,B177,B184,B186,B191,B193,B197,B198,B205,B212,B217,B219,B220,B221,B223,B225,B226,B227,B231,B238,B241	43% (n=86)

Table 8. SCL-38 Haplogroup Results.

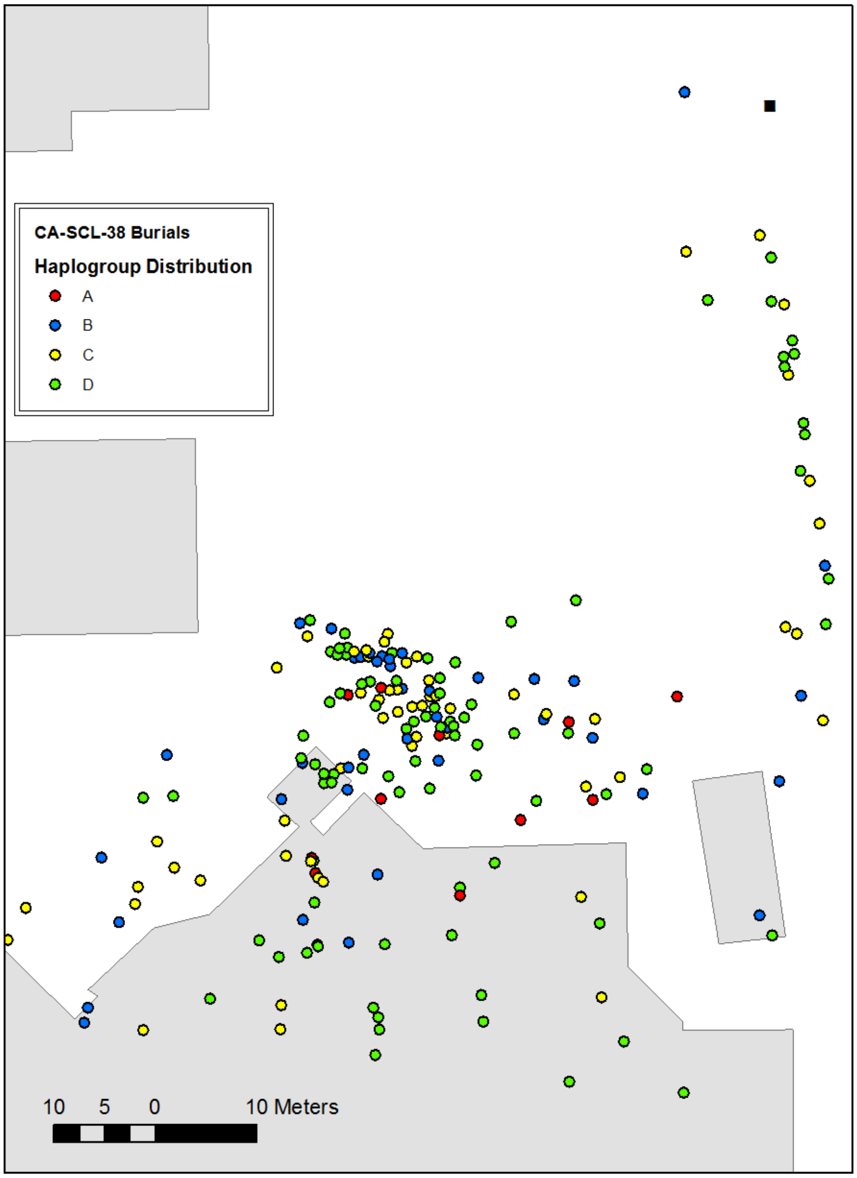

Figure 15. SCL-38 Haplogroup Distribution.

Haplotype/ lineage number (L)	Haplogroup A,B,C,D	Mutation motif	SCL-38 Sample Shared mtDNA	Count	Percent
L1	B	16042;16183;16184;16189; 16217;16260	B078, B085, B103, B123, B164, B188, B201	7	4%
L2	D	16084;16223;16325;16362	B015, B083	2	1%
L3	D	16084,16223,16278,16325; 16362	B010, B018, B045, B080, B137, B159, B191, B238	8	4%
L4	D	16086;16223;16325;16362	B122, B186	2	1%
L5	D	16092;16223;16325;16362	B029,B068,B109,B125,B128,B131,B146,B152,B168,B219,B220,B227	12	6%
L6	C	16093;16131;16207;16223; 16234;16244;16298;16325; 16327	B180, B211	2	1%
L7	D	16093;16223;16325;16362	B076, B081	2	1%

L8	C	16093;16223;16264;16298;16311;16325;16327	B069, B096, B118, B129, B144, B178	6	3%
L9	C	16093;16207;16223;16298;16325;16327;16362	B064, B065	2	1%
L10	C	16124;16223;16298;16325;16327	B042, B046, B054, B163, B179	5	3%
L11	B	16126;16183;16184A;16189;16217	B111, B172, B173, B203, B210	5	3%
L12	B	16126;16183;16184A;16189;16217;16260	B195	1	1%
L13	B	16126;16183;16189;16193.1;16217	B061, B116	2	1%
L14	B	16126, 16183,16189,16217	B034, B039, B047, B063, B105, B105a, B114, B196	8	4%
L15	C	16131;16207;16223;16234;16244;16298;16325;16327	B140	1	1%
L16	C	16131;16164;16207;16234;16244;16298;16325;16327	B004, B005, B138, B153, B232	5	

					3%
L17	C	16223;16298;16311;16325;16327	B183, B234	2	1%
L18	C	16223;16298;16325;16362	B062,B230	1	1%
L19	C	16223;16298;16325;16327	B092, B110, B192	3	2%
L20	C	16223;16298;16327	B031, B051, B132, B209, B213, B218, B228, B233	8	4%
L21	C	16223;16298;16299;16325;16327	B086	1	1%
L22	D	16223;16325;16362	B008,B009,B014,B019,B024, B026,B033,B037,B044,B048, B049,B050,B055,B056,B058, B066,B067,B070,073,B074, B084,B087,B090,B091,B093, B097,B107,B112,B134,B135, B136,B142,B145,B157,B160, B161,B166,B167,B170,B171, B177,B184,B205,B212,B217, B221,B223,B225,B226,B231, B241	51	27%

L23	A	16223;16290;16319;16362	B016, B025, B071, B072, B182	5	3%
L24	D	16223;16270;16325;16362	B169, B175	2	1%
L25	C	16223;16264;16298;16311;16325;16327	B035, B077, B082, B095, B156, B207, B222, B224	8	4%
L26	C	16248;16223;16298;16327	B100	1	1%
L27	C	16207;16223;16298;16325;16327	B032, B052, B104, B190, B202, B214, B235, B237	8	4%
L28	C	16207;16293;16298;16325;16327	B079	1	1%
L29	C	16192;16207;16223;16298;16325;16327	B088	1	1%
L30	B	16183,16184A,16189;16217	B185, B206, B229	3	2%
L31	B	16183;16189;16217	B003, B023	2	

					1%
L32	B	16183;16189;16217;16248	B013, B028, B130, B148	4	2%
L33	D	16183,16189,16223;16325; 16362	B038, B197, B198	3	2%
L34	B	1617516183;16189;16217;16248	B053, B057, B075, B119, B120, B165, B215	7	4%
L35	D	16142;16150;16223;16325; 16362	B011, B060	2	1%
L36	A	16111;16223;16290;16319; 16362	B001, B043, B108, B115, B141, B143	6	3%

Table 9. SCL-38 MtDNA Haplotype Lineages, Mutation Motifs, and Number and Name of Burials at SCL-38.

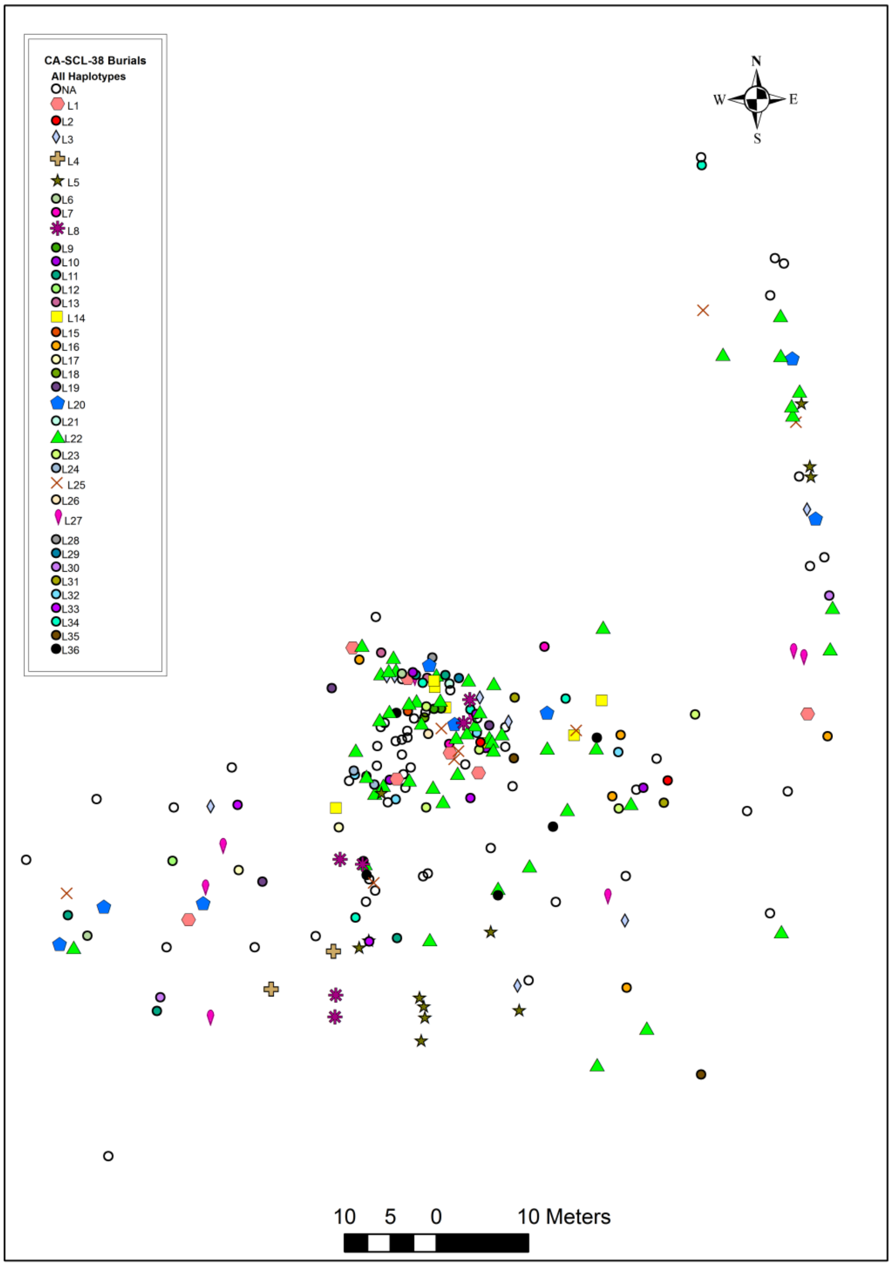

Figure 16. SCL-38 Haplotype Lineage Distribution

From a genetic standpoint, few cemeteries have been studied as extensively as SCL-38. Consequently, it has been hard to determine whether the number of unique haplotypes identified represent any meaningful social patterning or simply are the consequence of evolutionary forces. For comparison, the Norris Farms cemetery included 37 unique mtDNA lineages among the 50 samples (~74%) haplotyped. Superficially, this would indicate greater genetic diversity as only 19% of SCL-38 samples represent unique lineages. While some forces such as mutation are random, others such as admixture, migration, and even genetic drift are affected by human actors within their environments. Additional genetic and temporal structures within the SCL-38 cemetery would have been shaped further by human decisions and their cultural dictates, which could result in distinct mortuary patterning of maternal lineages (i.e., an overrepresentation or underrepresentation of particular lineages due to sociopolitical or religious factors). However, overall nucleotide diversity (π) suggest that both cemeteries are relatively similar with Norris Farms, estimated at $\pi=0.0150$ (99% CI ± <0.0001) and SCL-38 at $\pi=0.0148$ (99% CI ± <0.0001).

Regional Patterning

Haplogroup

An additional 102 samples from 15 sites were also extracted to explore genetic continuity and sharing of haplotype lineages throughout the Bay area (Figure 5). Seventy-three samples had amplifiable DNA and were haplogrouped as A, B, C, or D, while approximately 25% of these had complete haplotype data. The haplogroup frequencies exhibited by individuals from SCL-38 and other Bay area sites combined with those of previously studied populations are found in Table 10.

Geographic Area	**Dates (cal BP) or Period of Use**	**Total samples N=**	**Total samples haplogroup**	**% Success**	**Hg A (%)**	**Hg B (%)**	**Hg C (%)**	**Hg D (%)**	**DNA data source**
San Francisco Bay Area									
ALA-312	3670 BP	2	2	100	0	0	0	2 (100)	This Study
ALA-479	1257-1194 BP	2	2	100	1 (50)	0	0	1 (50)	This Study
SCL-30H-Mission Santa Clara	Historic 169-183 BP	8	6	75	0	1 (17)	3 (50)	2 (33)	This Study (Lenci et al. 2013)
SCL-38, Yukisma	245-2205 BP	208	200	96	11 (5.5)	4 (22)	59 (29.5)	86 (43)	This Study
SCL-134	2500 BP	23	20	87	0	4 (20)	9 (45)	7 (35)	This Study
SCL-287/SMA-263, Sandhill Road	1176-2220 BP	30	23	77	1 (4.3)	2 (8.7)	3 (13)	17 (74)	This Study ;(Monroe et al. 2009)
SCL-755, Santa Clara University	~1301-1203 BP	13	1	~8	0	0	1 (100)	0	This Study
SCL-775	2400-1200 BP		10		2 (20)	0	2 (20)	6(60)	(Kaestle 2004; Skowronek 2006;

									Wu 2006)
SCL-851	1061-240 BP	11	10	91	1 (10)	2 (20)	6 (60)	1 (10)	This Study
SCL-867	NA	1	1	1	0	0	0	1 (100)	This Study
SCL-869	1610 - 1770 BP	4	1	25	0	1 (100)	0	0	This Study
SCL-870 Schiele Ave	1231-1242 BP	2	2	100	0	2 (100)	0	0	This Study
SCL-894 Fox Theater	~1630 BP	1	1	100	0	0	0	1(100)	This Study
SCL-895 Blauer Ranch	~1680 BP	2	1	50	0	0	1 (100)	0	This Study
SOL-270, Cook	ca. 2000 BP		23		1 (4)	2 (9)	10 (44)	10 (44)	(Eshleman 2002)
Totals			**304**		**17 (6)**	**58 (19)**	**95 (31)**	**134 (44)**	
California Foothill/ Great Basin									
AMA-56, Applegate	1735-2090 BP		6		0	2(34)	4 (66)	0	(Eshleman 2002)
Fish Slough Cave	700-2000 BP		7		0	1(14)	4 (57)	2 (29)	(Kemp et al. 2006)
			16						

SJO-112, Cecil	2727-3826 BP				0	1 (6.2)	9 (56.3)	6 (37.5)	(Eshleman 2002)
Totals			**29**		**(0)**	**4 (14)**	**17 (59)**	**8 (28)**	
Central Coast									
MNT-391	733-567 BP	1	1	100	0	0	1 (100)	0	This study
MNT-831 (Early)	5450-4950- BP		1		1 (100)	0	0	0	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-831 (Middle)	1994-1717 BP		1		1	0	0	0	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-831 (Late)	290-0 BP		2		0	0	0	2	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
MNT-1256	920-770 BP	1	1	100	0	0	1 (100)	0	This study
MNT-1489b	Late		1		1 (100)	0	0	0	(Breschini and

	Period								Haversat 2008a; Breschini and Haversat 2008b)
MNT-1931 (MNT-1482)	Late Period		1		1(100)	0	0	0	(Breschini and Haversat 2008a; Breschini and Haversat 2008b)
Totals			**8**		**4 (50)**	**0**	**2 (25)**	**2 (25)**	

Table 10. Haplogroup Results from Current and Previous Studies.

While haplogroup frequencies varied site to site, a general Bay area pattern appears. When data collected in this study is compared to previous research, populations display high frequencies of haplogroup D (44%) along with appreciable frequencies of haplogroup B (19%) and C (31%) with haplogroup C being slightly more frequent. Haplogroup A is quite rare (6%) but is more frequent among Central Californian Coast populations, from Monterey to Channel Islands, where it reaches 50-90%. Haplogroup C in contrast has its highest frequency in the Central Valley/Foothills where it reaches 59%. At SCL-38, haplogroup frequencies follow the regional trend with less frequencies of haplogroup A (5.5%), some haplogroup B (22%) and haplogroup C (29.5%), and a large amount of haplogroup D individuals (43%).

Haplotype Results

The hypervariable region I sequence obtained from the sample extractions spans from np 16011 to 16383. The 36 identified haplotype lineages labeled L1 to L36 are shown again, along with information about haplotype sharing among other sites as well as temporal data which placed the lineages at various points in time (Table 11). Of 36 haplotypes, 21 are shared with burials from other archaeological sites or with living Native Americans, which confirms the validity of the data.

Median-joining haplotype networks were constructed for haplogroups B, C, and D (Figures 17, 18, and 19) and display the phylogenetic (tree-like) relationship of each individual to other ancient sites as well as extant indigenous populations from Central California, the Columbia Plateau, and the Great Basin. Haplogroup A lineages are quite rare and were only represented by two lineages that belonged to the founding A haplotypes, so no network was drawn for this group. Due to their separate evolutionary history, a network was created for each other haplogroup to represent more accurately mutational differences. Only published comparative data were used, and terminology to designate a tribal unit/group were preserved from these publications (Johnson et al. 2012; Johnson and Lorenz 2006; Kaestle 1998; Kaestle and Smith 2001; Malhi et al. 2004; Monroe et al. 2011; Monroe et al. 2009; Schroeder et al. 2011). Note that incomplete sequences from the literature and other archaeological sites could not be portrayed but some of these individuals did display unique mutations that link them to individuals within the network. The network diagrams display only mutations that exist in addition to those that defined the haplogroup/founding lineage. However, all mutations are shown in Appendix E. See Table 12 for mutations that define the founding Native American lineages. The reticulation in the network is caused by mutational hotspots, despite efforts taken to minimize them.

Four lineages (L15, L21, L28, and L29) are mtDNA isolates with no sharing between them and other individuals within SCL-38. However, three of these lineages belong to a diverse clade of haplogroup C (L15, L21, L28, and L29) that is shared with 17 other burials at the site. This clade, with a transversion mutation at np 16207, was first identified at SOL-270 and will be discussed in further detail later.

Haplotype/ lineage number (L)	Haplogroup A,B,C,D	Mutation motif	SCL-38 Sample Shared mtDNA across region	Time Period
L1	B	16042;16183;16184;16189;16217;16260	B078, B085, B103, B123, B164, B188, B201	B164 (Bd=440-230 BP)
L2	D	16084;16223;16325;16362	B015, B083	B083 (Bd=440-230 BP)
L3	D	16084, 16223,16278,16325; 16362	B010, B018, B045, B080, B137, B159, B191, B238	B010 (Ob=780 BP), B045 (769 +/-43BP), B80 (Bd=440-230 BP)
L4	D	16086;16223;16325;16362	B122, B186	
L5	D	16092;16223;16325;16362	B029,B068,B109,B125,B128,B131, B146,B152,B168,B219,B220,B227, ALA-312 B1	B068 (Bd=740-440 BP), B152 (Ob=426 BP), B168 (Ob=714 BP), B219 (Bd=740-440 BP), B227 (520±51 BP), ALA-312 B1 (3660± 30 BP)
L6	C	16093;16131;16207;16223;16234;16244;16298; 16325;16327	B180, B211, SCL 287/SMA 263 B020, SCL-851 B005	SCL-287/SMA-263 B020 (1,889±42 BP)
L7	D	16093;16223;16325;16362	B076, B081	
L8	C	16093;16223;16264;16298;16311;16325;16327	B069, B096, B118, B129, B144, B178, SCL-869 B1, SCL-30H B1&2,	B069 (Bd=740-440 BP), B144 (245 ±50 BP), B178 (895 ±280 BP)
L9	C	16093;16207;16223;16298;16325;16327;16362	B064, B065	B064 (455±230 BP), B065 (Bd=440-230BP)
L10	C	16124;16223;16298;16325;16327	B042, B046, B054, B163, B179, Costanoan, MNT-1256 B001	B042 (Ob=714 BP), B163 (Bd=440-230 BP), B179 (1725±200 BP), MNT-1256 B001 (1105 ±75 BP)
L11	B	16126;16183;16184A;16189;16217	B111, B172, B173, B203, B210, SCL-851 B009	B210 (295 ±70), SCL-851 B009 (1100 ±30

				BP)
L12	B	16126;16183;16184A;16189;16217;16260	B195, Ione Band Miwok, Miwok	
L13	B	16126;16183;16189;16193.1;16217	B061, B116	
L14	B	16126, 16183,16189,16217	B034, B039, B047, B063, B105, B105a, B114, B196, SCL-30H, Pomo	B063 (1175± 150 BP), B105 (Bd=740-440 BP),
L15	C	16131;16207;16223;16234;16244;16298;16325;16327	B140	B140 (Ob=532 BP)
L16	C	16131;16164;16207;16234;16244;16298;16325;16327	B004, B005, B138, B153, B232	B004 (401±53 BP)
L17	C	16223;16298;16311;16325;16327	B183, B234, AMA-56,SCL-134 B005,SCL-851 B001,SCL-287/SMA 263 B04-12,SJO-112, SOL-270	AMA-56 (1735-2090 BP), SCL-287/SMA-263 B04-12 (1,301±34 BP), SJO-112 (2727-3826 BP), SOL-270 (2000 BP)
L18	C	16223;16298;16325;16362	B062,B230, SCL-755 B005	B230 (1225 ±120 BP), SCL-755 B005(1400±105 BP)
L19	C	16223;16298;16325;16327	B092, B110, B192, SCL-851 B007, Shoshone, Pyramid Lake, Kawaiisu, Yokuts	B092 (Ob=650 BP) SCL-851 B007 1160±30
L20	C	16223;16298;16327	B031, B051, B132, B209, B213, B218, B228, B233, MNT-391 B001, SCL-134 B007c, SCL-204 B005, SOL-270	B051 (455 ±160 BP), B132 (790 ±51 BP), B209 (370 ±81 BP), B218 (Ob=377BP), MNT-391 (733-567 BP)
L21	C	16223;16298;16299;16325;16327	B086	B086 (Ob=1240BP)
L22	D	16223;16325;16362	B008,B009,B014,B019,B024,B026, B033,B037,B044,B048,B049,B050, B055,B056,B058,B066,B067,B070,073,B074,B084,B087,B090,B091,B	B008 (391±41 BP), B050 (410 ± 48 BP), B058 (Ob=426 BP),B084 (830 ±-66),

			093,B097,B107,B112,B134,B135,B136,B142,B145,B157,B160,B161,B166,B167,B170,B171,B177,B184,B205,B212,B217,B221,B223,B225, B226,B231,B241, ALA 312-B002,SCL-30H B006, SCL-134 B007b, B008,B011,B012, SCL287/SMA263 B01-2, B01-30,B4-8, SJO-112, SOL-270, Fish Slough Cave Coprolites 3,4, Mono, Shoshone, Northern Paiute, Tubatulabal, Vanyume, Washo, Yakima, Yokuts	B087 (Bd=740-44 BP), B090 (690±51 BP), B090 (705±220 BP), B093 (635 ±60 BP), B097 (815 +/-54 BP), B107 (750 ±85 BP), B166 (840 ±75 BP), B167 (1145 ±170 BP), B171 (355 ±30 BP), B184 (Bd=740-440 BP), B225 (Ob=532-780 BP), ALA-312 B002 (3670±30 BP), SCL-134 B007b (2490 ± 20 BP), SCL287/ SMA263 B01-2 (1,850±43BP), B4-8(1,822±35 BP), Fish Slough Cave (2000-700 BP)
L23	A	16223;16290;16319;16362	B016, B025, B071, B072, B182, SCL-479 B028	B071 (Bd=740-440 BP), B072 (Ob=332 BP), B182 (805±53 BP)
L24	D	16223;16270;16325;16362	B169, B175, Wishram	B169 (Bd=740-44 BP)
L25	C	16223;16264;16298;16311;16325;16327	B035, B077, B082, B095, B156, B207, B222, B224, SJO-112, SCL-134 B007a, B016a, SCL-343 B87, SCL-851 B008 , SCL-343 B87	B035 (711 ±36 BP), B082 (Ob=478 BP), B156 (Ob=478 BP), SCL-851 B008 (1161 ± 42 BP)
L26	C	16248;16223;16298;16327	B100, SCL-134 B023, SCL-851 B003 &B003A, SCL-895 B001	B100 (Ob=590 BP), SCL-134 B023 (2500 ± 30 BP), SCL-851 B003 (270 ±30 BP), SCL-895 (1680 ± 40

				BP)
L27	C	16207;16223;16298;16325;16327	B032, B052, B104, B190, B202, B214, B235, B237, SCL-287/SMA263 B003	B052 (Bd=440-230 BP)
L28	C	16207;16293;16298;16325;16327	B079	
L29	C	16192; 16207;16223;16298;16325;16327	B088	B088 (Bd=740-440 BP)
L30	B	16183,16184A,16189;16217	B185, B206, B229; SCL-134 B013, Ione Band of Miwok, Miwok, Salinan, Yokuts	B013 (465±50 BP), SCL-134 B013 (1560 ± 40 BP)
L31	B	16183;16189;16217	B003, B023, Pyramid Lake, Wishram	
L32	B	16183;16189;16217;16248	B013, B028, B130, B148	
L33	D	16183,16189, 16223;16325;16362	B038, B197, B198	
L34	B	16175 16183;16189;16217;16248	B053, B057, B075, B119, B120, B165, B215,SCL-287/SMA263 B019	B053 (Bd=440-230 BP), B120 (670±52)
L35	D	16142;16150;16223;16325;16362	B011, B060	
L36	A	16111;16223;16290;16319;16362	B001, B043, B108, B115, B141, B143, MNT-831 B001, B002, MNT 1489, MNT 1931, SCL-851 B010, Salinan, Yokuts	B001 (Ob=532 BP), MNT-831 B001 (4950-5450 BP), B002 (2340-2690 BP), MNT 1489, MNT 1931 (Late Period)

Table 11. SCL-38 MtDNA Haplotype Lineages Including Burial and Temporal Information. Ob=Obsidian hydration, BD= Bead typology

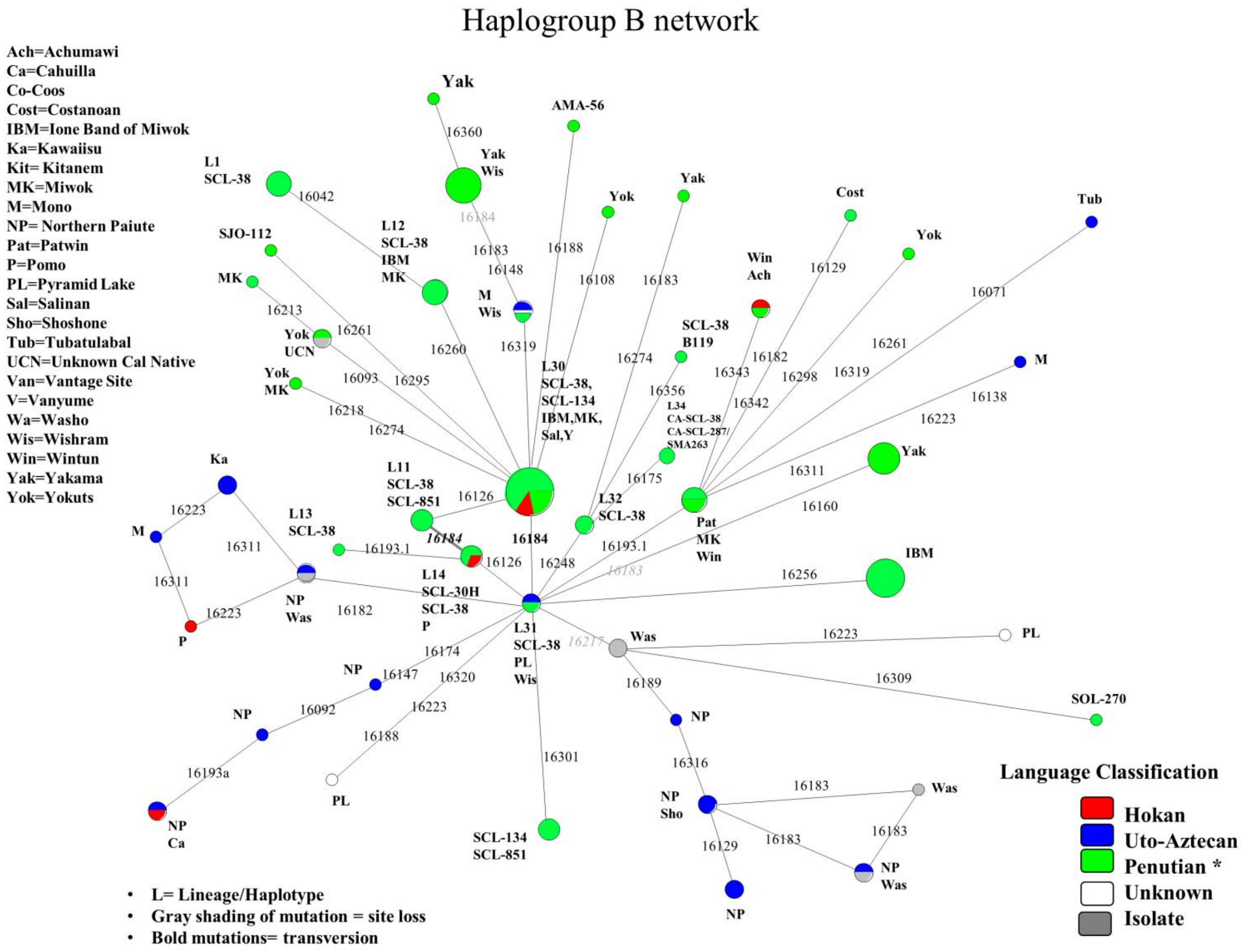

Figure 17. Haplogroup B Network.

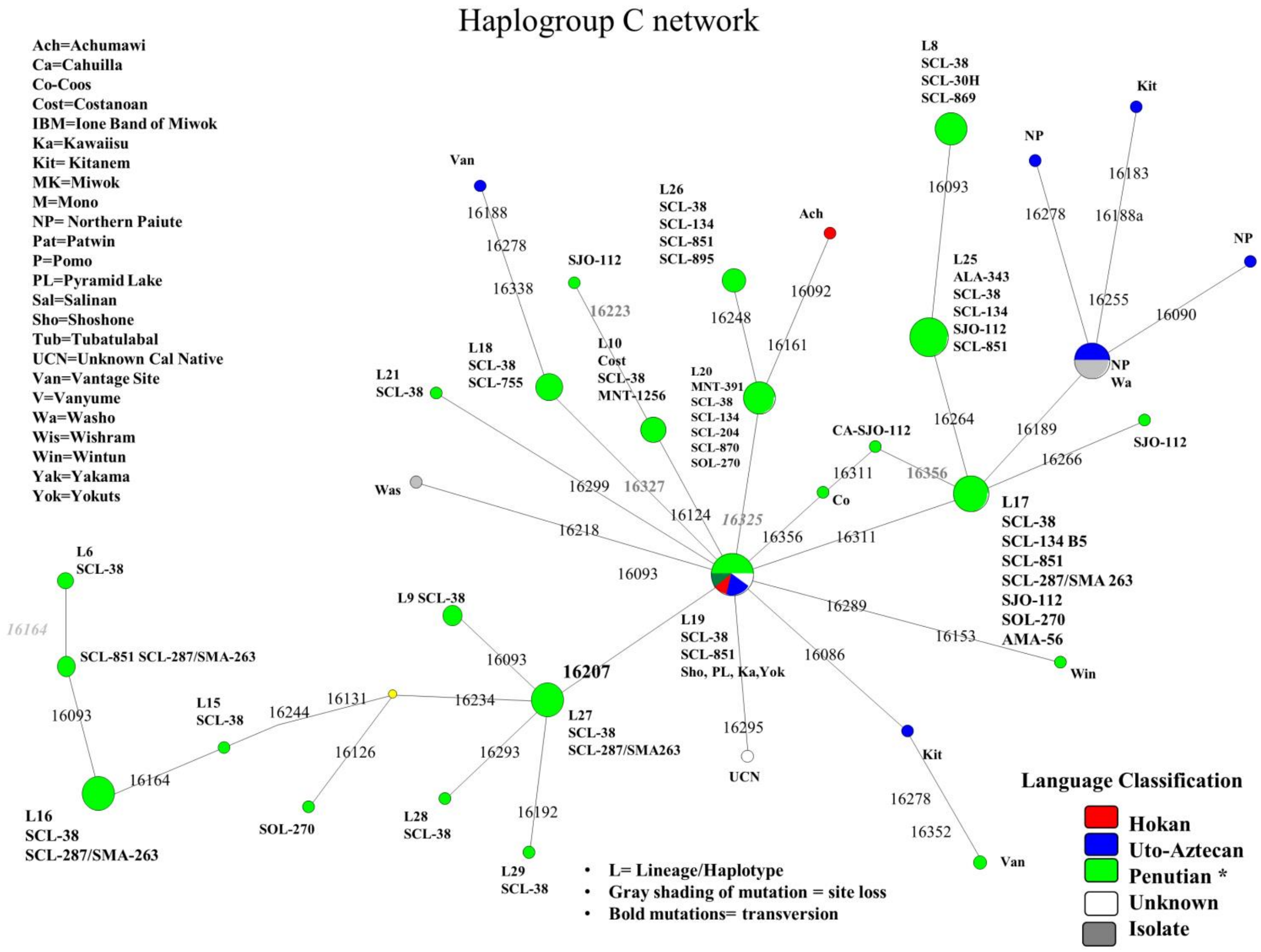

Figure 18. Haplogroup C Network.

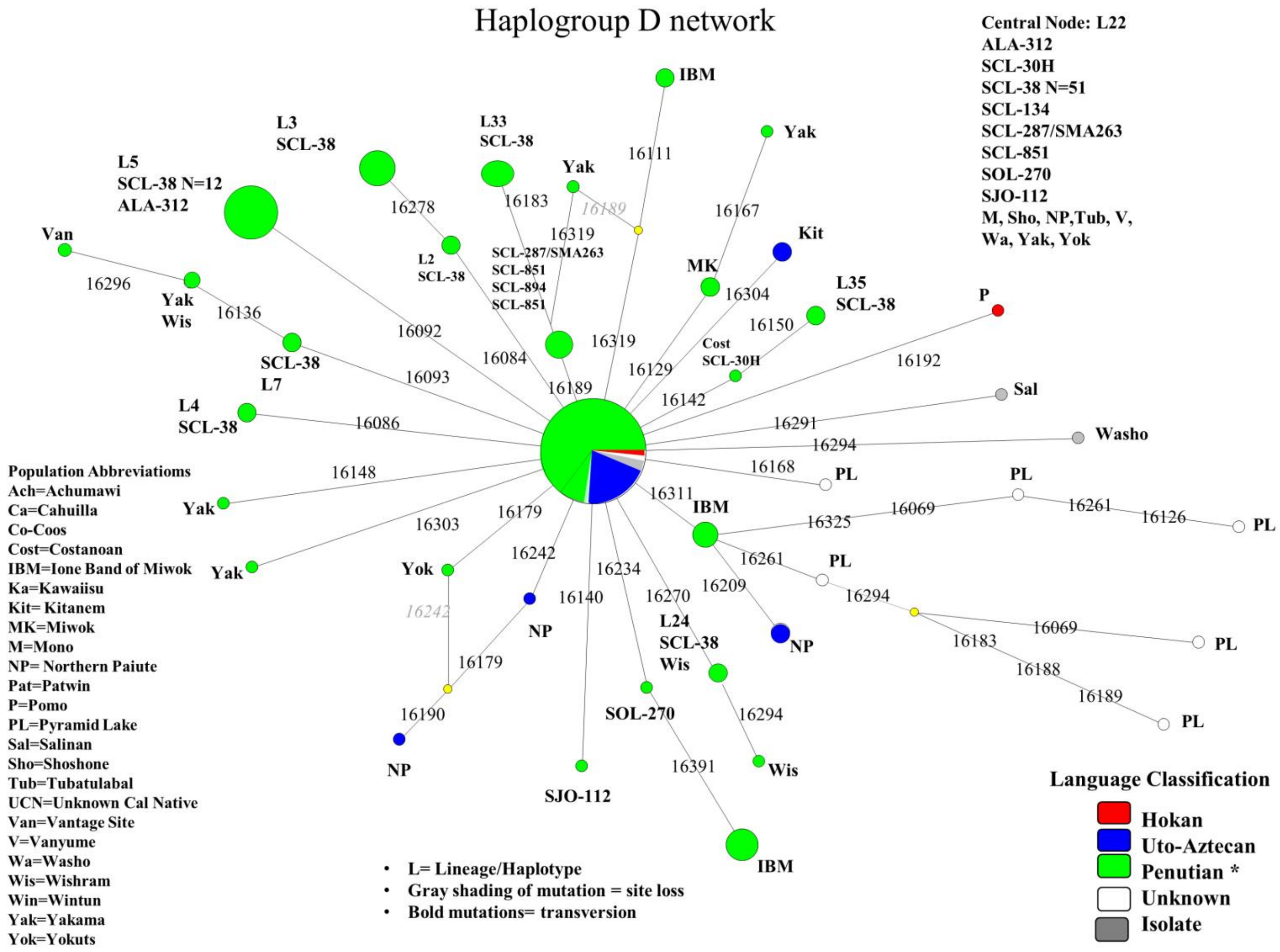

Figure 19. Haplogroup D Network.

Haplogroup	**Hypervariable Region I (HVI)**	**Hypervariable Region I (HVII)**	**Coding Region**
A	16223-16290-16319	73-235-263	663-173-4248-4824-8794
A2	16111-16223-16290-16319-16362	64-73-146-153-235-263	8027-12007
A2a	16111-16223-16290-16319-16362	64-73-146-153-235-263	3330
B	16189	73-263	8281-8289del
B4bd	16189-16217	73-263	827-15535
B4b	16189-16217	73-263	499-4820-13590
B2	16189-16217	73-263	3547-4977-6473-9950-11177
C	16223-16298-16327	73-249d-263	3552A-9545-11914-13263-14318
C1	16223-16298-16325-16327	73-249d-263-290-291d	-
C1b	16223-16298-16325-16327	73-249d-263-290-291d	493
C1c	16223-16298-16325-16327	73-249d-263-290-291d	1888-15930
C1d	16223-16298-16325-16327	73-249d-263-290-291d	7697
C4	16223-16298-16327	73-249d-263	2232iA-6026-11969-15204
C4c	16223-16245-16298-16327	73-263	11440-13368-14433-15148
D	16223-16362	73-263	4883-5178A
D4	16223-16362	73-263	3010,8414-14668
D1	16223-16325-16362	73-263	2092
D2	16129-16223-16271-16362	73-263	3316-7493-8703-9536-11215
D2a	16129-16223-16271-16362	73-263	11959
D2b	16129-16223-16271-16362	73-263	9181
D4h3	16223-16241-16301-16342-16362	73-263	3336-3396-3644-5048-6285-8949-9458-13135
D3	16223-16319-16362	73-263	951-8020-10181-15440-15951
X	16189-16223-16278	73-153-263	6221-6371-13966-14470
X2a	16189-16213-16223-16278	73-153-195-200-263	1719-8913-12397-14502

Table 12. Defining Mutations for Native American Founding Haplotypes.

Temporal and Spatial Variation of Haplotypes

Haplogroup A Haplotypes

At SCL-38 both haplogroup A founding lineages (L23, L36) are represented. L23 is shared with B016, B025, B071, B072, and B182 from SCL-38 and burial B028 from SCL-479. B182 dated to 805 BP and SCL-343 is dated to the Middle Period. Individuals B141 and B143 (both L36) whose isotopic signals indicated that they were not from any coastal region, had a matching haplotype to B001, B043, and B115 at SCL-38, and B010 from SCL-851. Obsidian hydration dated B001 to 532 BP. While belonging to a founding A haplotype, and therefore widely distributed throughout the Americas, there is a preponderance of this lineage along the California Coast. In particular, this type is found at Monterey Bay sites MNT-831 (4950-2690 BP), MNT-1489, and MNT-1931/1482 (Late Period). This lineage is also in very high frequencies at SCRI-333 in the Channel Islands and dates from 5200-4880 BP (Monroe et al., 2010). The age of this haplotype's presence along the coast and the near absence of haplogroup A throughout the entire interior of California may indicate that this lineage represents inhabitants that were present prior to the Penutian migration.

Haplogroup B Haplotypes

Forty-five haplotypes are found in the haplogroup B network. The central node represents the founding haplogroup B lineage L31 that entered into the Americas from Beringia. Often, but not always as is the case here for haplogroup B, the central node would be the largest within any particular network (as is the case for haplogroup D) (Figure 17, 19). As L31 is a founding lineage, it can be found among a diverse set of populations. In this case, it is shared by ancient individuals from Pyramid Lake (Nevada), SCL-38, and living Wishram people (Kaestle 1998; Malhi et al. 2004). However, the founding B lineage has been identified throughout North and South America at varying frequencies.

The most frequent node for haplogroup B is represented by a transversion mutation at 16184A (L30) with 12 derived lineages branching off in a star-like pattern, which denotes a past population expansion. Haplotypes within the 16184A clade are predominately found among Penutian speakers, including those from the Columbia Plateau. Its widespread geographic distribution among various Penutian language groups suggests that it is Penutian in origin. The few other individuals belonging to this clade, such as the Pomo, Mono, and Salinan, are thought to have obtained this lineage through intermarriage (Johnson et al. 2012; Johnson and Lorenz 2006; Schroeder et al. 2011). Lineage L30 is found at SCL-38 as well as at SCL-134; the latter is dated to 1560±40 BP. Three additional 16184A haplotypes (L1, L11, and L12) are found at SCL-38. Lineage 1 and 12 are defined by mutations at nps 16260 and 16042. Lineage L1 is thus far found only at SCL-38 (B078, B085, B103, B123, B164, B188, and B201) and bead typology for Burial B164 places it between 440 BP and 230 BP. However, L12 is an ancestral lineage to L1 and it belongs to one burial at SCL-38 (B195). Lineage L12 is also found among extant populations such as the Miwok and Yokuts (Johnson et al. 2012; Johnson and Lorenz 2006; Schroeder et al. 2011). Unfortunately, no absolute temporal data are available for this lineage.

An offshoot of the 16184A branch was found from a burial at SJO-112 with mutations at nps 16261 and 16295. The site dates between 2727 BP and 3826 BP, placing this branch of the lineage in the San Joaquin Valley during the Middle Period. An offshoot of this node is a lineage with a mutation at np 16126. This section of the network has a reversion at np 16184, causing reticulation. At some point in the past individuals who had both mutations at nps 16184 and 16126 lost the mutation at 16126, which reverted the nucleotide to its original state (when compared to the founding lineage). However, all haplotypes with 16126 are thought to be from the same ancestral source, i.e., originally from a maternal line that had a mutation at np 16184. This subclade (L11, L13) with both mutations at nps 16126 and 16184 is found in SCL-38 burials B111, B172, B173, B203, and B210, as well as B009 at SCL-851 which dates to 1100±30 BP. While sequencing is still not complete, two individuals from SCL-870 also have a mutation at np 16126 dating it to at least ~1242 BP (and perhaps earlier as further C-14 dates become available). This temporally places these haplotypes in the San Francisco Bay area after the proposed arrival of Penutian speakers in the region (Milliken et al. 2007). Previous molecular dates for the 16184A clade were estimated at approximately 7331-3417 years old with a mean date of ~5374 (±1957), falling directly within range of the initial Penutian migration (Golla 2011; Schroeder et al. 2011). The additional diversity discovered in the 16184A clade suggests a greater age for its initial divergence. The molecular date for the 16184A clade is now 5311 BP (99.5% CI: 7483-3140) when using an average mutation rate and confidence interval of 47.5%/site/myr (99.5% CI: 26.5-78.5%/site/myr) for the evolution of the d-loop (Henn et al. 2009; Howell et al. 2003). Thus, very little change in the date of this lineage was noted with additional data.

The second clade of interest within haplogroup B is one defined by a mutation at np 16248 (L34). A derived form has been found in the Yakama (Plateau Penutian) and a lineage with an additional mutation at np 16175 has been discovered at SCL-38 (L32) (B053, B057, B075, B119, B120, B165, B215) and SCL-287/SMA 263 (B019). A radiocarbon date for B120 places this lineage (L34) at SCL-38 at 670±52 BP. The molecular date for this clade using the above mutation rate is 1491 BP years (99.5% CI: -3563/-822). The large error range pushed this lineage past the present-day date, probably due to the lack of diversity in the clade and a small sample size. An additional haplogroup B haplotype defined by an insertion at np 16193.1C is underscored here because this part of the HVI region, called the Poly-C stretch, is hypermutable. As such, this mutation probably reoccurred multiple times throughout prehistory. Interestingly Great Basin populations (Northern Paiute, Washo, Shoshone, and ancient samples from Pyramid Lake) deviate away from haplogroup B lineages found among Penutian speakers (Figure 17).

Haplogroup C Haplotypes

Thirty-one lineages are portrayed in the haplogroup C network (Figure 18), 15 of which are found at SCL-38. Two derived clades and three additional less diverse lineages within haplogroup C have implications for the prehistory of the region. The first defined by a transversion at np 16207 is restricted to the Bay area, and its diversity suggests great antiquity. Out of the nine distinct haplotypes in the 16207 subgroup, seven are found at SCL-38 (L6, L9, L15, L16, L27, L28, and L29). The basal node for this clade (L27) is found in B032, B052, B104, B190, B202, B214, B235, and B237, and B003 at SCL-287/SMA263. No direct dates are available for L27 burials at SCL-38 or SCL-287/SMA263. However, bead typology for B052 places this lineage during the Late Period at SCL-38 (440-230 BP). Lineages L9, L15, L16, L28, and L29 (16207 clade) are unique to SCL-38. A direct date of 455±230 BP (B065) was obtained for L9 and 401±53 BP (B004) for L16. Burial B140 was the only individual belonging to L15 and has an associated obsidian hydration date of 532 BP. A relative date (740-440 BP) for L29 is based on bead/pendant typology. Other haplotypes in this clade with accumulated mutations are shared with other archaeological sites in the region (L6, L15, and L16). Haplotype L6 has been identified in two burials at SCL-38 (B180 and B211) as well as a single burial at SCL 287/SMA 263 (B020) and at SCL-851 (B005). The derived nature of this lineage (i.e., number of mutations separating this lineage from its ancestral node L27) marks it as the oldest within the group, and suggests a deep time-frame from when the clade originally split. While there are no direct dates for

SCL-38, burial B020 from SCL-287/SMA 263 is dated to 1889±42 BP. Lineage L15 and L16 (discussed above) are equally diverse, but early dates for these types are also unavailable. A related haplotype, diverged from the ancestral L27, is found at SOL-270 which dates to 2727-3826 BP (Eshleman 2002). The molecular date for the 16207 node is 7368 BP (99.5% CI: 10313-4424).

The second clade is represented by a mutation at np16311 followed by secondary mutations at nps 16264 and 16093. These haplotypes are found throughout the San Francisco Bay region, but also from archaeological sites in Amador and San Joaquin Counties; Owen Valley, California; and among indigenous Great Basin populations. The mutation at np 16311 within haplogroup C has been found in populations throughout the American Southwest and extensively in South America in both modern and ancient DNA samples. The wide geographic distribution may place this lineage early in the initial migration throughout the Americas. However, np 16311 is considered a mutational hotspot so its distribution may be due to homoplasy. However, the other mutations in this clade (nps 16264 and 16093) are unique to Central California. The mean date of this clade, when only including California and Great Basin groups, dates to approximately 5652 BP (99.5% CI: 8070-3233).

Other noteworthy clades are those that have reverted mutations at nps 16325 (L18) and 16327 (L20 and L26), respectively. Both showed haplotype sharing among archaeological sites in the region as well as with modern Costanoan individuals (Figure 18). Though not depicted in the network, this lineage is also discovered in an ancient Great Basin sample that dates to ~3300-1600 BP. Within L18 only two individuals at SCL-38 are found with this type (B062, B230) and are shared with a burial from SCL-755 (B005) which dates to 1400±105 BP.

Burials (B031, B051, B132, B209, B213, B218, B228, and B233) represent mtDNA lineage (L20), which is also found at four other archaeological sites (MNT-391, SCL-134, SCL-204, and SOL-270). This lineage dates from 790-370 BP at SCL-38. Its oldest appearance is ca. 2,000 years ago at SOL-270. Only one individual (B100) at SCL-38 belongs to L26, but has been found at SCL-134 (B023), SCL-851 (B003/B003a), and SCL-895 (B001). Obsidian hydration indicates a Late Period (590 BP) timeframe for this haplotype at SCL-38. Radiocarbon dates place this lineage at 270±30 BP at SCL-851 and the Late Middle Period at SCL-895 (1680±40 BP).

A rarer haplogroup C haplotype (L10), defined by a mutation at np 16124, appears to be restricted to Central California. It was first noted in SJO-112, but with an additional back mutation at 16223. It was documented in low frequencies at SCL-38 (B042, B046, B054, B163, and B179), MNT-1256, and a living Rumsen Ohlone/Esselen elder who is maternally descended from Rumsen ancestors from the village of Tucutnut (Breschini 2014; Johnson and Lorenz 2006). The oldest occurrence of this lineage is B179 (1725±200 BP) at SCL-38, 848±30 BP at MNT-1256 B001, and 3826-2727 BP at SJO-112.

Haplogroup D Haplotypes

The majority of individuals from SCL-38 belong to the mtDNA founding haplotype called D1 (L22) and is denoted by the central node (Figure 19). This lineage represents 27% of burials found at SCL-38 (n=51). This haplotype is also very common throughout Central California, Sierra Nevada, and Great Basin. An additional clade, one defined by a mutation at np 16189 (creating a Poly-C stretch in the hypervariable region), is also found across space and time in the San Francisco Bay area. At SCL-38 (L33), it was found among three burials (B038, B197, and B198).

A rarer lineage with a mutation at np 16142 is unique and has been identified in a living Costanoan individual. An additional mutation which occurs at np 16150 produces lineage L35. At SCL-38, it is only found in burials B011 and B060. Despite its infrequency, these two mutations are quite unusual and are likely population defining markers.

Lineage L2, L3, and L4 are thus far restricted to SCL-38 and range in frequency from two to eight burials. A radiocarbon date from B045 dates L3 lineage to 769±43 BP in the Bay area.

The haplotype defined by a mutation at np 16092 (L5) is the second most frequent lineage at SCL-38, being found among 12 burials. This lineage has also been discovered at ALA-312 B1 which dates to 3660±30 BP (DiGiuseppe and Grant 2012), making it the oldest lineage with an associated radiocarbon date from the San Francisco Bay. Comparison of strontium isotope data from ALA-312 B1 with other regional sites shows deviation from the Central Valley, as well as from sites in Santa Clara Valley (Eerkens and Jorgenson 2012). Carbon and nitrogen isotopes data fall in line with other sites from the Bay area (Bartelink 2012).

The haplogroup D haplotype (L7), defined by a mutation at np 16093, reveals a definitive connection to Plateau Penutian populations including the Wishram and Yakama, as well as an ancient individual from the Vantage Site along the Middle Columbia River (dated 500 to 1500 BP) (Malhi et al. 2004). A similar pattern was also found with lineage L26, which is shared between the Wishram and burials at SCL-38.

Haplotype (Lineage) Sharing within SCL-38

The distribution of different lineages within each previously defined spatial cluster (SC1-SC8) revealed that each is incredibly diverse and that very few mtDNA types were shared within each grouping (Tables 13, 14, 15). Between 36% and 83% of individuals, within any given spatial cluster, belong to a lineage that is not shared within that cluster. Spatial cluster SC5 is the most diverse in terms of number of representative haplotypes, but also has the most shared types between burials. Since most lineages are not isolates (n=29), the sharing of mtDNA types appears to be among spatial clusters, not within them. In fact, only three lineages that belonged to more than one individual had a distribution limited to a single spatial cluster. These types (L4, L9, and L13) were still infrequent with n=2. Thus, most lineages that belong to two or more individuals are found among more than one cluster

Spatial Cluster	Haplotype (Lineage)	Number of Haplotypes (Lineages) in Cluster	Total individuals in Spatial Cluster n=
SC1	L2,L7,L10,L14,L16,L20,L22, L23,L25,L31,L32,L34,L35, L36	14	28
SC2	L3, L16, L22, L27, L35	5	7
SC3	L16, L22, L23, L27, L30	5	7
SC4	L3,L4,L5,L8,L11,L19,L22, L25,L33,L34,L36	11	25
SC5	L1,L2,L3,L5,L6,L7,L8,L9, L10, L11,L13,L14,L15,L16L17, L18,L19,L20,L21,L22,L23, L24,L25,L26,L27,L28L29, L31, L32,L33,L34,L36	32	89
SC6	L1, L3, L12, L27, L30	5	6
SC7	L6, L11, L17, L20, L22, L25, L27, L30	8	12
SC8	L3,L5,L20,L22,L25,L34	6	15

Table 13. Lineage Distribution within Spatial Clusters.

Haplotypes Occurring with n= Number of Individuals	Number of Haplotypes	% of total Haplotypes	Haplotype/Lineage
1	7	19	L12,L15,L18,L21,L26, L28,L29
2	10	28	L2,L4,L6,L7,L9,L13, L17,L24,L31,L35
3	3	8	L19,L30,L33
4	1	3	L32
5	4	11	L10,L11,L16,L23
6	2	6	L8,L36
7	2	6	L1,L34
8	5	14	L3,L14,L20,L25,L27
12	1	3	L5
51	1	3	L22

Table 14. Number of Individuals Belonging to each Haplotype.

Spatial Cluster											
	Total number across SCL-38	**SC1**	**SC2**	**SC3**	**SC4**	**SC5**	**SC6**	**SC7**	**SC8**	**None**	**(n=) Clusters**
L1	7	-	-	-	-	5	1	-	-	1	2 (1)
L2	2	1	-	-	-	1	-	-	-	-	2
L3	8	-	1	-	1	4	1	-	1	-	5
L4	2	-	-	-	2	-	-	-	-	-	1
L5	12	-	-	-	8	1	-	-	3	-	3
L6	2	-	-	-	-	1	-	1	-	-	2
L7	2	1	-	-	-	1	-	-	-	-	2
L8	6	-	-	-	4	2	-	-	-	-	2
L9	2	-	-	-	-	2	-	-	-	-	1
L10	5	2	-	-	-	3	-	-	-	-	2
L11	5	-	-	-	1	2	-	2	-	-	3
L12	1	-	-	-	-	-	1	-	-	-	1
L13	2	-	-	-	-	2	-	-	-	-	1
L14	8	3	-	-	-	5	-	-	-	-	2
L15	1	-	-	-	-	1	-	-	-	-	1
L16	5	1	1	1	-	2	-	-	-	-	4
L17	2	-	-	-	-	1	-	1	-	-	2
L18	1	-	-	-	-	1	-	-	-	-	1
L19	3	-	-	-	1	2	-	-	-	-	2
L20	8	1	-	-	-	2	-	3	2	-	4
L21	1	-	-	-	-	1	-	-	-	-	1
L22	51	10	3	2	2	27	-	1	6	-	7
L23	5	1	-	1	-	3	-	0	-	-	3
L24	2	-	-	-	-	2	-	0	-	-	2
L25	8	1	-	-	1	3	-	1	2	-	5
L26	1	-	-	-	-	1	-	-	-	-	1
L27	8	-	1	2	-	2	1	2	-	-	5
L28	1	-	-	-	-	1	-	-	-	-	1
L29	1	-	-	-	-	1	-	-	-	-	1
L30	3	-	-	1	-	-	1	-	-	1	2 (1)
L31	2	1	-	-	-	1	-	-	-	-	2
L32	4	1	-	-	-	3	-	-	-	-	2
L33	3	-	-	-	1	2	-	-	-	-	2
L34	7	1	-	-	2	3	-	-	1	-	4
L35	2	1	1	-	-	-	-	-	-	-	2
L36	6	3	-	-	2	1	-	-	-	-	3
Total	**189**	**28**	**7**	**7**	**25**	**89**	**5**	**11**	**15**	**2**	

Table 15. Distribution of Haplotype Lineages across all Spatial Clusters.

Haplotype (Lineage) Distribution within Spatial Clusters

The numbers of haplotypes present in each previously defined spatial cluster and the distribution of specific haplotypes amongst those clusters at SCL-38 will be discussed separately.

Spatial Cluster 1 (SC1)

Within SC1, 14 haplotypes represented by 28 individuals are identified (Table 16; Figure 20). Ten of these lineages are each represented by a single individual, while one is found with two burials. Only three haplotypes are identified that belong to more than two individuals. L14 and L36 are each represented by three individuals (L14=B034, B039, and B047; L36=B001, B043, and B115) and represent 37.5% and 50% of the total number this type at SCL-38. The final lineage, L22 (n=10), is the most common haplotype at SCL-38. SC1 contains the largest number of individuals belonging to this lineage outside of the central cluster (SC5).

There are an approximately equal number of haplotypes found between males and females (7 and 8 respectively) with only two that are shared between sexes (L22 and L36). Three lineages are found among children (L22, L31, and L36), none of which share a haplotype with nearby burials regardless of age or sex, suggesting burial placement went beyond kinship. Yet, L22 and L36 are the only haplotypes in SC1 shared between sexes and children perhaps still indicating some sort of familial grouping.

Haplotype/ Lineage	**SC1 n=**	**% of Total SC1**	**Total Count of Haplotype at SCL-38**	**% of Haplotype Total SCL-38**	**Burials**
L2	1	4	2	50	B015
L7	1	4	2	50	B081
L16	1	4	5	20	B005
L20	1	4	8	12.50	B031
L23	1	4	5	20	B016
L25	1	4	8	12.50	B035
L31	1	4	2	50	B003
L32	1	4	4	25	B028
L34	1	4	7	14	B057
L35	1	4	2	50	B060
L10	2	7	5	40	B042,B046
L14	3	11	8	37.50	B034,B039,B047
L36	3	11	6	50	B001,B043,B115
L22	10	36	51	20	B019,B026,B033, B044,B048,B049, B056, B066,B067,B074
Total	28	100			

Table 16. Distribution of Haplotype Lineages in SC1.

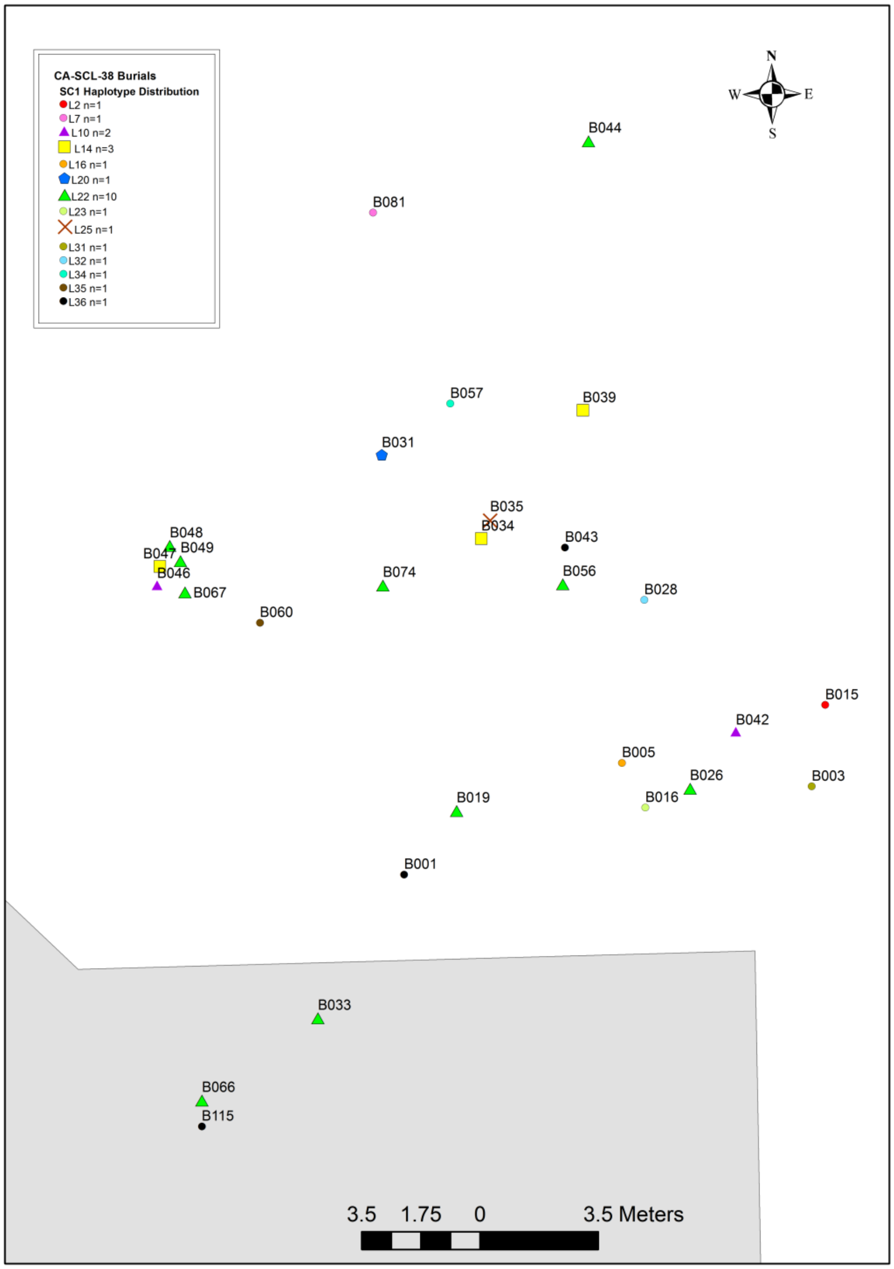

Figure 20. Haplotype Lineage Distribution in SC1.

Spatial Cluster 2 (SC2)

Five separate lineages are documented among the seven burials haplotyped (Table 17; Figure 21). Haplogroup data was obtained for the two remaining burials in this cluster, B012 and B036, but has not been completely sequenced. Lineage L22 is again the most frequent haplotype (n=3) and is the only one shared between males, females, and burials of unknown sex. Three lineages are found among females and two are associated with males. Haplotypes L3 and L27, each found among a single burial, are two of the more frequent lineages at SCL-38 (n=8) and are one of the most widely distributed lineages across all clusters.

Haplotype/ Lineage	**SC2 n=**	**% of Total SC2**	**Haplotype at SCL-38 n=**	**% of Haplotype Total SCL-38**	**Burials**
L3	1	14	8	13	B010
L16	1	14	5	20	B004
L27	1	14	8	13	B032
L35	1	14	2	50	B011
L22	3	43	51	6	B008, B009, B014

Table 17. Haplotype Lineage Distribution in SC2.

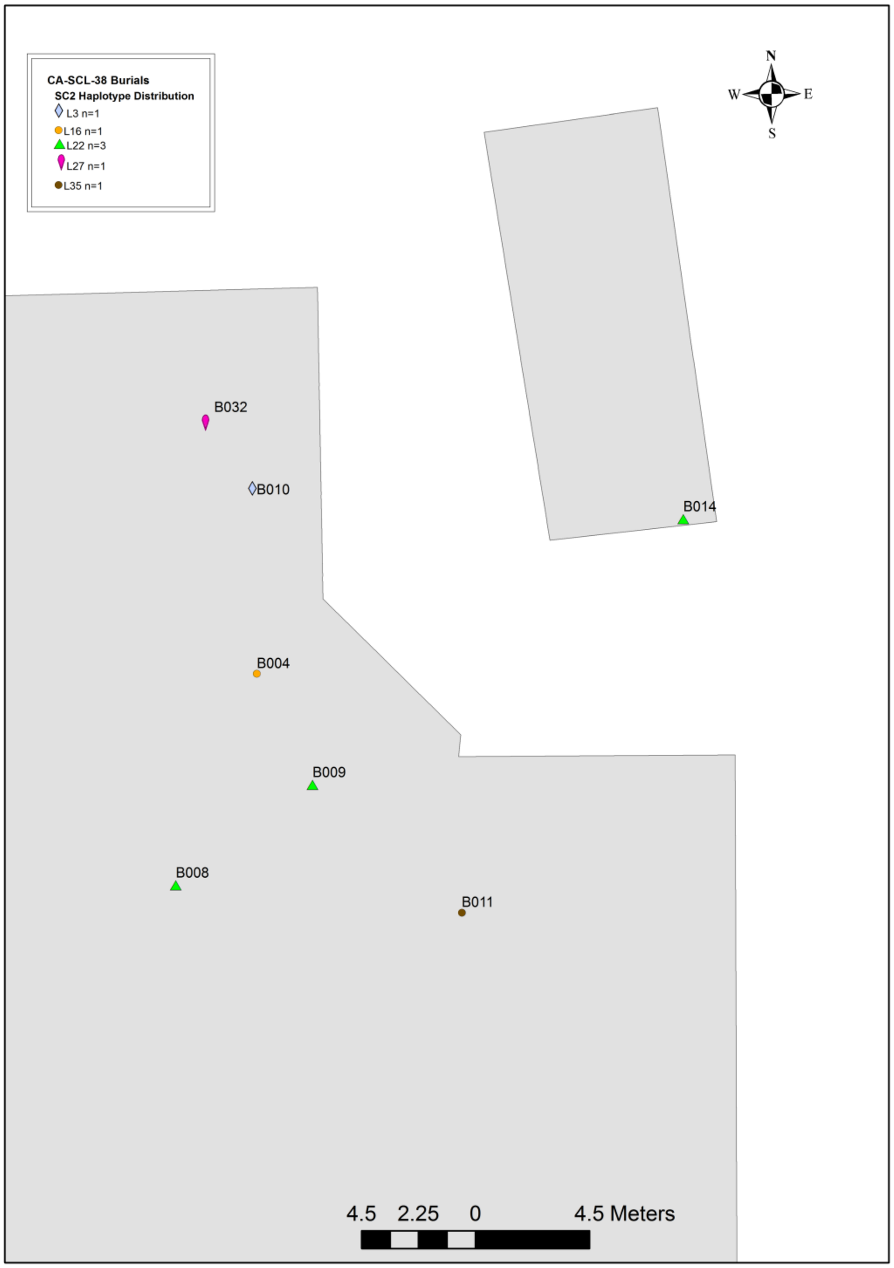

Figure 21. Haplotype Lineage Distribution SC2.

Spatial Cluster 3 (SC3)

The overall distribution of haplotypes within SC3 is comparable to SC2 both in the number of separate lineages and number of individuals for which sequence data are available (5/7) (Tables 18; Figure 22). Two lineages (L22 and L27), both belonging to more than one individual within this cluster, are also distributed throughout the site. One haplotype (L27) is found with a young adult male (B235) and one child (B237), and are in close proximity with each other, while L22 is restricted to adult males. The remaining SC3 haplotypes are also relatively frequent at SCL-38.

Haplotype/ Lineage	**SC3 n=**	**% of Total SC3**	**Haplotype at SCL-38 n=**	**% of Haplotype Total SCL-38**	**Burials**
L16	1	14	5	20	B232
L23	1	14	5	20	B025
L30	1	14	3	33	B206
L22	2	29	51	4	B205,B221
L27	2	29	8	25	B235,B237
Total	7	100			

Table 18. Haplotype Lineage Distribution SC3.

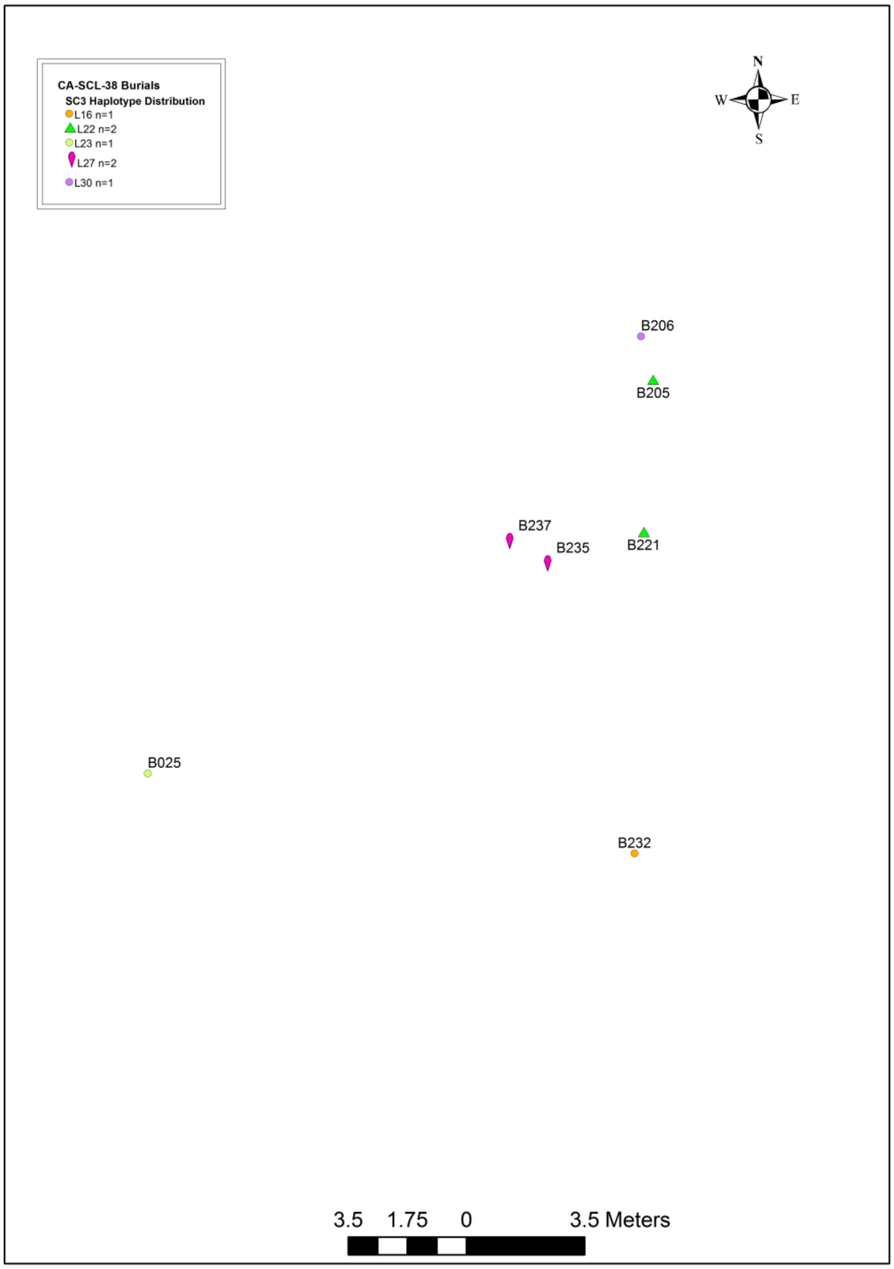

Figure 22. Haplotype Lineage Distribution in SC3.

Spatial Cluster 4 (SC4)

Eleven haplotypes from 25 burials have been identified in SC4. Lineage L4 is restricted to this cluster (B015 and B083). Five lineage types occur only once while four different haplotypes are found at least twice. However, a majority of the haplotypes are documented in relatively high frequency throughout the site and among multiple clusters (Table 19; Figure 23). Two of these, L3 and L25, are some of the most widely distributed, being found in five different clusters. Haplotype L5 is predominately in this cluster (n=8) with three other individuals identified in SC8. Four burials belonging to L5 were adult males (B029, B109, B131, and B152), three were adult females (B068, B125, and B146), and one was an infant. Burials B109, B125, B131, and B152 group together in the southeast corner of SC4, possibly representing maternal relatives, consisting of three adult males and an older female. Most L5 individuals in SC4 have no grave goods, while two adult men have 1-2 artifacts interred with them. Interestingly, two of the three elderly female burials belonging to this L5 lineage had the most number and types of artifacts.

Similarly, L8 was also in high frequency in this cluster (67% n=4/6) and appeared with two males, one female, and one infant grave. One of these males was one of the “Mystery Men” (B144) buried within a group in the northern portion of the cluster. The presence of this “Mystery Man” along with the prevalence of the L8 lineage within SC4 may designate him as distant maternal kin. However, unlike L5 the burials are not in close proximity to each other. Interestingly, the only L8 individual who belonged to this cluster and also had a large amount and type of grave goods belonged to a child (B178 with 302 total number and 5 different types of artifacts). Consequently, some lineages (L5) perhaps indicate a clustering of potential relatives supporting the notion put forth by Bellifemine who suggested SC4 was made up of kin groups. Other maternal types, such as L8, present a more ambiguous patterning, as it is found more often in this cluster, but displays no close associations within SC4 itself. Grave wealth with this lineage is linked to a single child and no adults.

Haplotype/ Lineage	SC4 n=	% of Total SC4	Haplotype at SCL-38 n=	% of Haplotype Total SCL-38	Burials
L3	1	4	8	13	B018
L11	1	4	5	20	B111
L19	1	4	3	33	B192
L25	1	4	8	13	B156
L33	1	4	3	33	B197
L4	2	8	2	100	B122,B186
L22	2	8	51	4	B107,B142
L34	2	8	7	29	B119,B120
L36	2	8	6	33	B141,B143
L8	4	16	6	67	B118,B129, B144,B178
L5	8	32	12	67	B029,B068, B109,B125, B128,B131, B146,B152

Table 19. Haplotype Lineage Distribution in SC4.

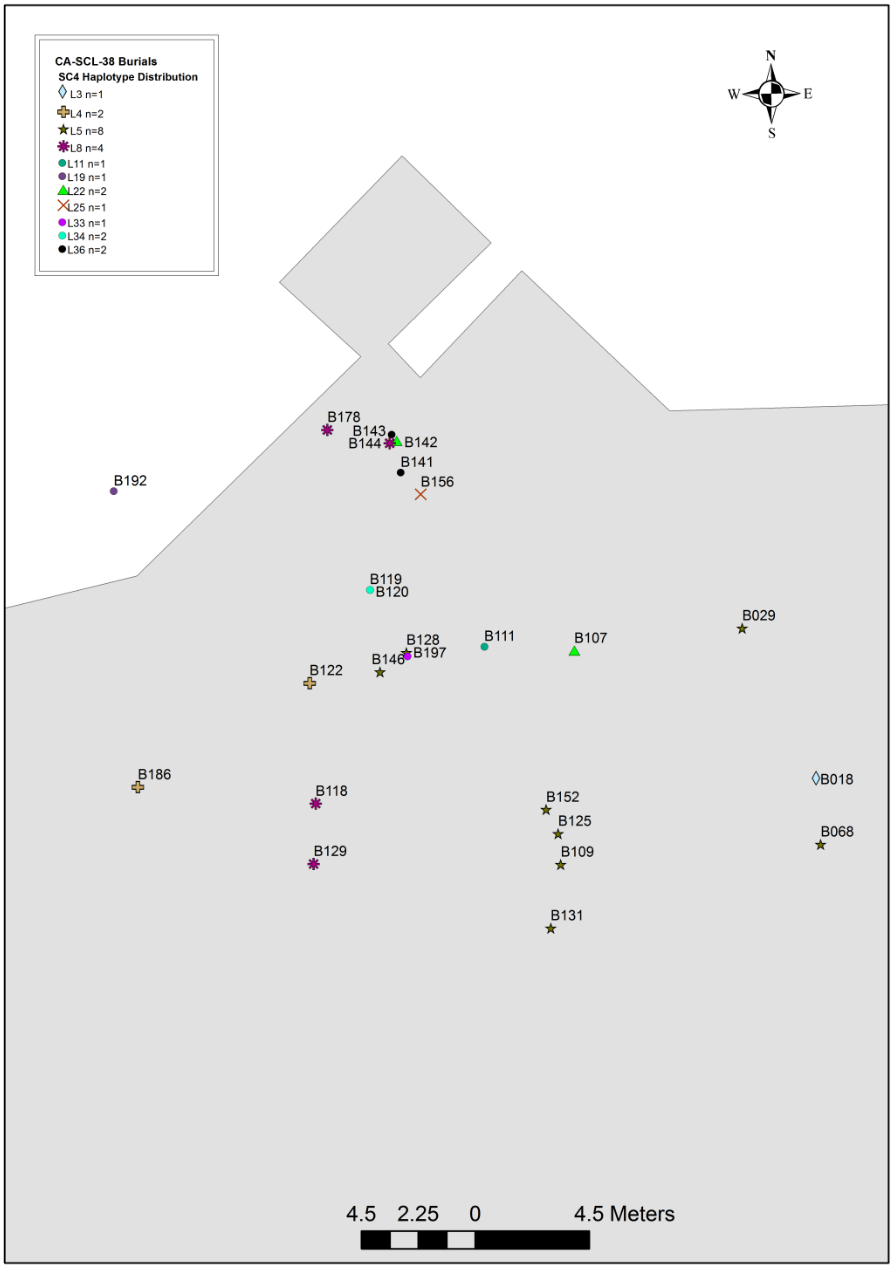

Figure 23. Haplotype Lineage Distribution SC4.

Spatial Cluster 5 (SC5)

Spatial Cluster 5 has the highest genetic diversity with 32 out 36 lineages being present (Table 20; Figure 24-25). Nine haplotypes are only found in this cluster, six of which have a sample size of one across the entire site. Four types (L4, L12, L30, and L35) are not identified in this cluster. Lineage L4 (n=2) is restricted to SC4, L12 is a type found in SC6, and L30 is found in SC3, SC6, and in a burial that is outside any cluster. Thus, while SC5 has the highest sample size in terms of total number of burials, it also has the highest representation of separate mtDNA types.

Over half of the individuals belong to L22 (54% n=27/89) which, based on artifact diversity and quantity as described by Bellifemine (1997), was a burial area designated for elites. This is striking as 27% of the individuals sequenced at the site (n=51) belong to this lineage, and it is identified among more spatial clusters (n=7) (Figure 26) than any other type. In SC5 fourteen males, seven females, and six of unknown sex, (three are infants or children) belong to L22. Also within the cluster, 19 individuals have four to nine distinct artifact types. These presumably represent the wealthiest burials. Thirteen of these individuals belong to L22 (68%). However, when looking at grave wealth distribution within L22 in SC5, almost 60% have three or fewer artifacts (Table 21).

Haplotype/ Lineage	SC5 n=	% of Total SC5	Haplotype at SCL-38 n=	% of Haplotype Total SCL-38	Burials
L2	1	1	2	50	B083
L5	1	1	12	8	B168
L6	1	1	2	50	B180
L7	1	1	2	50	B076
L15	1	1	1	100	B140
L17	1	1	2	50	B183
L18	1	1	1	100	B062
L21	1	1	1	100	B086
L26	1	1	1	100	B100
L28	1	1	1	100	B079
L29	1	1	1	100	B088
L31	1	1	2	50	B023
L36	1	1	6	17	B108
L8	2	2	6	33	B069,B096
L9	2	2	2	100	B064,B065
L11	2	2	5	40	B171,B173
L13	2	2	2	100	B061,B116
L16	2	2	5	40	B138,B153
L19	2	2	3	67	B092,B110
L20	2	2	8	25	B051,B152
L24	2	2	2	100	B169,B179
L27	2	2	8	25	B052,B104
L33	2	2	3	67	B038,B198
L10	3	3	5	60	B044,B021, B043
L23	3	3	5	60	B071,B072, B182
L25	3	3	8	38	B077,B082, B095
L32	3	3	4	75	B013,B130, B148
L34	3	3	7	43	B053,B075, B165
L3	4	4	8	50	B045,B080, B137, B159
L1	5	6	7	71	B078,B085, B103 ,B123, B164

L14	5	6	8	63	B063,B105, B105A, B114, B196
L22	27	30	51	53	B024,B037, B050, B055,B058, B070, B073,B084, B087, B090,B091, B093, B097,B112, B134, B135,B136, B145, B157,B160, B161, B166,B167 ,B170, B171,B177, B184
Total	**89**				

Table 20. Haplotype Lineage Distribution in SC.

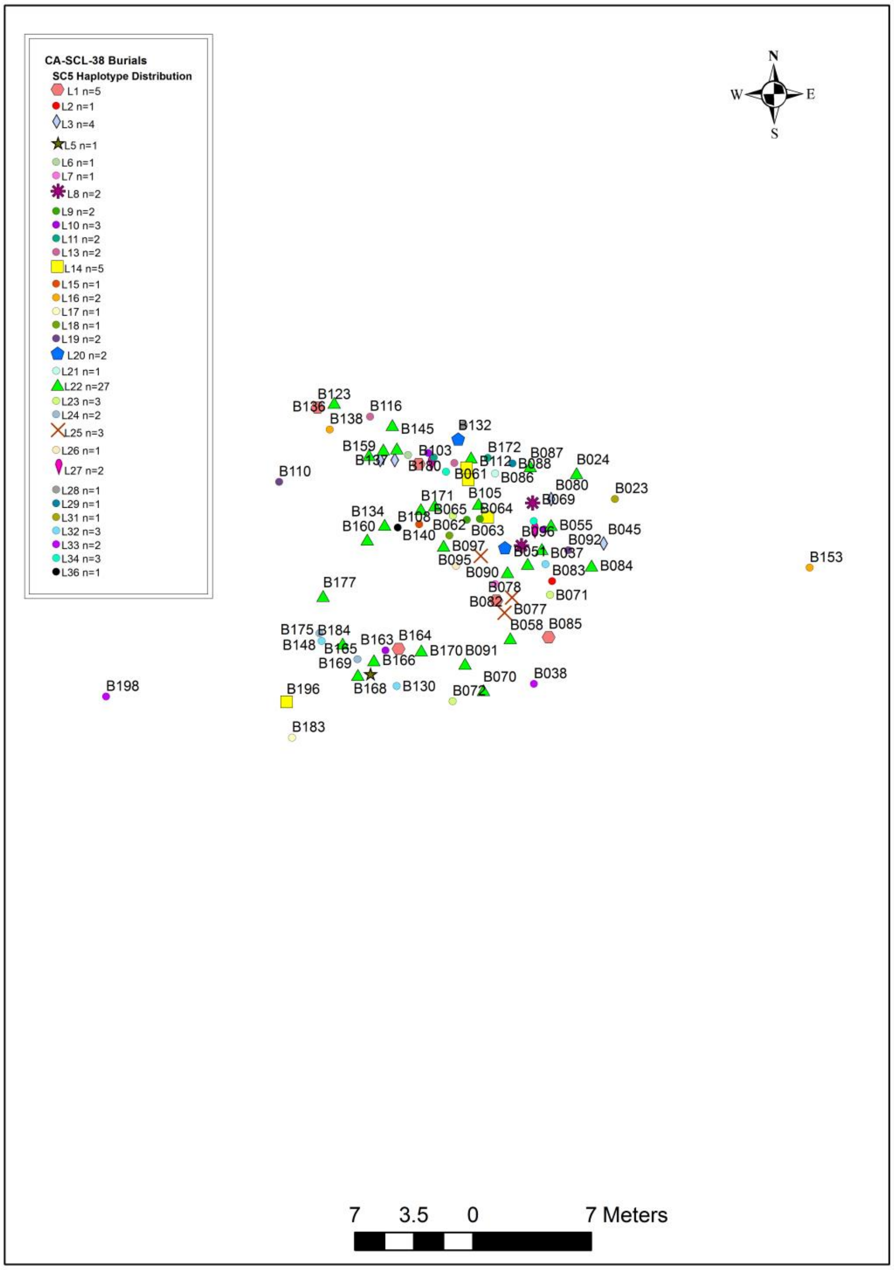

Figure 24. Haplotype Lineage Distribution in SC5.

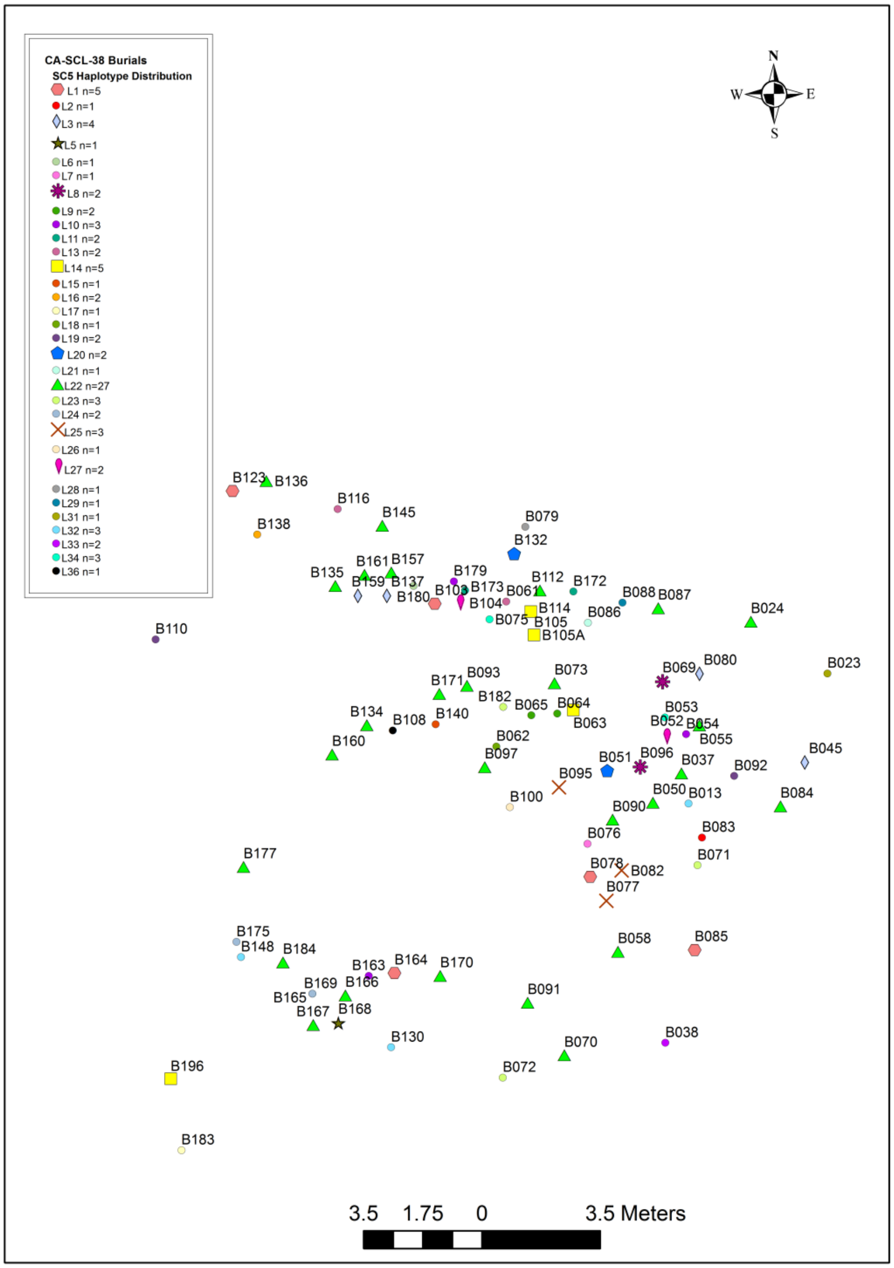

Figure 25. Close-up of SC5 Haplotype Distribution.

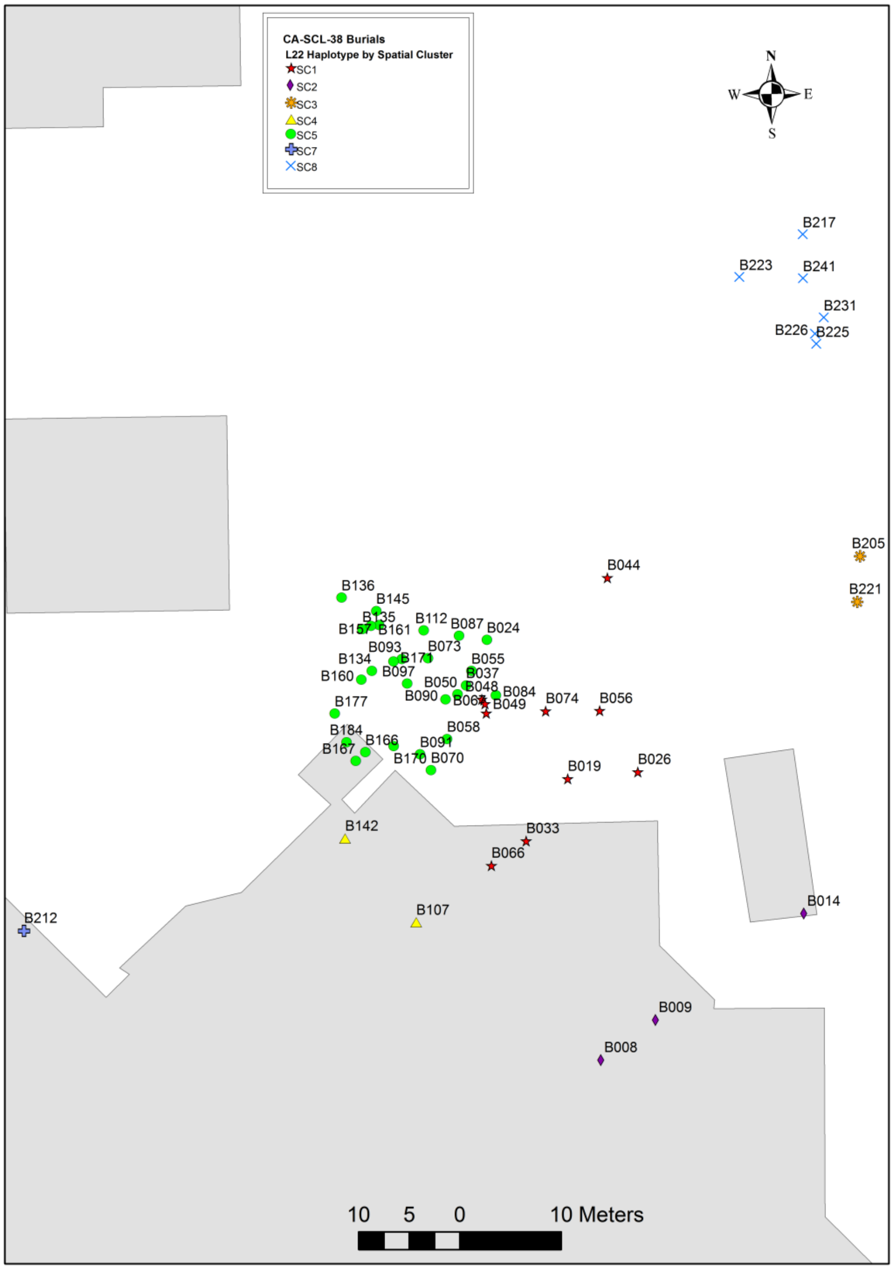

Figure 26. Distribution of L22 at SCL-38 by Spatial Cluster.

Total Number of Artifact	**Number of L22 individuals within SC5**	**% of Total L22**
0	3	11
1-10	9	33
11-50	2	7
51-100	2	7
101-500	5	19
500-1000	3	11
1001-5000	3	11

Table 21. Distribution of Number of Artifacts Types of L22 Burials in SC5.

A similar pattern is found when looking at total number of artifacts (Table 22). Throughout all of SCL-38, 27 burials have artifact types with counts of four or higher. Regardless of cluster, 14 of these individuals belong to L22 (~52%). However, when the distribution of number of artifact types and L22 is displayed throughout SCL-38, a majority of the burials which belong to this lineage has either one or no types (Table 23). The same is true for the overall quantity of artifacts (Table 22). Haplotype L22 also has the highest distribution at the site, being found in seven spatial clusters. Consequently, while there appears to be a connection between wealthy burials and L22, both within SC5 and at SCL-38 as a whole, belonging to L22 did not guarantee that a burial necessarily had more grave goods.

Total Number Artifacts	**Number of L22 Individuals at SCL-38**	**% of Total L22**
0	11	22
1-10	20	40
11-50	5	10
51-100	2	4
101-500	7	14
500-1000	3	6
1001-5000	3	6

Table 22. Distribution of Total number of Artifacts of L22 Burials in SC5.

Number of Artifact Type	**Number of L22 individuals at SCL-38**	**% of Total L22**
0	18	35
1	10	20
2	7	14
3	2	4
4	7	14
5	2	4
6	4	8
7	0	0
9	1	2

Table 23. Distribution of Number of Artifacts Types of L22 Burials across SCL-38.

The second most frequent haplotypes in SC5 was L1 (n=5) and L14 (n=5). Interestingly, the only other spatial cluster where L14 has been identified was SC1. Three burials belonging to L14 (B114, B105, and B105a) are buried in close proximity, with B105 and B105a being part of a double burial. This may indicate familial relationship which is discussed later in this chapter in regards to multiple/associated burials. The SC1 cluster also had the second highest frequency of burials typed as L22, revealing that this cluster, other than SC5, had the second highest occurrences of the two most frequent lineages. Haplotype L1 was quite infrequent outside of SC5, being detected in only one burial from SC6 and another burial that did not belong to a cluster.

Spatial Cluster 6 (SC6)

Five different haplotypes from five burials were documented at SC6. These included L1, L3, L12, L27, and L30 (Table 24; Figure 27). Lineage L12 is limited to SC6, and L3 and L27 are among the most frequent types at the site and are found in most clusters. However, the most frequent type, L22, did not belong to this cluster. Only one burial with genetic data (B188 who belonged to L1) had any grave goods. The cluster did not deviate from the norm in terms of age or sex.

Haplotype/Lineage	**SC6 n=**	**% of Total SC6**	**Haplotype at SCL-38 n=**	**% of Haplotype Total SCL-38**	**Burials**
L1	1	20	7	14	B198
L3	1	20	8	13	B191
L12	1	20	1	100	B195
L27	1	20	8	13	B190
L30	1	20	3	33	B185
Total	**5**	100			

Table 24. Haplotype Lineage Distribution in SC6.

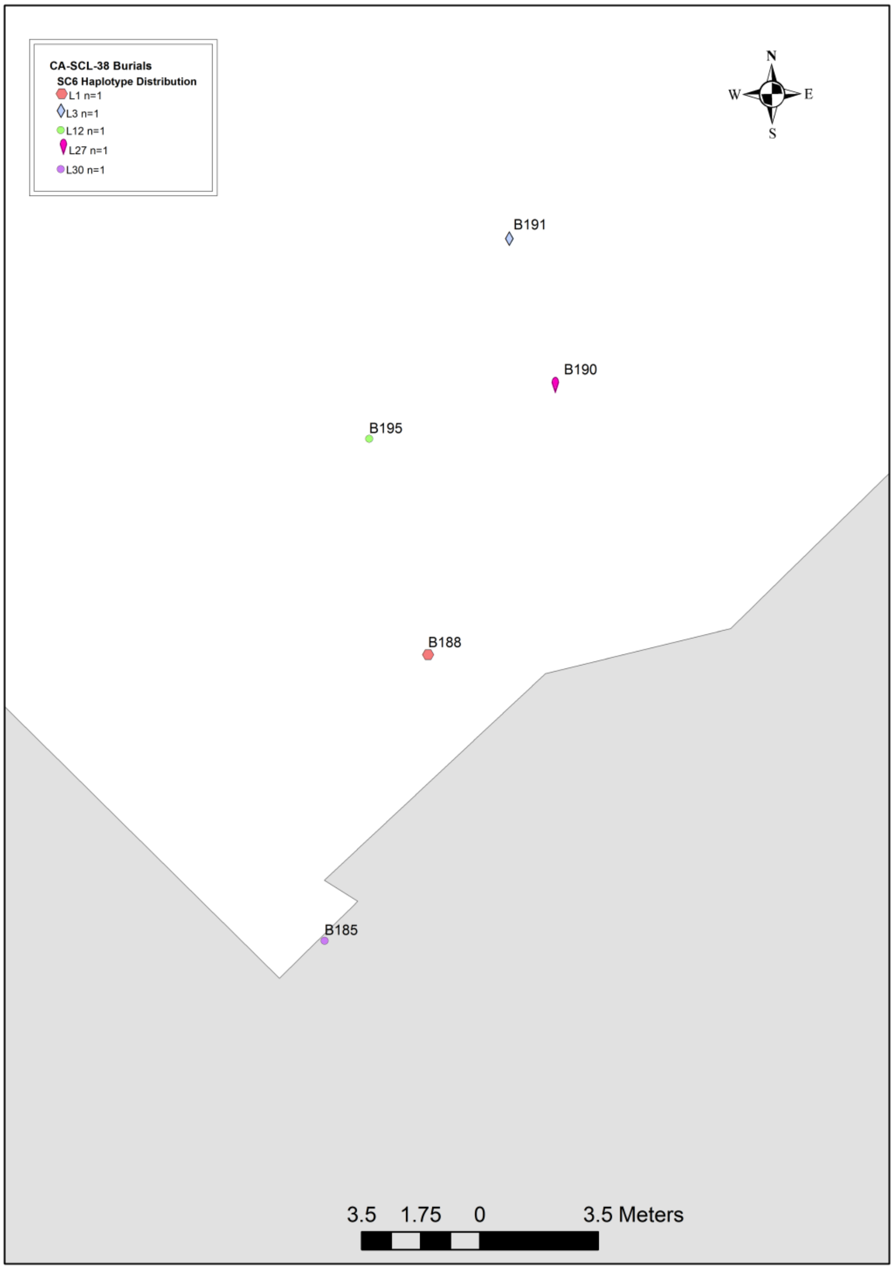

Figure 27. Haplotype Lineage Distribution in SC6.

Spatial Cluster 7 (SC7)

Seven haplotypes (L6, L11, L17, L20, L22, L25, and L27) were identified among a total of 11 burials (Table 25; Figure 28). Three of these (L11, L27, and L20) occur in more than one burial, but none are limited to any particular age or sex. No burials with DNA data have more than one artifact type, which consists of three shell beads with B209 (who belongs to L20).

Haplotype/ Lineage	**SC7 n=**	**% of Total SC7**	**Haplotype at SCL-38 n=**	**% of Haplotype Total SCL-38**	**Burials**
L6	1	9	2	50	B211
L17	1	9	2	50	B234
L22	1	9	51	2	B212
L25	1	9	8	13	B207
L11	2	18	5	40	B203, B210
L27	2	18	8	25	B202, B214
L20	3	27	8	38	B209, B213, B233
Total	**11**	100			

Table 25. Haplotype Lineage Distribution in SC7.

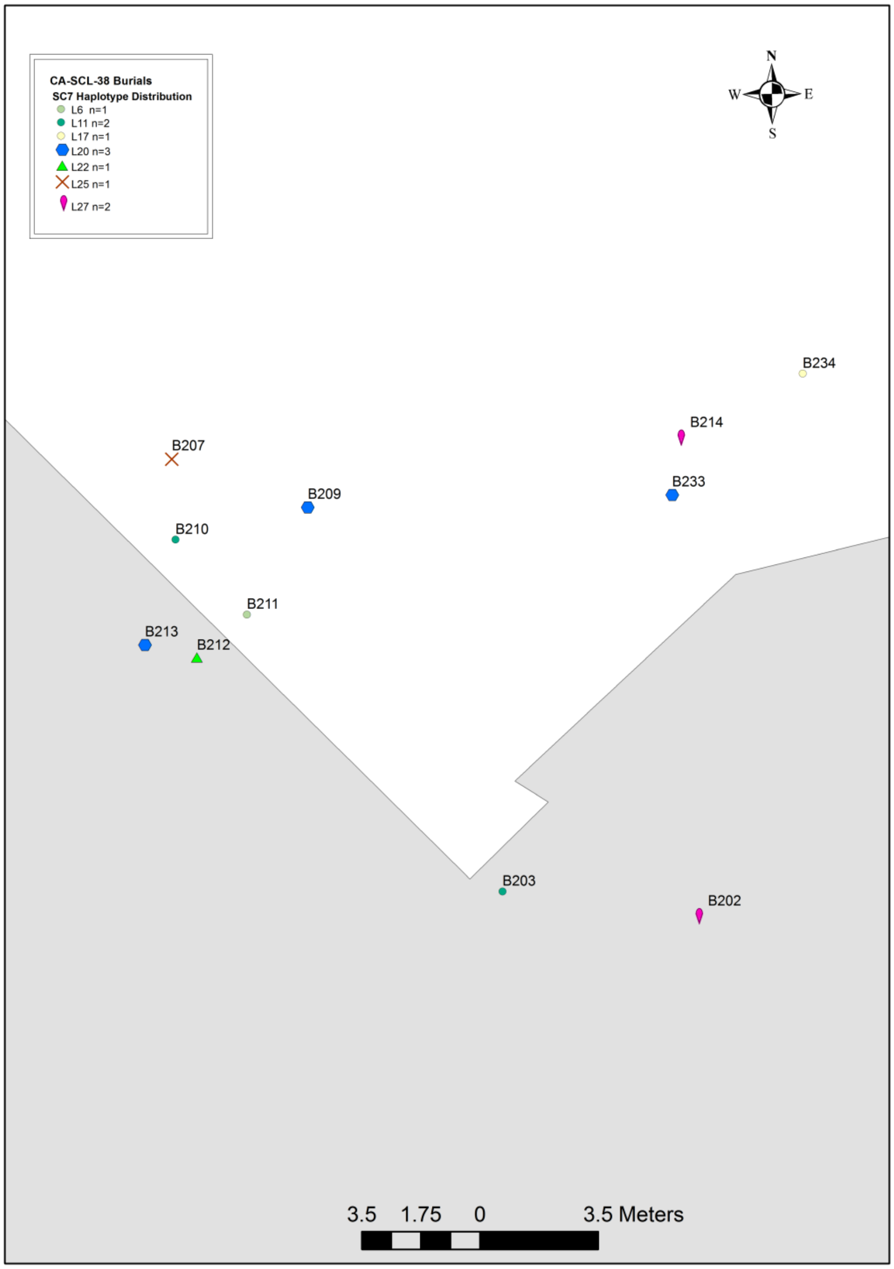

Figure 28. Haplotype Lineage Distribution in SC7.

Spatial Cluster 8 (SC8)

Out of 15 burials, six different haplotype lineages are identified. None are restricted to this spatial cluster and the most frequent is L22 (n=6). The second most common type is L5, which has its highest occurrence in SC4 (n=8) and a single instance in SC5. Lineage L25 is detected in two burials. Nine individuals have grave goods, four of which have four or more types of artifact classes. Two of these B217 (child) and B226 (elderly female) belong to L22. The other two instances are B220, a young child who was identified as L5, and B224, a young male who is L25. Thus, the largest amount of grave wealth occurs in burials that have more than one representative within the cluster, and also have higher relative frequencies throughout all burials and their associated clusters. However, every lineage present in this cluster reoccurs throughout SCL-38 (Table 26; Figure 29).

Haplotype/ Lineage	**SC8 n=**	**% of Total SC8**	**Haplotype at SCL-38 n=**	**% of Haplotype Total SCL-38**	**Burials**
L3	1	7	8	13	B238
L34	1	7	7	14	B215
L20	2	13	8	25	B218,B228
L25	2	13	8	25	B222,B224
L5	3	20	12	25	B219,B220, B227
L22	6	40	51	12	B217,B223, B225, B226,B231, B241
Total	**15**	100			

Table 26. Haplotype Lineage Distribution in SC8.

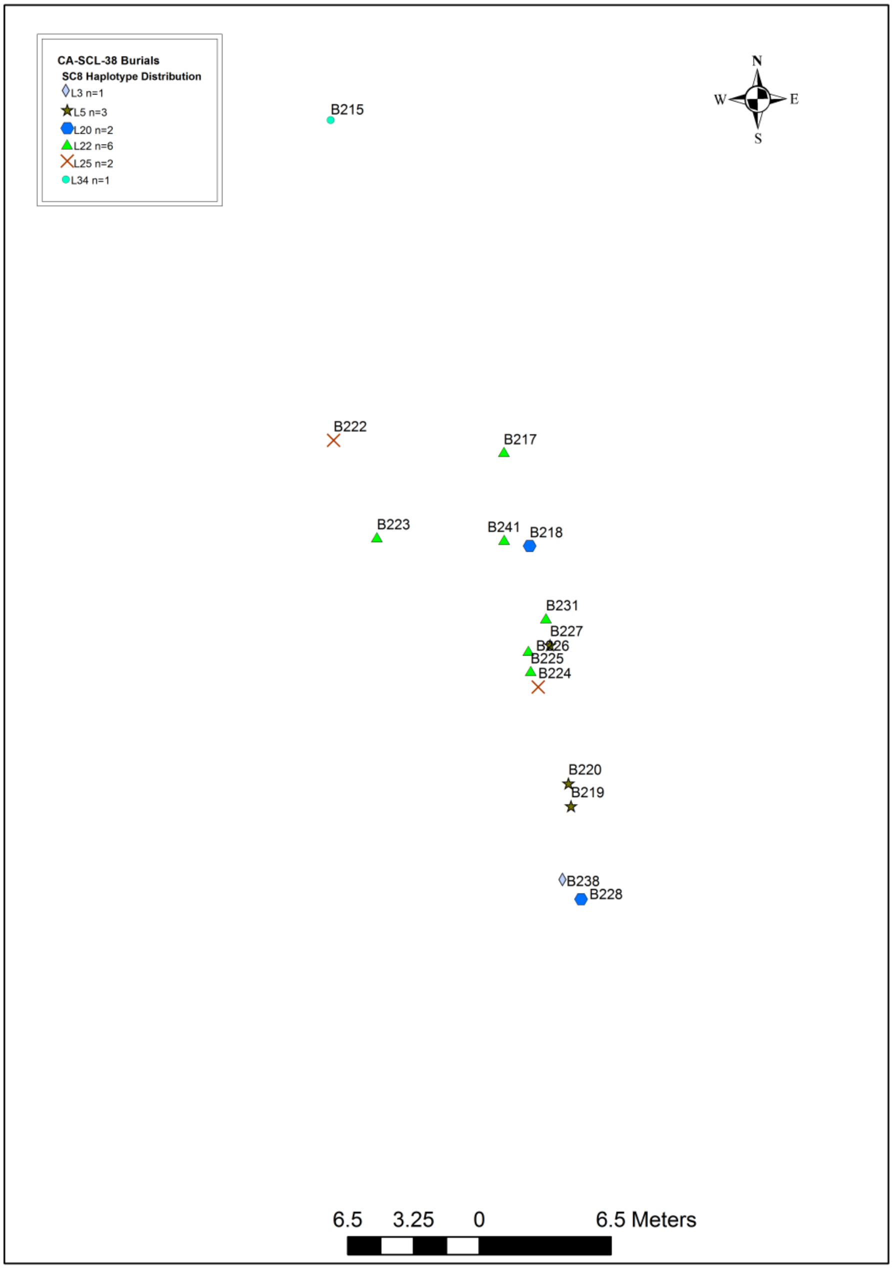

Figure 29. Haplogroup Lineage Distribution in SC8

Haplotype Distribution among Group or Multiple Burials

160s Cluster

This set of associated burials was interred in a rough semi-circle. All were located in SC5, and included burials B148, B161-169, and B184. A majority were male (n=9/12), but one elderly female (B148) and a child (B169) were included in the grouping. DNA was not obtained from burial B162. Six burials had evidence of burning. Table 27 displays the mtDNA results for this proposed sub-clustering as well as the number of artifact types and total number of artifacts. Four burials (B161, B166, B167, and B184) belonged to the ubiquitous L22 haplotype, while the remaining five all had different mtDNA haplotypes. Overall, the 160s cluster had higher than average grave wealth in both diversity and overall quantity. However, no one lineage was correlated with this wealth.

Burial 160's Cluster mtDNA			
Lineage/ Haplotype	**Burial**	**Total number Artifact Types (Diversity)**	**Total number of Artifacts**
L1	B164	4	572
L5	B168	4	1075
L10	B163	5	291
L22	B161, B166, B167, B184	0, 2, 4, 2	0, 4093, 381, 2
L32	B148	2	3
L34	B165	1	2
NA	B162 -No DNA	4	869

Table 27. Distribution of Haplotype Lineages in 160s Cluster.

“Mystery Men” Group Burial

This interment includes the remains of four young males (B141, B142, B143, and B144) buried in a non-traditional manner, two of whom show evidence of violence. Isotopic evidence indicates that these men are not from the region. Burial B141 and B143 are both identified as L36 which belong to haplogroup A, a rarer haplogroup for the Bay area as well as among all Penutian speakers. These two individuals have identical haplotypes and therefore are maternally related. Unfortunately, L36 is a founding A2 lineage in the Americas. Across all of the North and South America, this lineage is quite common and therefore not definitive for a particular region, except for its relative absence in Central California Valley, as well as the San Francisco Bay, and its prevalence from Monterey Bay south to the Channel Islands. At SCL-38 this lineage is also found to match B001, B043, and B115, although none of these individuals belong to cluster SC4. Burial B142 is typed as L22 (haplogroup D), the most common lineage at SCL-38 as well as in Central California and Great Basin populations. Burial B144 is identified as L8. This lineage is found predominately within the San Francisco Bay region but related/ancestral lineages are also found in ancient Amador and San Joaquin Counties which are proposed to have been Hokan speakers prior to the Penutian language expansion. This exact lineage is also found at SCL-30H (Santa Clara Mission) as well as SCL-869. Interestingly, all L8 individuals except B069 and B096 (who belong to the “elite” SC5 cluster) separate into the SC4 cluster, suggesting a maternal connection of B144 with these individuals.

Additional Group Burials and Artifact Associations

An additional 15 sets of burials are part of multiple interments, are double burials, or are double burials later classified as a single individual. Nine of these had retrievable DNA data. The rest of these either had no DNA or no material was given for study. Generally, this was the result of poor preservation of the remains. Results are reported in Table 28.

Burial	**Burial Type**	**Lineage Haplotype**	**Sex**	**Age**
B013, B050, (B083)	double burial with B083 touching	L32, L22, L2	male, male, unknown	38, 21, 25
B052,B053 (B055)	B052 above B053, B055 less 1 meter away	L27,L34, L22	male, male, female	26, 32, 44
B102, B104	unknown: 1 or 2 indiviudals	haplogroup B (no haplotype), L27 (haplogroup C)	unknown, unknown	11, 11
B105, B105a	double burial	L14	male, unknown	40, 18
B119, B120	double burial	L34	unknown, female	1.5, 19
B134, B160	possible double burial	L22	unknown, male	17, 25
B137, B159	double burial	L3	unknown, unknown	3.5, 4.5
B219,B220	possible double burial	L5	male, unknown	27, 0-1
B226,B227	possible double burial	L22, L5	male, unknown	19, 17

Table 28. Distribution of Haplotype Lineages within Group Burials.

Most double or group burials were uncovered in SC5. The exceptions are the "Mystery Men" discussed above and B119 and B120, which are found in SC8. Five sets of these double burials share the same mtDNA haplotype, while four are found to have differing maternal lineages. The multiple burial including B013, B050, and B081, and possibly B083, are relatively rich burials. Three of these graves contained between 200 and 1,450 shell beads. B050 and B083 are associated with elk artifacts or elk bone. Burial B050 had multiple large mortars placed atop the body and has the largest number and types of artifacts. This individual belongs to L22, which has the potential for being linked to elite status as discussed earlier. The only female in this group (B081), whose haplotype is L7, received the least number and types of grave goods. The other two individuals belong to L32 and L2.

Similarly, burials B052, B053, and B055 belong to different lineages. Two burials had moderate to large amounts of artifact types (4) and quantity (26-876). However, B055 belongs to lineage L22 and had only one grave good, which provides evidence against L22 being representative of elite status as discussed above.

Burials B102 and B104 were comingled remains and osteological analysis could not determine whether the burials represented a single individual or were two separate bodies. Additionally, B103 was also situated very closely to both B102 and B104. While haplotype data is not complete for B102, it does belong to haplogroup B. Burial B104 is typed as L27 which is a haplogroup C lineage, therefore distinguishing these burials as two distinct individuals. However, B103 belonged to

L1, a haplogroup B haplotype, suggesting a possible tie to B102. Whether B102 and B103 are the same individual is still unknown.

Two adult males (B105 and B105a) within a double burial are identified as belonging to L14, the second most common haplotype in SC5. A double burial of an infant and young woman (B119 and B120) share a maternal lineage (L34). The grave had the infant placed on top of mortar atop the young woman. These data confirm that the grave probably represents a mother and child. Two young adult males (B134 and B160) both are typed to the L22 lineage. Burial B134 has three different types of graves goods totaling 16, while B160 has only one artifact. Two young children are buried together and both belong to the same mtDNA type (L3). It is possible these two individuals may have been siblings. An adult male (B219) and an infant (B220) are buried together. The infant had no associated grave goods, while the male had a *Haliotis* "Big Head" banjo effigy pendant. Both persons belong to haplotype L5. Lastly, two young adults (B226 and B227) from SC8 are typed to mtDNA haplotype L22 and L5. A single bone tool is buried with B227.

Haliotis Banjo Effigies and Haplotype Associations

Only 20 banjo effigy or "Big Head" *Haliotis* pendants were discovered among seven burials at SCL-38. However, as it is hypothesized to have been a distinct marker of status and authority it could be potentially useful to see if any noteworthy associations occur with its distribution and mtDNA haplotypes (Table 29, Figure 30)

Burial	**Banjo Pendants**	**Number of Artifacts**	**Number of Types of Artifacts**	**Sex**	**Age**	**MtDNA Haplotype/ Lineage**	**Spatial Cluster**
B51	2	1137	2	Male	32	L20	SC5
B64	5	365	3	Male	25	L9	SC5
B65	4	439	4	Indet	25	L9	SC5
B71	2	31	3	Male	18	L23	SC5
B164	4	572	4	Male	35	L1	SC5
B189	2	5	3	Female	48	?	SC6
B219	1	2	2	Male	27	L5	SC8

Table 29. Distribution of *Haliotis* Banjo Effigy Pendants.

No apparent patterning occurs between the presence of Banjo pendants and maternal haplotype, with all but two burials belonging to different maternal lineages. Unfortunately, while mtDNA is retrievable from all of the male burials with this pendant type, no DNA was found from B189 the lone female with this pendant type.

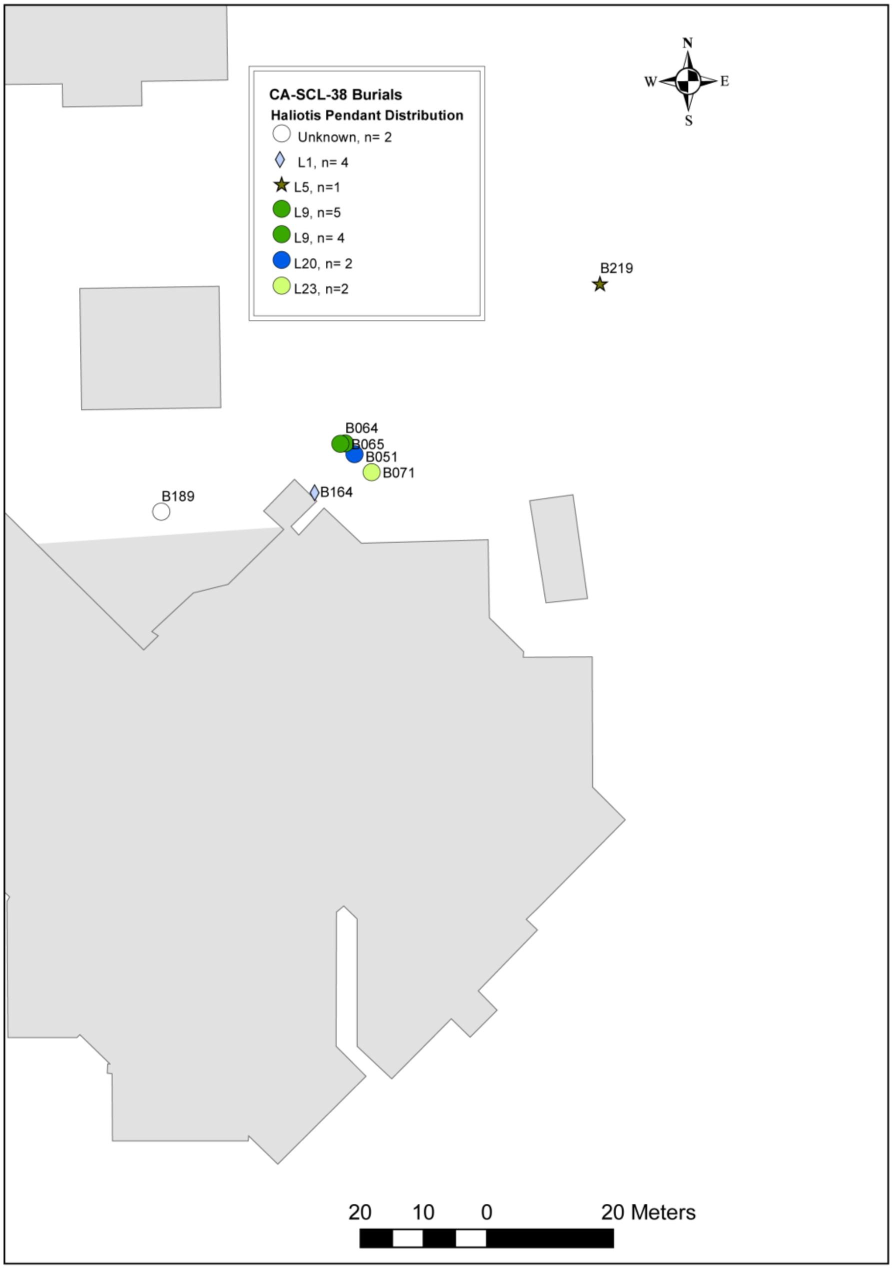

Figure 30. Distibution of *Haliotis* Pendants by Haplotype.

Female Burial Haplotypes

Considering that authoritative female leadership roles associated with status occur in Ohlone culture, wealthy female burials are compared to ascertain if any correlation exists with maternal lineages (Table 30). Most wealthy female burials resided in SC5, with some wealthy graves occurring in SC1, SC4, and SC8. Out of the 15 wealthiest female burials (having five or more artifacts), nine separate matrilines were identified. Haplotype L22 is the most frequent lineage found among five burials, but it is also, as discussed above, found in the highest frequency across all of SCL-38, regardless of grave wealth or sex. Interestingly, nine of these women were 35 years or older at the time of death. This is in sharp contrast to wealthy male burials with a majority falling between 18 and 35 years old.

Burial #	**Number of Artifacts**	**Number of Artifact Types**	**Age**	**Spatial Cluster**	**MtDNA Haplotype/ Lineage**
B31	312	9	52	SC1	L20
B35	101	3	43	SC1	L25
B37	544	2	18	SC5	L22
B54	168	2	44	SC5	L10
B63	20	7	32	SC5	L14
B67	361	6	20	SC1	L22
B72	110	4	25	SC5	L23
B90	461	2	23	SC5	L22
B93	650	9	49	SC5	L22
B112	105	2	23	SC5	L22
B125	125	2	45	SC4	L5
B190	49	1	35	SC6	L27
B218	6	4	38	SC8	L20
B230	10	5	35	SC5	?
B232	6	3	43	SC3	L16

Table 30. Haplotype Affiliation of Wealthy Female Burials.

Spatial Correlation and Landscape Interpolation of mtDNA

Statistical testing for spatial autocorrelation was used in GenAlEX 6.1 (Peakall and Smouse 2007; Peakall and Smouse 2006) to determine whether the SCL-38 cemetery is genetically structured across the entire expanse of the site. For this test the null hypothesis *H0* is a random distribution of mtDNA haplotypes across space (*r*=0). A non-random distribution of genotypes would be accepted if *r*<>0. Various distance classes, in addition to multiple numbers of distance classes, were tested, ranging from 0.5 to 10 for class intervals. Distance classes were measured in increments of one meter. Number of distance classes varied from 15 to 60. The results are plotted as a function of the coefficient of *r* in multiple correlograms. If genetic structure is present, the observed patterning *r* would deviate outside the 95% confidence interval depicted by U and L. Multiple distance classes are tested to avoid missing any spatial and genetic autocorrelation that may have occurred within smaller or larger portions of of space. Results indicate that no maternal, genetic, spatial autocorrelation exists at SCL-38, regardless of distance class size and number of distance classes (Figures 31-34). Consequently, despite spatial clustering according to grave wealth, there is no relationship between maternal lineages across the entire expanse of the site.

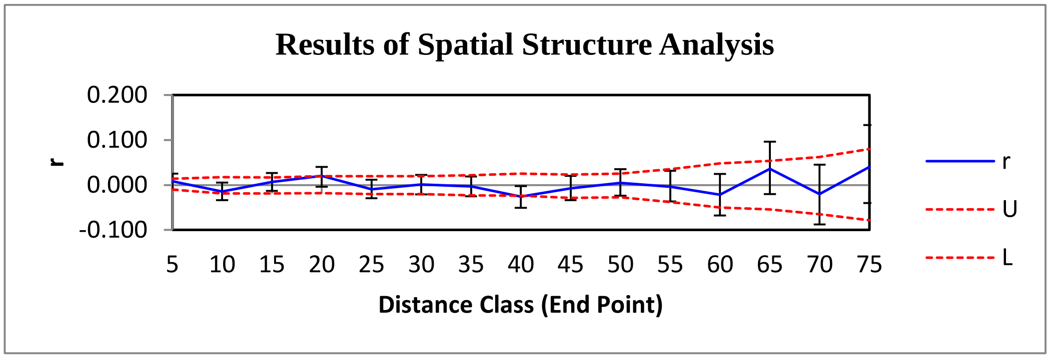

Figure 31. Results of Spatial Autocorrelation with 5 Distance Classes with a Size each of Distance Class Equal to 15.

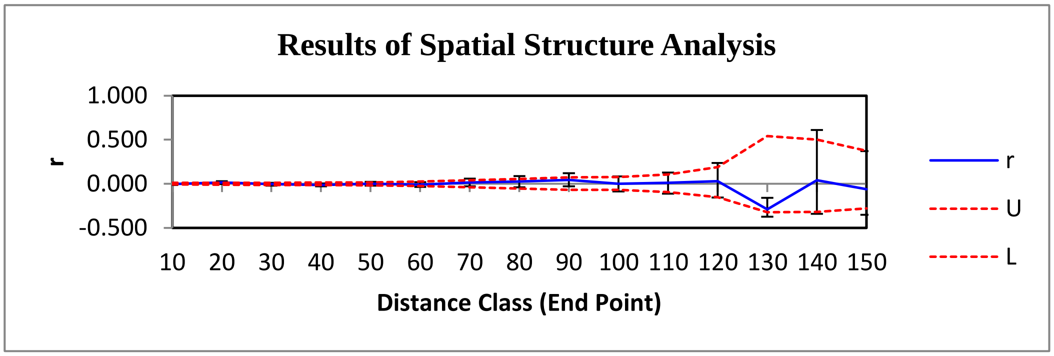

Figure 32. Results of Spatial Autocorrelation with 10 Distance Classes with a Size each of Distance Class Equal to 15.

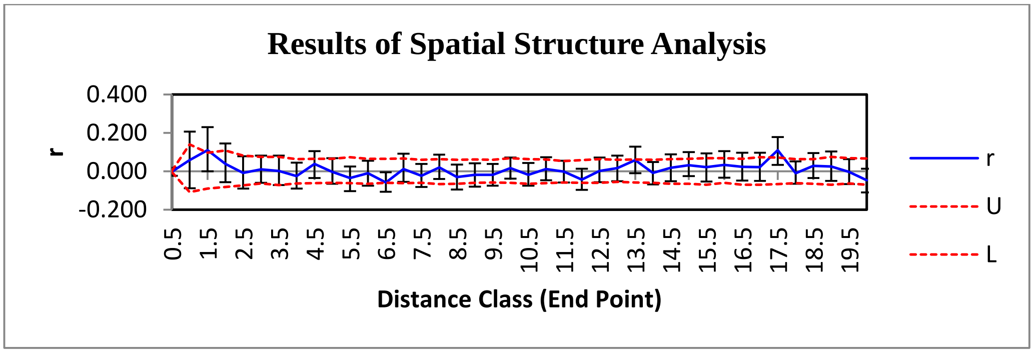

Figure 33. Results of Spatial Autocorrelation with 40 Distance Classes with a Size each of Distance Class Equal to 1.

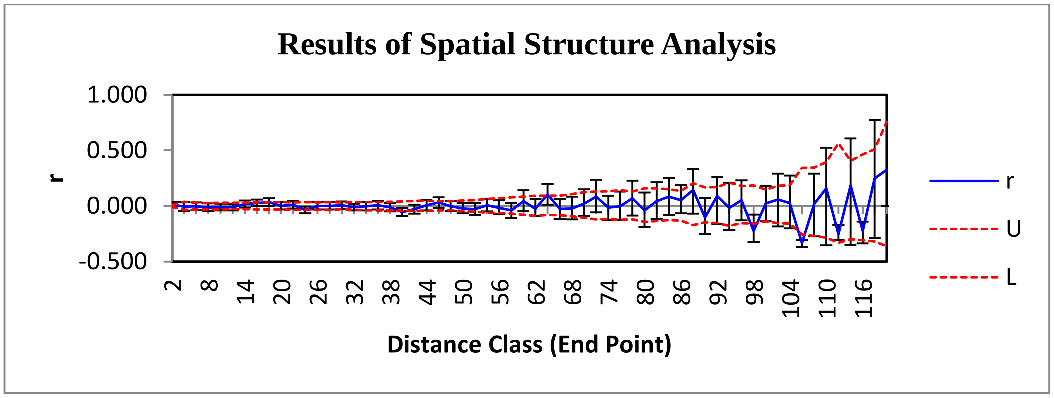

Figure 34. Results of Spatial Autocorrelation with 50 Distance Classes with a Size each of Distance Class Equal to 2.

Alleles in Space (AIS) (Miller 2005) was subsequently used to correlate mtDNA genetic data across the spatial extent of the site in order to confirm or refute previously defined spatial groupings, as well as to characterize any previously unidentified groups or sub-clusters based on relatedness. The interpolation function is used to explore landscape shape. This procedure yields an interpolation-based graphical depiction of both genetic similarity and differentiation across a defined space, in this case the entire extent of SCL-38. X and Y coordinates are the midpoints of each edge of a triangulation calculation. Results of the triangulation are displayed visually as peaks and valleys. Height is a reflection of the genetic distance between observations (i.e., haplotypes of each burial) found at the vertices of all triangles. Residual genetic distances are than plotted as landscape peaks. Subsequently, peak heights reflect genetic diversity/distance patterns over the geographical landscape, while dips represent genetic similarity. Overall results indicate no correlations between mtDNA haplotypes and geography (Figure 35). The foremost peak heights denote the central portion of SCL-38, and it is notable that the burials in the outer portions of the site have the highest genetic distances (SC7, SC8). While overall interpolation indicates genetic distance, there are pockets of genetic similarity, which appear over the southernmost portion of SC5 and most of SC4.

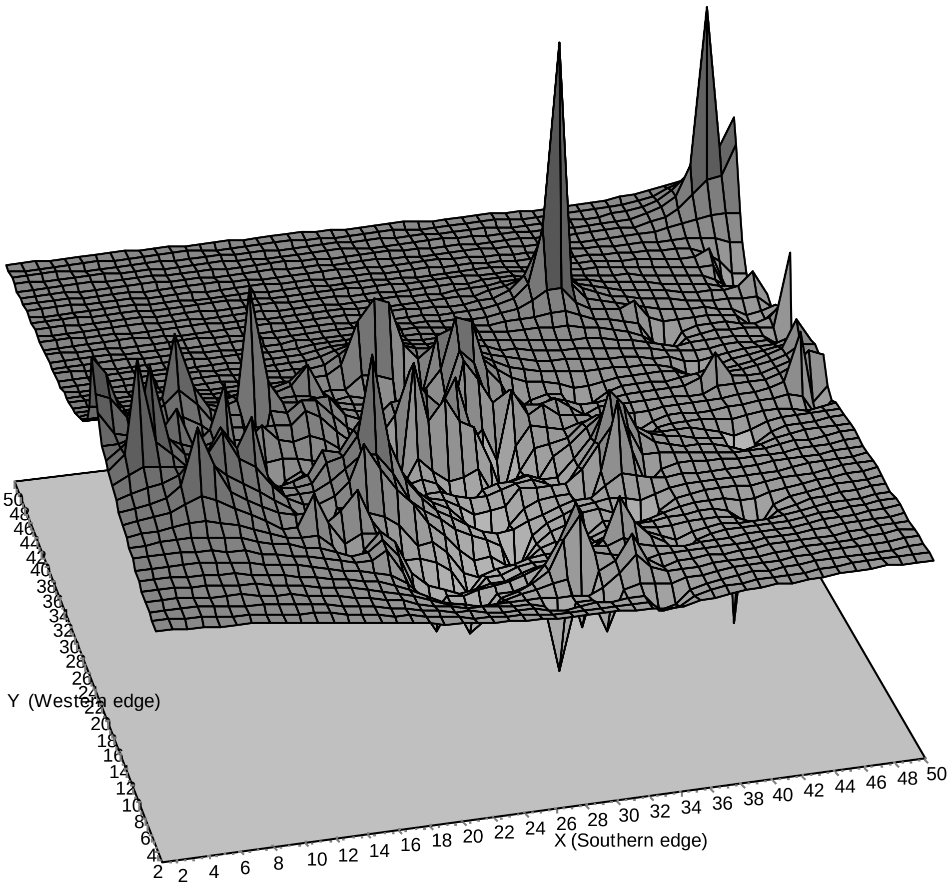

Figure 35. Landscape Interpolation Results for SCL-38.

X. Discussion

The mtDNA haplotype affiliation for 189 ancient samples (ancestral Ohlone), from SCL-38, in conjunction with data from 15 other San Francisco Bay archaeological sites, identifies previously unrecognized maternal genetic variability at the local and regional level. The primary objective of this study is to explore the inter- and intra-site variability of ancient mtDNA lineages from the San Francisco Bay area. In particular, aDNA is analyzed to test for correlations between the genetic relatedness of individuals, grave goods, and burial patterns in order to identify social inequality during the Late Period in Central California. At the inter-site level, the same data are used to explore the timing and geographic distribution of the Penutian speaking populations, in addition to documenting the presence and continuity of earlier Hokan lineages.

Distribution of mtDNA Lineages within SCL-38

Archaeological evidence from the Late Period (900 BP-250 BP) indicates a shift in settlement pattern (site abandonment and population aggregation), as well as mortuary patterns, that distinguishes it from earlier periods. The decrease in quantity of, but increase in the number of types of grave goods during this period is thought to be the result of as either a reduction in social inequality or a shift toward redistributing wealth among corporate kin groups. This view is controversial, and opposing arguments suggest increasing social differentiation characterized by a widening gap between smaller numbers of elite individuals and a larger number of non-elite. The function of cemetery sites during the Late Period also is disputed. Shell/earth mounds are argued to have shifted from habitation sites with mortuary precincts to exclusive burial areas that were regional hubs for feasting and ceremonial use, similar to the ethnographic annual mourning ceremony. Such use would have drawn individuals from the surrounding region and even further afield, regardless of ethnic identity. Consequently, these sites would have had seasonal occupation and little to no development of midden, no evidence of house floors, or contain any other accumulated debris which would indicate long term habitation such as debitage or hearths. Others have contended that some mounds sites were abandoned or retained a multi-functional use but were much smaller in size. Evidence from SCL-38 suggests that it functioned as a discrete cemetery, at least during the Late Period, and a system of social ranking may have been in place. However, there is no data which biologically links wealthy burials to particular kin groups. Whether site function or inequality is displayed at SCL-38 or other regional sites, DNA data can provide insights into past mortuary behavior in the San Francisco Bay area.

To address the contradictory claims discussed above, hypothesis #1 predicts that burials at SCL-38 which have a high diversity or large quantities of grave goods represent elite, high-ranking individuals. An earlier hierarchical cluster analysis (Bellifemine 1997) defined spatial cluster SC5 as a grouping of elite individuals with higher than average grave wealth. If such individuals, regardless of age or sex, share mtDNA lineages, inherited wealth and status could be inferred at least matrilineally.

Alternatively, if no spatial patterning or sharing of mtDNA haplotypic lineages occurred among wealthy burials, a system of achieved status may be in place. Unfortunately, the lack of spatial patterning does not preclude the possibility of patrilineal descent or fluctuating use of the site through time (i.e., a different group using the cemetery every generation or so). In contrast, hypothesis #2 addresses the potential that the spatial clusters at SCL-38 represented familial or lineal descent groups. Within each cluster, particular lineages would predominate regardless of grave wealth, and a matrilineal system was in place. Even if the individuals from SCL-38 were from ambilineal or patrilineal descent groups, there is an expectation that pockets of shared maternal lineages would exist throughout the site (e.g., burials of mother and offspring together or siblings together).

MtDNA results from SCL-38 revealed a cemetery with 36 different matrilines. How representative the mtDNA data from SCL-38 is of a whole community or region is unclear. The number of matrilines is less than Norris Farms (a proto-historic Oneida site), the only other Native American cemetery site extensively studied to any extent (Stone and Stoneking 1998); however, the overall genetic diversity at the site is comparable. Additionally, the inclusion of mtDNA data from 15 additional sites throughout the Bay area and Central California coast (Monterey) revealed very few matrilines that were not already represented at SCL-38. Lineages that differed were offshoots of unique clades also found at SCL-38, and varied from individuals at the site by one or two mutations. Other archaeological sites analyzed in this study dated from the Early Period to the historic period so any unlike haplotypes could be explained by chance mutation through time. Thus, it is reasonable to conclude that the matrilines identified at SCL-38 characterize the South Bay area and possibly larger extents of the San Francisco Bay area and California Delta.

Additional analyses, which explored spatial autocorrelation and landscape interpolation, reveal no genetic structure at SCL-38 site, with the spatial distribution of mtDNA haplotype lineages across the whole site being random. The landscape interpolation did reveal some pockets of related individuals near or in SC4 and this probably represents a cluster of individuals belonging to lineage L5 which has its highest frequency in SC4.

Interestingly, only older women from lineage L5 in SC4 have any appreciable amount of grave goods. Though speculative, it is worthwhile to consider that these women had influential roles during life possibly related to the Máien and Hóypuh kulé (·) yih or “women chiefs”. Female burials with any artifacts are uncommon at SCL-38; however, the graves with the most types of artifacts (a measure of artifact diversity) are elderly women. A majority of mortuary wealth among females is also found with women over the age of 35. Ethnographically, powerful female positions were at times inherited; however, very few wealthy, adult, female graves (five or more total grave goods) shared mtDNA types. Even the two burials with the most artifacts types at SCL-38, older females (B063 and B093), do not share the same mtDNA type. Additionally, the majority of wealthy female burials were found in the “elite” SC5 cluster. However, it is interesting that the reverse is true for “rich” male burials, where a majority while belonging to SC5, are between the ages of 18-35. This age discrepancy between men’s and women’s grave wealth could indicate gendered differences in how status was attained during this period of prehistory. Men may have had increased opportunities to achieve higher ranks through activities where younger men may have excelled, such as warfare or particular types of hunting. In contrast, female rank may have necessitated a longer period of time to achieve a similar or higher rank.

The results of the two spatial analyses are also supported by information gleaned from exploring the presence, absence, and overall frequencies of different lineages within various spatial clusters. Every spatial cluster reveals a notable amount of heterogeneity in the sense that very few lineages are shared within any given cluster but are shared across clusters. This implies that burials are not interred according to matrilines. It also suggests that the spatial clusters which are defined by grave wealth and artifact diversity indices have no relationship to haplotypes. This is confirmed by the 160s cluster burials which have an appreciable amount of prestige artifacts but the majority of individuals do not share mtDNA lineages.

On the whole, there is no correlation between maternal lineages and a higher total number of artifacts or increased diversity of artifact types. Two exceptions to this discussion are haplotypes L8 and L22, which are two lineages found in higher frequencies across the site. All but two burials that belong to L8 are found in SC4, suggesting a maternal connection. This includes the burial of a young male who is not from the region. Lineage L22 is found throughout all clusters and represents approximately one-third of the cemetery. This alone would suggest preferential use of the site for this lineage. Wealthy burials, both in the elite SC5 cluster and the site as a whole, more often belong to L22; however, there are as many if not more individuals who are identified as L22 that have no associated artifacts, making it difficult to conclusively link this type to ascribed status. Overall, few burials of sub adults and infants exist with a large quantity or diversity of grave goods, somewhat negating the occurrence of ascribed status. Also problematic is that L22 is a founding haplogroup D haplotype, one that is found throughout all of North and South America, albeit in generally lower frequencies. Due to its lack of accumulated mutations, it makes it challenging to distinguish any internal subdivision that may have existed. Thus, due to the resolution of analysis used here, it is possible that multiple different families share the same mtDNA haplotype (in this case, L22). Whole genome mtDNA sequencing could further refine this lineage and its distribution at SCL-38, splitting this group into multiple new mtDNA lineages. Individual cases of shared mtDNA types in group burials, such as a young mother and child, conclusively document that the site contained at least some groupings and spatial associations of related individuals.

The large number of distinct lineages within each cluster may indicate exogamy with outside women marrying into local groups. Alternatively, the high number of lineages, shared across all spatial clusters at SCL-38, indirectly supports the notion of the site functioning as a ceremonial center where a diverse set of individuals, possibly elite, were buried from the surrounding region. This may explain the high frequency of L22 as well, with this lineage representing a local component of the cemetery.

If the function of SCL-38 was solely as a ritual space reserved for the dead continuously from 2205-245 BP, then the number of burials discovered could not represent the entire population, at least based on ethnographic village size estimates of 250-400 people. Therefore, it seems that the burials at SCL-38 are a *representation* of the overall population throughout multiple generations. Regarding grave wealth, the analysis presented here is somewhat biased as wealth displayed through items that were made of organic materials would not be preserved and would be classified as a burial without wealth. Specifically this would include feather regalia. Gifford (1955) noted in his study on the Central Miwok Ceremonies the death of a Hohi (18 year old female) dancer and her death:

> The last hohi danced at Chakachino village, about 1894, was for a half-breed girl named Hateya, nearly nineteen years old. She had taken the part of osabe in the kuksuyu dance and because of her participation; her funeral was out of the ordinary. A description of the funeral provides a detailed account of the hohi funeral ceremony for a dancer. Hateya had merely substituted for the man who, dressed as a woman, usually took the part of osabe in the kuksuyu dance. At Hateya's burial, the costumes of all three of the regular participants in the kuksuyu dance were buried with her, including the costumes of kuksuyu himself, mochilo, and the regular osabe dancer.
> Hateya's body lay in a modern coffin in her mother's house. The kuksuyu dancer, whose name was Yeleyu, followed by the regular osabe dancer, a man called Wininu, circled the coffin counterclockwise, wailing, and many people who were wailing for the dead girl followed them. The osabe had a single-bone whistle, which he blew frequently. The mochilo dancer, Kutatcha, danced near the door and not with the procession of dancers; he carried no whistle. Each time the kuksuyu dancer rested, all the people stopped too. At each rest interval, he took off his costume and laid it lengthwise on top

> of the coffin, wailing anew as he did so. When ready to dance again, he donned his costume again. The mochilo and the osabe wore flicker headbands, but not costumes; their costumes were laid on top of the coffin during the dance indoors. When the body was removed to the burial place, these costumes of the mochilo and osabe were carried out on top of the coffin.
>
> As the coffin was carried along, mochilo danced in front of it while osabe brought up the rear. Kuksuyu, who had kept his costume on, but rolled up on his head, danced all around the coffin. After it had been laid over the grave, before being lowered into the ground, he danced four times around it to the right, starting and stopping at its head each time, while all the people cried. After the fourth circuit, the kuksuyu doffed his costume and laid it upon the coffin. (1955:311)

Therefore, if one was to encounter and excavate Hateya's grave, one would find no evidence of grave associations (other than the coffin) and interpret her grave as "poor." The same could be true for identifying individuals who belonged to the Kuksu religion as ethnographic symbols of membership took the form of ceremonial robes or capes (Gamble 2012). While the banjo effigy pendant may be a symbol of the "Big Head" ceremonial dance within the Kuksu religion, their presence at SCL-38 is less frequent than other types of *Haliotis* ornamentation. Still, the distribution of this type of shell pendant follows what is known from historical and ethnographic sources. A majority is found with adult males, and the only female with banjo pendants was 48 years old. All but two individuals (one being the elderly female) belonged to SC5, and most had different mtDNA haplotypes.

The general pattern, when considering grave wealth in terms of type and number of preserved artifacts, is one of randomness. This is true for associations between mtDNA and grave wealth and mtDNA and spatial groupings. The site has no matrilineal organization, which is somewhat surprising as ambilineal descent groups were not entirely unknown for the region (Milliken, 2007). Ultimately, for both hypothesis #1 and #2 the null cannot be rejected, and supports the argument of reduced social inequality (at least in terms of inherited wealth and status). The results also refute to some degree that area cemeteries were being used as repositories for lineal descent groups. Instead, the available evidence presents a scenario in which different maternal lineages are represented across the extent of the site. The same is true for the “elite” SC5 cluster. The SCL-38 cemetery as a whole, or only SC5, could therefore have functioned as dedicated cemetery space for regional elites, both male and female, that was used generationally. This could include members of regional religious organizations. Each lineage might signify individuals who were buried at SCL-38 as provincial “representatives” in order to establish or maintain their rights to a particular ritual space.

However, spatial patterning may exist through patrilineal descent and future Y-chromosome studies could alter the interpretations discussed above. Additional temporal refinement, in the form of additional AMS dates, will be crucial to further understanding spatial patterning at SCL-38, as the site did span ~22-32 generations (perhaps a small time-scale from an archaeological standpoint but large with regard to the hypotheses proposed here). It also highlights the importance of diachronic data in mortuary studies, as spatial patterning in the use of the site can change rapidly—sometimes generationally. Additional dates may reveal small scale changes (e.g., across 2-10 generations) in the use of the cemetery through the Late Period.

Conversely, additional AMS dates could potentially reveal that portions of the site not yet dated belong to earlier periods, consequently documenting status changes, if any, through multiple eras. If this was the case, genetic signatures may also be present that show population admixture, extinction, or replacement, which has particular significance in light of the Penutian migrations into Coastal and Central California.

Penutian Expansion

The expansion of Penutian speaking groups into and throughout California has had significant impact on the interpretation of California prehistory (Breschini 1983; Moratto 1984). Linguistic and archaeological evidence estimates that the Utian branch of Penutian split between 4500-5200 years ago from either the southern Colombian Plateau or Northern Great Basin (Callaghan 1997; Moratto 1984). This date overlaps with the first appearance of the Windmiller Culture in the Sacramento Delta/San Joaquin Valley, which is often interpreted as evidence for a migration of Penutian populations into the region. By 3500 BP, Penutian groups were thought to have arrived into the San Francisco Bay region (Breschini 1983; Moratto 1984). However, how Penutian groups spread across the California landscape and the biological signatures that may have been left behind remain somewhat ambiguous.

Ancient DNA data from SCL-38, as well as an additional 15 sites from San Francisco Bay ranging from 3850 BP to 169 BP, have identified multiple lineages that denote an admixture event or events between Penutian speakers and ancestral

Hokan populations. Some haplotypes that belong to haplogroup B and D are directly linked to Penutian speakers from the Columbia Plateau and other populations from the Great Basin, both proposed homelands for the initial migration into California. Other clades belong to haplogroup A and C and prove to have great antiquity based on measures of molecular dating and nucleotide diversity. These lineages may represent remnant Hokan populations and are being described in detail for the first time. Some lineages are rare but have limited distribution, allowing conjecture on their origins.

Penutian-Affiliated mtDNA Haplotypes

Haplogroup B 16184A Clade

Previous DNA studies noted a mutation at np 16184A (L30) that shows a definitive link to Penutian speakers throughout California. It is the most common form of haplogroup B found throughout Central California. Lineage L30 is found at SCL-38 as well as at SCL-134, which dates between 3350 and 981 BP. If the earliest dates for this site are taken into account, this would be the earliest documentation of the 16483A clade in the Bay area. An additional 16184A lineage not yet discovered in the Bay area is found at SJO-112. This site dates to between 3826 BP and 2727 BP, making it contemporaneous with L30.

This study identifies five additional haplotypes (L1, L11, L12, L13, and L14) that belong to this clade, greatly increasing the known geographic distribution and diversity of this lineage. Lineage L1 has implications for prehistory, as it is a derived form with an additional mutation at 16042. This haplotype thus far has only been found at SCL-38. However, it is a descendant lineage of L12 that has been documented at SCL-38 but also among various Miwok groups. This lends credence to an Utian split, where L12 is solely an Utian maternal type that was dispersed into both Costanoans and Miwoks as the groups fissioned and spread throughout Central California. The additional mutations would have then accumulated in isolation after Costanoan/Ohlone groups moved into the Bay area. Unfortunately, SCL-38 is a Late Period occupation so the earliest this haplotype can be documented at the site is through bead chronologies, which places it between 440 and 230 BP. The L11 offshoot of the 16184A branch was categorized by a mutation at 16126 and is found at SCL-38 as well as SCL-851, which dates to 1100±30 BP. Molecular dating of this clade, with the newly identified diversity presented here, is 5907 BP (99.5% CI: 8251-3563). Consequently, molecular dating places the initial Penutian expansion at ~600 years (~5374 (±1957) slightly earlier than previous molecular and linguistic estimates.

The diversity and geographic presence of various forms of the 16184A clade conforms well to the scenario put forth by regional archaeologists (Breschini 1983; Breschini and Haversat 1997). By 3450 BP, Costanoans are hypothesized to have occupied most of East San Francisco Bay and by 2450 a Hokan/Penutian hybrid population had reached as far south as Monterey Bay. Variations of this clade are documented in the San Joaquin Valley from 3826 to 2727 BP, Amador County between 2090 to 1735 BP, and in Santa Clara Valley from 3350 to 981 BP. The fact that the later lineage from Santa Clara (L11) is isolated to the region and is descendant of another lineage that is shared across Central California by multiple Penutian (Utian) speakers (L12), fits the scenario put forth that fissioning groups in the Sacramento Delta/San Joaquin spread west. Subsequent generations of Penutian speakers would have been isolated to the Bay area and this would have allowed mutations to accumulate, thus explaining the distribution of haplotypes from the California foothills to the East Bay. Other lineages within haplogroup B, Lineage 32 and L34, are shared with Penutian groups as far north as the Yakama who reside in Central Washington, but also have a documented presence in Santa Clara by 1176-1954 BP.

Haplogroup D Haplotypes

The most frequent haplotype (L22), as discussed above, belongs to the founding haplotype, D1. As such, one cannot conclude that this haplotype is absolutely the result of a Penutian intrusion. However, the lack of this haplogroup in any appreciable quantity in non-Penutian populations in Central California and its overwhelming majority in Yok-Utian groups, specifically at Santa Clara archaeological sites, makes it unlikely that it is a remnant Hokan lineage. Its earliest presence in the Bay area is ~3670 BP (ALA-312). The majority of Penutian lineages outside of California also belong to the founding D type or a descendant form of it, reinforcing the idea that haplogroup D lineages are probably Penutian in origin. It could be hypothesized alternatively that the existence of haplogroup D in non-

Penutian populations such as Numic groups in the Great Basin is the result of admixture prior to 4500 BP and the split of proto-Yok-Utian.

Haplotype L5 in haplogroup D is defined by a unique mutation at np 16092, thus making it more distinctive. It is the second most frequent type at SCL-38 and has been documented as early as ~3670 BP in East Bay (ALA-312). This lineage has also been discovered in ALA-312 B1, which is dated to 3660±30 BP. Two infrequent haplotypes with a mutation at np 16142 are identified in SCL-38 and a living Ohlone/Costanoan descendent (Johnson and Lorenz 2006). These two types are unique enough to be population defining markers and may represent a coastal-specific lineage among Utian speakers which diverged from the founding D lineage (L22). Indeed, its earliest documented presence at ALA-312 fits the predicted time frame for an early entrance of immigrating populations, as evidenced by the proposed occupation of Utian speakers at the nearby site of ALA-307 [West Berkeley Mound (~3850 BP)]. An associated burial at ALA-312 reinforces this notion, as that individual belonged to L22. Strontium isotopic signals are identical for both individuals but also suggest high mobility. Thus, concerning hypothesis #3, haplogroup B and D haplotypes are identified that elucidate the timing and spread of Utian groups into the San Francisco Bay region. The appearance of the more identifiable 16184A haplogroup B clade and the more frequent haplogroup D haplotypes coincide with the Early Bay culture and the beginnings of Berkeley Pattern during the Early Period.

Hokan-Affiliated mtDNA Haplotype

Haplogroup A

Thus far, no haplogroup A haplotypes have been discovered within the San Francisco Bay or Central Valley that do not belong to founding(basal) lineages A1 or A2 even though it occurs in high frequency among the Chumash and often with derivative mutations (Monroe et al. 2010). However, these types date to upwards of 5200 BP in Monterey Bay and appear in higher frequencies throughout prehistory. Breschini proposes that these haplogroup A types represent pre-Penutian populations (specifically Esselen and their ancestors) that were either reduced in number or exterminated by incoming groups. This fits into broader hypotheses by Breschini and others (Breschini and Haversat 2008; Eshleman et al. 2004; Johnson et al. 2012; Johnson and Lorenz 2006) which suggest that haplogroup A represented an initial peopling of the Americas along the coast of North America. Data from SCL-38 and SCL-851 support the first of these ideas, as haplogroup A frequencies are quite low, averaging around 4% of all haplotypes identified. The frequency of haplogroup A types among Penutian speakers and throughout the California interior and Great Basin was negligible. Additional evidence of the two males from a group burial also indicated that these individuals were non-local to the San Francisco Bay area and did not come from the Central Valley. An alternative may be that these men originated from the Santa Cruz Mountains, and may represent a “relic” Hokan, population from that area (cf. Breschini 1983; Hylkema 1991).

Haplogroup C 16207 mtDNA Clade

Haplogroup C haplotypes are rare in both past and present Penutian populations outside of California. When they do occur, they tend to belong to the founding C1 lineage or the 16311 clade discussed later. The 16207 clade, in contrast, represents a highly diverged branch of haplogroup C that was first identified in a burial from SOL-270 (ca. 2000 BP) (Eshleman 2002). Made up of nine distinct lineages, seven were newly identified at SCL-38. An additional type was found at SCL-851 and SCL-287/SMA-263, which dated its earliest appearance to 1889±42 BP. Consequently, this clade was restricted to the Bay area and firmly placed it in the Middle Period. The newly discovered diversity within the 16207 node, however, has implications for prehistory as the initial coalescence of this clade must have had great antiquity. Molecular clock estimates date the 16207 clade to 7368 BP (99.5% CI: 10,313-4424). Based on its distribution and great age, the 16207 clade may be a remnant of a previous Hokan-speaking population prior to the Penutian expansion into the region. As very few Central Valley sites have been studied, it cannot be precluded that this type originated there and subsequently spread to the San Francisco Bay after an admixture event with intruding groups in the Sacramento Delta (i.e., Windmiller). So while the exact geographic origin of this clade cannot be determined, all evidence points to somewhere in Central California.

Haplogroup C 16311 Clade

The clade defined by a mutation at np 16311 (L8, L17, and L25) has a geographic distribution from all over Western North and South America, probably designating it as an early archaic type. The additional mutations at np 16264 and 16093, however, are unique to Central California. Great Basin populations that belong to the 16311 clade deviate from California groups with a mutation at np 16189, which formed a distinct subclade. The date of this haplogroup C branch (including Great Basin populations) is approximately 5652 BP (99.5% CI: 8070-3233). The restriction of the 16264/16093 sub-branch to Central California, in particular to the San Francisco Bay, define it as a probable ancestral lineage in the region—one that existed prior to the arrival of Penutians to the region. However, the star-like pattern of the 16311 clade indicates a past population expansion. It is possible, then, that the clade spread westward into the Bay area after Yok-Utians had intermarried and absorbed the local Sacramento Delta/San Joaquin Valley populations around 4500 BP. Again, the fact that the more derived types were almost exclusively restricted to the Bay area supports this scenario, as they evolved in situ after migration into the region around 3000 BP.

A rare lineage (L10) defined by np 16124 was first noted at SJO-122 and dates to 3800-2700 BP. It is later found at SCL-38, dating to ~1700 BP, MNT-1256 dating to ~850 BP, and with a living indigenous Ohlone/Esselen elder from Monterey County. Further exploration of this lineage is needed to understand its distribution as it is infrequently observed. However, the general pattern thus observed fits the one discussed above, in which haplogroup C haplotypes are indigenous to the Central Valley and were carried into the Bay area through intermarriage with incoming groups. However, the possibility in this case remains that it was a local coastal California type that moved inland at a later date because the more derived form was found at SJO-112, which is located in the interior.

In regards to hypothesis #3, there is evidence of haplogroup C lineages (in particular the 16207 clade that dates to 7000 BP), which most likely originated with native Hokan speakers prior to the arrival of proto-Yok-Utians. The evidence does not allow rejection of the proposition that these ancestral Hokan speakers, and thus their mtDNA lineages, were restricted to the Central Valley or that they did not exist contemporaneously on the California Coast. However, the known distribution of lineages thus identified suggests that these types were carried eastward with the Penutian wave. There is also evidence to support the idea that haplogroup A haplotype probably represented a Hokan remnant within the San Francisco Bay, due to its relatively low frequency there and its higher frequency throughout the west coast of North America.

XI. Concluding Remarks

This dissertation project incorporates genetic analyses into the study and application of mortuary theory, in particular the identification of social ascription at SCL-38, a Late Period cemetery. Additionally, it uses the analytical results to gain a more nuanced understanding of genetic patterns across the regional landscape in an effort to understand migrations and continuity of maternal lineages from the inter-site perspective.

Ultimately, the first part of this study relies on a set of assumptions first put into place with the Saxe-Binford approach to mortuary analysis. This research considers the use of cemeteries as a territorial statement of ownership by legitimizing ties to ancestors. It also follows that while not all corporate groups maintained cemeteries, if they did exist they were organized by lineal descent. The presence of high quality and quantities of grave goods are assumed to be a signifier for elite, possibly ascribed status.

While this stance is taken with caution, it does appear to be a reasonable supposition considering recent mortuary studies in Central California. Previously identified spatial clusters are used as a starting point in order to identify genetic structure across the expanse of the SCL-38; however, the analysis presented here utilizes spatial autocorrelation analysis regardless of the spatial clusters. Consequently, the application of DNA to mortuary analysis is also an attempt to identify the vertical and horizontal affiliation at the inter- and intra-site level, in direct response to post-processual critiques that claim that clan affiliations, which are documented historically, are not addressed with the Saxe-Binford approach to mortuary analysis.

Conclusions of Intra-site Variability and Analysis at SCL-38

Intra-site analyses at SCL-38 indicate that there are no correlations between mtDNA lineages and increased number or types of mortuary goods, regardless of the spatial clusters. This pattern remains true when spatial clusters are not considered. Spatial autocorrelation and landscape interpolation reveal that the distribution of maternal haplotypes is random across the expanse of the site, indicating no intent to inter particular individuals within certain parts of the site. Thus at the maternal level there are no correlations between genes and social status, or between genes and spatial placement of burials, which would have indicated lineal descent. SCL-38 is not organized by either status or matrilineal descent at the site level.

Exceptions are noted at a smaller scale with some correlation of haplotypes within group burials. Overall, though, the site was quite heterogeneous in the distribution of maternal lineages. This may have implications for the function of the site, in that it could have been used as a pan-regional ceremonial center, thus having regional elites (representing different mtDNA haplotypes) interred in the elite spatial clusters. Alternatively, the lack of any spatial patterning between quantity and quality of grave goods and DNA may indicate a reduction in overall social inequality during the Late Period. However, mtDNA is limited in its ability to identify all genetic relationships. The pattern seen may be due to patrilineal descent and maternal exogamy. Whole mtDNA genome analysis may also allow further refinement of the ubiquitous but somewhat uninformative L22 lineage. The lack of temporal resolution may also be a factor because the cemetery spans more than 20 generations and recent mortuary studies have documented dramatic change in cemetery structure within a few generations (Eerkens et al. 2013). Future research will address these possibilities.

Conclusions Regarding Inter-site Variability and Analysis at SCL-38

Multiple shared mtDNA haplotypes occur across Central California archaeological sites that spanned multiple time periods. Radiocarbon dates alone suggests thousands of years of genetic continuity to at least the end of the Early and beginning of the Middle Periods in the San Francisco Bay and the Santa Clara Valley. Several clades are clearly identifiable as Penutian (e.g., the 16184A clade). Molecular dating places the beginning of the Penutian population expansion to ~5900 BP. The sharing of most haplogroup D haplotypes with extant and ancient Penutian populations supports a geographic origin of the expansion somewhere in the southern Columbian Plateau and movement into the Great Basin, followed by an expansion into the Sacramento Delta and subsequently the San Francisco Bay. MtDNA clades within haplogroup C are also identified (16207; 16311) which appear to have been in situ developments among Hokan speakers. It is proposed here that the former is a localized development while the latter was secondarily carried into the Bay area from the Sacramento Delta through intermarriage with Penutian speakers. These data conform to previously proposed models of the Utian radiation which emphasizes admixture between groups. Further studies of interior Central Valley populations, as well as Early Holocene burials from the San Francisco Bay, need to be undertaken to preclude the possibility that these two clades had other geographic origins.

By no means is this dissertation exhaustive in comparing aDNA data to all archaeological variables available at SCL-38. However, it is hoped that as one of only a few studies of this kind, especially among prehistoric hunter and gatherers, this study will inspire my own and others' future research. This project combines archaeological and DNA data as an improved means to reconstruct mortuary behavior as well as broader aspects of population prehistory in that it provides direct observations of what genetic relatedness and variation are present when and where in the past.

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Appendix A. Glossary of Terms.

Amplification/Amplify- An increase in the number of copies of a target DNA; see PCR

Ancient DNA or aDNA- Ancient DNA research is “defined broadly as the retrieval of DNA sequences from museum specimens, archaeological finds, fossil remains, and other unusual sources of DNA…” (Paabo et al 2004, Ann. Rev. Genet. 38:645-79). Generally, any sample that is degraded or in low copy number can be regarded as ancient (e.g. forensic samples are akin to ancient DNA samples).

Base Pair or bp- in DNA the bases adenosine (A) always pairs with Thymine (T) and Cytosine (C) always pairs with Guanine (G). The size of targeted DNA molecules is often expressed in the number of base pairs amplified.

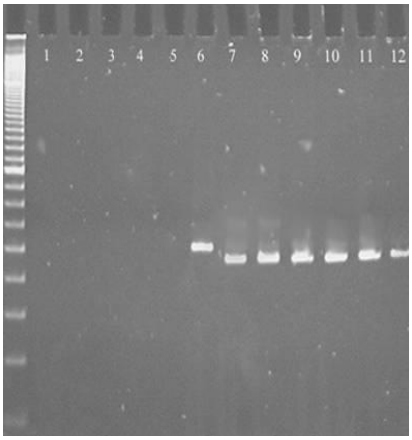
Clade-A group made up of an ancestor and all descendants, which forms a branch from the most recent common ancestor (MRCA). Within a phylogenetic tree/network the MRCA is often represented by the central node.

Coalescent theory/event-Process to trace shared genes of a population back to a single ancestral individual- who often is referred to as the most recent common ancestor (MRCA). The relationships between genes/alleles are portrayed as a gene genealogy- similar phylogenetic tree-and designated as the coalescent. The statistical correlation of the coalescent under different conditions is the foundation of coalescent theory.

Contamination- DNA that is not endogenous to the sample, but which can out-compete the degraded ancient DNA in PCR, leading to false positives and erroneous results. The level of contamination is dependent on the specificity of the PCR. For example, human studies are particularly prone to contamination because DNA of any human that has come into contact with the remains can potentially be amplified. However, this problem is not specific to human studies. Bacterial samples from the soil that are closely related to targeted pathogen DNA can also contaminate samples. Contamination is not a problem, for instance, if salmon DNA is targeted while the sample is contaminated with human DNA because a properly designed PCR that targets salmon cannot amplify human DNA.

Founding haplotype/lineage-lineages or haplotypes that are thought to represent original maternal lineages that were a part of initial populations that entered into the Americas. As a result, all additional/resulting mutations that create sub-branches/sub-clades in phylogenetic networks occurred after migration and settlement into the Americas.

Gel electrophoresis- the process of separating charged molecules, such as fragments of DNA which are negatively charged. An electric current is passed through a gel and DNA migrates through the gel based on base pair size (see Base Pair).



Genetic drift- shift in the frequency of genetic variance in a population as a result of random sampling/chance. The frequency of any given genetic type in a population thus changes to the effects of genetic drift, even causing some variants to disappear. Group isolation or population bottlenecks are extreme forms/effects of genetic drift.

Haplogroup-Large group of haplotypes which have a shared polymorphisms or mutations and denote a common origin or shared ancestry sometime in the past. Nomenclature is often confusing, but is usually labeled as a letter. For example A,B,C, D and X are all Native American haplogroups

Haplotype- Specific lineage within a haplogroup defined by sequence variation or mutations beyond that defining the haplogroup

Homoplasy- a genetic state that is shared between two individuals, species, or taxa not because of common ancestry, but due to convergence or reversals (reversions) of mutations (polymorphisms).

Hot-spot/hypermutable (in mtDNA)- The portion of the mtDNA genome, in particular the hypervariable region I, II (HVI, HVII) that exhibits an unusually high propensity to mutate. Specifically, hotspots, are nucleotide positions in the HVI-HVII region that mutate more rapidly than the region as a whole. These spots can be less informative due to this tendency, often confounding a researcher’s ability to reconstruct phylogenetic histories. As a result, they are either down-weighted or removed from analyses

Hypervariable control region or non-coding region- a segment of the mitochondrial genome that that does not code for any specific function. Has a higher random mutation rate and therefore is useful in studying population prehistory since there is time for mutations to accumulate and therefore distinguish between populations.

Inhibition- this is the result of co-extracting chemicals from bone or teeth that prevents the PCR reaction from occurring by either directly inhibiting the polymerase or binding to DNA, and thus preventing DNA amplification. Common inhibitors encountered in ancient DNA include humic acids, folvic acids, collagen type, tannins, and maillard products.

Insertion/deletion (mutation)-An insertion is the addition of one or more nucleotide base pairs into a DNA sequence, conversely a deletion is the removal of one or more nucleotide base pairs in a DNA sequence.

Low copy number DNA-Forensic and ancient DNA terminology used to denote the quality of a DNA sample. In this case “low” refers to a sample containing less than 100 picograms (pg) of template DNA, which is equal to about 15 diploid or 30 haploid cells or less (this would mean there are 30 copies of mtDNA in a sample). Low copy number (LCN) samples are often the result of damaged or degraded DNA.

Mitochondrial DNA or mtDNA-Small circular molecule located outside the nucleus and is comprised of approximately 16,000 base pairs or nucleotides long. It is in high copy number with approximately 1000 copies per cell. It is maternally inherited and therefore does not recombine and is under weak selection. Useful in ancient DNA studies, because of its high copy number.

Mitochondrial DNA coding region-A region of the mtDNA genome which does not code for genes, amino acids, or proteins. It is usually polymorphic or highly mutable and is used interchangeably with the hypervariable region.

Molecular clock/molecular dating-A molecular evolution method which uses calculated “rates” of molecular change (generally genetic or DNA data) to estimate the ages of ancestral nodes and to predict a time when two species, taxa, or populations diverged. Human rates are often derived from a hypothetical MRCA between chimpanzees and humans. The date for the MRCA is derived from fossil evidence.

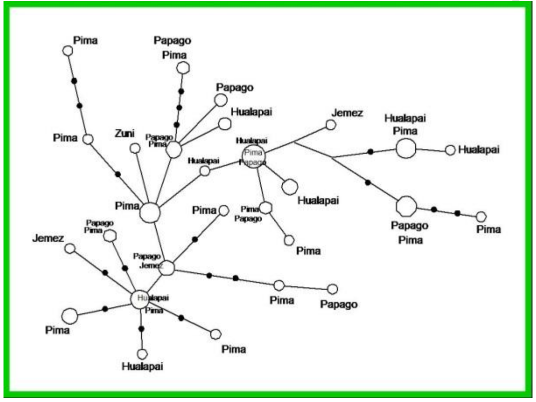
Nuclear DNA or autosomal DNA- DNA found within the nucleus of a cell. Nuclear DNA recombines so long term genealogical studies may be difficult. Portions of nuclear genome are under selection. These regions may be informative when looking at adaptation to environments like tropical forests and high altitudes.

Nucleotides- Adenine (A), Guanine (G), Cytosine (C), Thymine (T)- the basic building blocks for DNA strands.

Nucleotide diversity-A statistical method in genetics which calculates the level of polymorphisms or mutations within a population. Ultimately, it is a measure of genetic variation and population diversity which is used to understand evolutionary relationships within and between populations.

Nucleotide Position or np- Where a particular nucleotide is located within a genome. Often when used in ancient DNA studies it is reporting the presence or absence of a particular polymorphism. It is often denoted by a numerical position such as 16189 or 611.

Phylogenetic network (Haplotype network)- a tree-like visualization of the evolutionary relationships between DNA sequences and thus individuals and populations. Unlike phylogenetic trees, networks allow researchers to identify reticulation or reversion of mutational spots.



Poly regions (human mtDNA)- is a region of a DNA sequence where there is an increased frequency of any given DNA pattern (i.e., CCCCCCC, AAAAAA, or CACACACA). In the the "Poly C region this is the occurrence of multiple cytosines in a row. Poly regions often have a higher frequency of insertion or deletion mutations.

Polymerase Chain Reaction or PCR- a method for amplifying specific DNA segments into billions of copies. Utilizes, *Taq* polymerase, primers, DNTPs, Magnesium, buffers, and DNA template

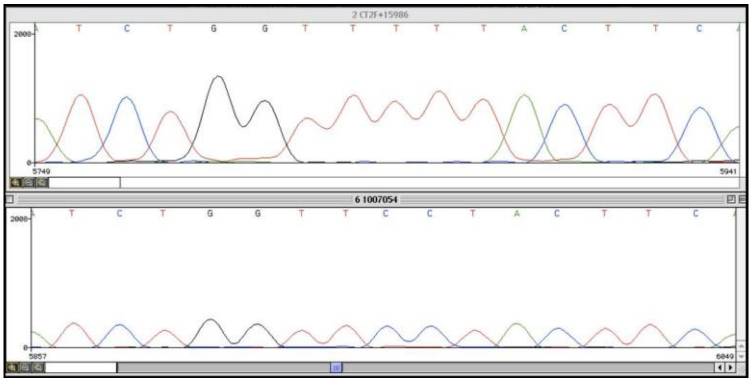
Polymorphism-synonymous with mutation.

Primer- a short length of synthetic DNA used in Polymerase chain reaction to target a specific region within a genome, varies in length and specificity.

Restriction fragment length polymorphism analysis or RFLP analysis- a method by which amplified target DNA is cut with an enzyme that recognizes a specific string of nucleotides (i.e.,. the restriction enzyme called *Hae*III cuts the sequence GGCC in half). If the specific string of nucleotides is present in the sample, the DNA will be cut. It if, using a restriction enzyme, at specific sequences resulting in a range of fragment sizes. It can be informative in quickly determining haplogroups.

Reticulation (in phylogenetic networks)- the representation of multiple possible evolutionary pathways, or ancestor/descendant relationships, between nodes in a network.

Sequence-order of bases or nucleotides in DNA To "sequence" a DNA strand is to determine this order of nucleotides.



***Taq* polymerase**- an enzyme that can synthesize new DNA strands using DNA template in a Polymerase Chain Reaction. Other enzymes or polymerase exist, but *Taq* is often the most frequently used.

Transition mutation- A transition mutation is when a purine is replaced by another purine (C to T or vice versa) or pyrimidine is replaced by another pyrimidine (A to G or vice versa).

Transversion mutation- A mutation where a purine (A or G) is replaced by a pyrimidine (C or T) base pair or vice versa. Transversions are 50 times less likely to occur than transitions and therefore are useful in phylogenetic analysis, as they are less prone to site loss (back-mutation to the ancestral state).

Appendix B. List of Abbreviations Used.

aDNA= ancient DNA
BP= Before present
bp= base pair(s)
EDTA ethylenediaminetetraacetic disodium salt
HVI Hypervariable Region I
HVII Hypervariable Region 11
PCR Polymerase Chain Reaction
MtDNA= mitochondrial DNA
Np= nucleotide position
RFLP= Restriction fragment length polymorphism
SAP/*EXO* I shrimp alkaline phosphatase/ exonuclease 1
STE Sodium chloride, Tris-HCL, EDTA buffer
TE= Tris-EDTA
ul=microliter

California County Trinomial Codes Used for Archaeological Sites.
Alameda = ALA
Contra Costa = CCO
Marin = MRN
Monterey = MNT
Napa = NAP
Sacramento = SAC
Santa Clara = SCL
San Francisco = SFR
San Mateo = SMA
Santa Cruz = SCR
Santa Cruz Island = SCRI
San Joaquin = SJO
Sonoma = SON
Solano = SOL

Appendix C. Burial Location, Mortuary data, MtDNA Data, and Burial Demographics**

Burial	Northing	Easting	Total Number Artifacts	Number of Artifact Types	Haplogroup	Haplotype	Spatial Cluster	Age	Age Cat S	Age Cat
B001	596777.76	4141702.71	1	1	A	36	1	30	3	4
B002-Bear burial	596789.04	4141710.12	--	--	--	--	--	--	--	--
B003	596789.83	4141705.33	2	2	B	31	1	9	1	2
B004	596785.76	4141685.17	1	1	C	16	2	45	3	5
B005	596784.21	4141706.02	2	2	C	16	1	24	3	4
B006	596803.3	4141706.55	0	0	B	--	3	24	3	4
B007	596775.1	4141685.96	1	1	--	--	4	--	--	0
B008	596782.56	4141676.81	0	0	D	22	2	34	3	4
B009	596787.96	4141680.78	312	1	D	22	2	52	4	6
B010	596785.58	4141692.5	1	1	D	3	2	47	3	5
B011	596793.86	4141675.73	0	0	D	35	2	23	3	4
B012	596801.36	4141693.28	0	1	B	--	2	47	3	5
B013	596769.46	4141712.93	939	4	B	32	5	38	3	5
B014	596802.61	4141691.29	1	1	D	22	2	21	3	4
B015	596790.23	4141707.74	1	1	D	2	1	37	3	5
B016	596784.9	4141704.7	0	0	A	23	1	46	3	5
B017	596798.88	4141704.41	0	0	--	--	3	48	3	5
B018	596773.88	4141685.38	0	0	D	3	4	30	3	4
B019	596779.31	4141704.6	1	1	D	22	1	43	3	5
B020	596772.56	4141711.42	5	3	--	--	--	--	--	0

B021	596772.56	4141713.53	79	9	--	--	5	18	3	4
B022-Elk Burial	596778.06	4141694.51	--	--	--	--	--	--	--	--
B023	596773.58	4141716.79	0	0	B	31	5	11	1	2
B024	596771.31	4141718.32	2	2	D	22	5	39	3	5
B025	596793.21	4141714.93	0	0	A	23	3	48	3	5
B026	596786.22	4141705.26	1	1	D	22	1	40	3	5
B027	596773.36	4141707.11	0	0	D		5	30	3	4
B028	596784.87	4141710.85	1	1	B	32	1	37	3	5
B029	596770.97	4141691.31	1	1	D	5	4	38	3	5
B030	596786.82	4141706.75	0	0	--	--	1	6	1	2
B031	596777.1	4141715.15	0	0	C	20	1	54	E	6
B032	596783.72	4141695.09	0	0	C	27	2	23	3	4
B033	596775.2	4141698.45	27	3	D	22	1	33	3	4
B034	596780.04	4141712.67	0	0	B	14	1	39	3	5
B035	596780.3	4141713.2	101	3	C	25	1	43	3	5
B036	596785.68	4141697.34	0	0	--	--	2	25	3	4
B037	596769.25	4141713.83	544	2	D	22	5	18	2	3
B038	596768.77	4141705.84	1	1	D	33	5	44	3	5
B039	596783.05	4141716.47	1	1	B	14	1	24	3	4
B040	596769.52	4141714.52	10	4	--	--	5	--	U	0
B041	596770.97	4141700.38	109	1	--	--	1	10	1	2
B042	596787.58	4141706.95	22	3	C	10	1	42	3	5
B043	596782.52	4141712.4	3	1	A	36	1	40	3	5
B044	596783.21	4141724.44	0	0	D	22	1	5	1	2
B045	596772.9	4141714.14	327	3	D	3	5	31	3	4
B046	596770.44	4141711.29	1	1	C	10	1	14	2	3
B047	596770.52	4141711.84	2	1	B	14	1	19	2	3
B048	596770.81	4141712.45	0	0	D	22	1	51	4	6
B049	596771.13	4141712	2	1	D	22	1	30	3	4

B050	596768.4	4141712.95	1451	4	D	22	5	21	2	4
B051	596767.05	4141713.91	1137	2	C	20	5	32	3	4
B052	596768.83	4141714.92	26	4	C	27	5	26	3	4
B053	596768.76	4141715.48	876	4	B	34	5	32	3	4
B054	596769.39	4141714.98	168	2	C	10	5	44	3	5
B055	596769.79	4141715.25	1	1	D	22	5	42	3	5
B056	596782.45	4141711.31	0	0	D	22	1	35	3	4
B057	596779.12	4141716.67	0	0	B	34	1	39	3	5
B058	596767.37	4141708.53	30	1	D	22	5	18	2	3
B059	596768.22	4141709.49	0	0	--	--	5	3	1	2
B060	596773.48	4141710.17	1	1	D	35	1	38	3	5
B061	596764.06	4141718.92	392	3	B	13	5	35	3	4
B062	596763.77	4141714.62	10	2	C	18	5	19	2	3
B063	596766.05	4141715.7	20	7	B	14	5	32	3	4
B064	596765.57	4141715.6	365	3	C	9	5	25	3	4
B065	596764.81	4141715.55	439	4	C	9	5	25	3	4
B066	596771.76	4141696.02	0	0	D	22	1	12	2	3
B067	596771.26	4141711.07	361	6	D	22	1	20	3	4
B068	596774.07	4141682.76	5	2	D	5	4	49	4	6
B069	596768.7	4141716.54	3575	2	C	8	5	33	3	4
B070	596765.78	4141705.46	1	1	D	22	5	41	3	5
B071	596769.73	4141711.1	31	3	A	23	5	18	2	3
B072	596763.96	4141704.8	110	4	A	23	5	24	3	4
B073	596765.49	4141716.5	69	6	D	22	5	22	3	4
B074	596777.13	4141711.28	0	0	D	22	1	47	3	5
B075	596763.57	4141718.39	24	4	B	34	5	14	2	3
B076	596766.47	4141711.74	6	1	D	7	5	50	3	6
B077	596767.03	4141710.04	1	1	C	25	5	21	3	4
B078	596766.55	4141710.76	1	1	B	1	5	42	3	5
B079	596764.63	4141721.13	0	0	C	28	5	34	3	4

B080	596769.79	4141716.77	432	3	D	3	5	42	3	5
B081	596776.83	4141722.33	10	1	D	7	1	46	3	5
B082	596767.48	4141710.94	249	3	C	25	5	35	3	5
B083	596769.86	4141711.92	229	3	D	2	5	25	3	4
B084	596772.19	4141712.85	875	4	D	22	5	18	2	3
B085	596769.65	4141708.59	1	1	B	1	5	23	3	4
B086	596766.48	4141718.29	725	3	C	21	5	36	3	5
B087	596768.56	4141718.72	473	2	D	22	5	43	3	5
B088	596767.5	4141718.89	828	2	C	29	5	27	3	4
B089	596766.58	4141717.56	0	0	--	--	5	42	3	5
B090	596767.21	4141712.45	461	2	D	22	5	23	3	4
B091	596764.7	4141707.03	4	2	D	22	5	18	2	3
B092	596770.81	4141713.75	310	2	C	19	5	35	3	5
B093	596762.9	4141716.42	650	9	D	22	5	49	4	5
B094	596763.88	4141715.18	775	3		--	5	31	3	4
B095	596765.63	4141713.4	113	3	C	25	5	16	2	3
B096	596768.03	4141714.01	1	1	C	8	5	17	2	3
B097	596763.43	4141714.01	1530	6	D	22	5	21	3	4
B098	596763.61	4141697.32	1	1	B	--	4	22	3	4
B099	596764.14	4141697.61	2	1	--	--	4	31	3	4
B100	596764.17	4141712.82	16	3	C	26	5	25	3	4
B101	596764.14	4141697.61	--	--	--	--	4	41	4	5
B102	596761.35	4141718.79	0	0	B	--	5	11	1	2
B103	596761.95	4141718.85	6	1	B	1	5	49	5	5
B104	596762.71	4141718.89	0	0	C	27	5	11	1	2
B105	596764.89	4141717.93	1167	3	B	14	5	40	3	5
B105A	596764.89	4141717.93	80	2	B	14	5	18	2	3
B106	596759.43	4141714.01	8	1	--	--	5	16	2	3
B107	596764.33	4141690.42	1	1	D	22	4	42	3	5
B108	596760.7	4141715.1	0	0	A	36	5	9	1	2

B109	596763.8	4141681.97	0	0	D	5	4	24	3	4
B110	596753.68	4141717.79	6	1	C	19	5	41	3	5
B111	596760.78	4141690.58	0	0	B	11	4	30	3	4
B112	596765.06	4141719.25	105	2	D	22	5	23	3	4
B113	596762.27	4141709.17	0	0	B	--	5	24	3	4
B114	596764.79	4141718.62	0	0	B	14	5	16	2	3
B115	596771.76	4141695.25	0	0	A	36	1	4.5	1	2
B116	596759.07	4141721.66	4	1	B	13	5	27	3	4
B117	596761.47	4141708.43	53	2	--	--	5	19	2	3
B118	596754.12	4141684.38	0	0	C	8	4	38	5	5
B119	596756.26	4141692.83	1	1	B	34	4	1.5	1	1
B120	596756.26	4141692.83	5	3	B	34	4	19	2	3
B121	596757.4	4141694.55	1	1	D	--	4	45	3	5
B122	596753.88	4141689.14	2	2	D	4	4	45	3	5
B123	596755.96	4141722.19	0	0	B	1	5	48	3	5
B124	596761.68	4141706.95	53	1	--	--	5	21	3	4
B125	596763.69	4141683.19	202	2	D	5	4	45	3	5
B126	596758.48	4141725.57	1	1	--	--	5	46	3	5
B127	596758.41	4141695.75	0	0	?	--	4	0.5	1	1
B128	596757.7	4141690.34	0	0	D	5	4	1	1	1
B129	596754.04	4141682	0	0	C	8	4	44	3	5
B130	596760.65	4141705.7	300	5	B	32	5	19	2	3
B131	596763.4	4141679.46	0	0	D	5	4	40	3	5
B132	596764.3	4141720.34	35	4	C	20	5	18	2	3
B133	596755.57	4141707.69	6	1			5	16	2	3
B134	596759.94	4141715.25	16	3	D	22	5	17	2	3
B135	596759	4141719.38	3	2	D	22	5	10	1	2
B136	596756.95	4141722.49	0	0	D	22	5	2.5	1	1
B137	596760.53	4141719.08	389	4	D	3	5	3.5	1	2
B138	596756.69	4141720.9	0	0	C	16	5	40	3	5

B139	596761.9	4141713.14	7	1			5	25	3	4
B140	596761.97	4141715.28	20	3	C	15	5	38	3	5
B141	596757.47	4141697.46	0	0	A	36	4	23	3	4
B142	596757.32	4141698.71	1	0	D	22	4	18	2	3
B143	596757.12	4141698.96	0	0	A	36	4	26	3	4
B144	596757.04	4141698.62	0	0	C	8	4	25	3	4
B145	596760.39	4141721.17	0	0	D	22	5	41	3	5
B146	596756.66	4141689.58	0	0	D	5	4	55	4	6
B147	596758.59	4141709.35	13	3	--	--	5	35	3	5
B148	596756.21	4141708.38	3	2	B	32	5	35	3	5
B149	596761.92	4141712.42	16	2	--	--	5	25	3	4
B150	596761.31	4141712.19	0	0	--	--	5	15	2	3
B151	596760.65	4141712.03	1	1	--	--	5	25	3	4
B152	596763.22	4141684.14	2	1	D	5	4	22	3	4
B153	596785.11	4141712.71	1	1	C	16	5	25	3	4
B154	596762.64	4141714.49	0	0	--	--	5	17	2	3
B155	596757.75	4141696.99	101	2	C	--	4	1	1	1
B156	596758.27	4141696.6	12	1	C	25	4	1.5	1	1
B157	596760.66	4141719.78	1	1	D	22	5	25	3	4
B158	596759.01	4141713.56	0	0	--	--	5	15	3	3
B159	596759.67	4141719.08	11	2	D	3	5	4.5	1	2
B160	596758.91	4141714.38	1	1	D	22	5	25	3	4
B161	596759.86	4141719.71	0	0	D	22	5	43	3	5
B162	596757.45	4141708.22	869	4	--	--	5	29	3	4
B163	596759.99	4141707.82	291	5	C	10	5	21	3	4
B164	596760.76	4141707.9	572	4	B	1	5	35	3	5
B165	596758.32	4141707.29	2	1	B	34	5	43	3	5
B166	596759.3	4141707.24	4093	2	D	22	5	19	2	3
B167	596758.35	4141706.36	381	4	D	22	5	20	3	4
B168	596759.09	4141706.42	1075	4	D	5	5	21	3	4

B169	596758.32	4141707.29	2	1	D	24	5	4.5	1	2
B170	596762.11	4141707.82	241	3	D	22	5	35	3	5
B171	596762.08	4141716.18	56	5	D	22	5	37	3	5
B172	596766.05	4141719.22	0	0	B	11	5	31	3	4
B173	596762.84	4141719.25	15	1	B	11	5	17	2	3
B174	596761.31	4141710.57	0	0	--	--	5	16	3	4
B175	596756.07	4141708.83	47	7	D	24	5	25	3	4
B176	596759.78	4141705.36	680	2	--	--	5	27	3	4
B177	596756.29	4141711.05	1	1	D	22	5	3	1	2
B178	596754.58	4141699.15	302	5	C	8	4	3	1	2
B179	596762.51	4141719.51	2093	2	C	10	5	43	3	5
B180	596761.32	4141719.38	58	2	C	6	5	37	3	5
B181	596758.64	4141711.5	0	0	--	--	5	32	3	4
B182	596763.97	4141715.79	1164	4	A	23	5	30	3	4
B183	596754.45	4141702.65	0	0	C	17	5	46	3	5
B184	596757.45	4141708.22	4	2	D	22	5	60	4	6
B185	596735.03	4141684.13	2	2	B	30	6	32	3	4
B186	596747.09	4141685.03	0	0	D	4	4	1	1	1
B187	596745.29	4141689.58	2	2	--	--	4	20	3	4
B188	596738.09	4141692.6	1	1	B	1	6	42	3	5
B189	596736.51	4141704.82	5	3	--	--	6	48	3	5
B190	596741.85	4141700.59	49	1	C	27	6	35	3	5
B191	596740.49	4141704.92	0	0	D	3	6	20	3	4
B192	596746.14	4141696.72	0	0	C	19	4	50	3	6
B193	596751.94	4141690.79	0	0	D	--	4	25	3	5
B194	596742.8	4141709.16	2	1	B	--	6	31	3	5
B194A	596742.8	4141709.16	0	0	--	--	6	12	2	3
B195	596736.35	4141699	0	0	B	12	6	6	1	2
B196	596754.13	4141704.77	0	0	B	14	5	19	2	3
B197	596757.75	4141690.2	0	0	D	33	4	35	3	5

B198	596743.44	4141705.08	2	2	D	33	5	42	3	5
B199	596728.09	4141705.72	0	0	--	--	--	--	0	0
B200	596720.42	4141699.1	0	0	--	--	--	--	0	0
B201	596805.46	4141715.01	0	0	B	1	--	35	3	5
B202	596740.48	4141681.91	1	1	C	27	7	42	3	5
B203	596734.65	4141682.65	0	0	B	11	7	8.5	1	2
B204	596729.38	4141666.84	0	0	--	--	7	16	3	4
B205	596808.17	4141726.59	2	2	D	22	3	37	3	5
B206	596807.81	4141727.88	0	0	B	30	3	40	3	5
B207	596724.87	4141695.45	0	0	C	25	7	47	3	5
B208	596735.71	4141689.58	0	0	--	--	7	20	3	4
B209	596728.89	4141694.02	0	0	C	20	7	20	3	4
B210	596724.97	4141693.07	1	1	B	11	7	58	4	6
B211	596727.09	4141690.85	0	0	C	6	7	28	3	4
B212	596725.61	4141689.58	0	0	D	22	7	43	3	5
B213	596724.07	4141689.95	0	0	C	20	7	29	3	4
B214	596739.95	4141696.09	0	0	C	27	7	5	1	2
B215	596793.95	4141774.75	0	0	B	34	8	44	3	5
B216	596793.87	4141775.62	0	0	--	--	8	16	3	4
B217	596802.51	4141758.38	1	1	D	22	8	6	1	2
B218	596803.79	4141753.73	6	4	C	20	8	38	3	5
B219	596805.82	4141740.88	2	2	D	5	8	27	3	4
B220	596805.69	4141742	0	0	D	5	8	0.75	I	1
B221	596807.9	4141722.08	6	4	D	22	3	31	3	4
B222	596794.1	4141758.95	0	0	C	25	8	6.5	1	2
B223	596796.24	4141754.17	1	1	D	22	8	49	3	5
B224	596804.2	4141746.77	92	6	C	25	8	24	3	4
B225	596803.83	4141747.56	16	6	D	22	8	25	3	4
B226	596803.72	4141748.55	0	0	D	22	8	19	2	3
B227	596804.78	4141748.83	1	1	D	5	8	17	2	3

B228	596806.32	4141736.29	0	0	C	20	8	25	3	4
B229	596675.74	4141670.84	0	0	B	30	--	35	3	5
B230	596801.38	4141760.58	10	5	C		8	35	3	5
B231	596804.59	4141750.17	39	3	D	22	8	35	3	5
B232	596807.62	4141712.56	6	3	C	16	3	43	3	5
B233	596739.68	4141694.39	0	0	C	20	7	35	3	5
B234	596743.54	4141697.99	1	1	C	17	7	50	3	6
B235	596805.04	4141721.15	0	0	C	27	3	1	1	1
B236	596807.28	4141732.05	0	0	C	--	8	27	3	4
B237	596803.92	4141721.81	0	0	C	27	3	22	3	4
B238	596805.4	4141737.26	0	0	D	3	8	35	3	5
B239	596804.54	4141740.85	0	0	--	--	8	12	2	3
B240	596805.72	4141731.1	2	2	--	--	8	30	3	4
B241	596802.52	4141754.04	1	1	D	22	8	31	3	4
B242	596801.9	4141764.62	0	0	--	--	8	25	3	4
B243	596802.88	4141764.05	0	0	--	--	8	8.5	1	2

****Coding Key**

Total number of artifacts and total number of artifact type categories equates to the number of item found with each burial.
Haplogroup: A=1; B=2; C=3; D=4
Haplotype: 1-36= L1-L36
Spatial Cluster: 1-8=SC1-SC8
Sex: 1=male; 2=female; 3=indeterminate; 0=uknown
AgeCat: (0-3 years)=Infant=1; (4-12 years)=Child=2; (13-20 years)=SubAdult=3; (21-35 years)Young Adult=4; (36-50 years)=Mature Adult=5; (+50 years)=Old/elderly

Appendix D. Burial Interment Data**

Burial	Interment Type	Cremation	Other Burning	Rock cairn	Orientation	Orientation-Cardinal	Disturbed	Burial Type	Associated burials	Isotope Study	Percent complete
B001	1	1	1	0	N 75 E	5	0	S		Y	75
B002-Bear burial	--	--	--	--	--	--	--	--		--	--
B003	1	0	1	1	N 50 Due N	1	1	S		Y	30
B004	1	0	1	0	N 50 E	5	1	S		Y	75
B005	1	0	1	0	E 35 S	6	1	S		Y	20
B006	1	0	1	0	Due E	3	0	S		N	75
B007	1	0	0	0			1	S		N	100
B008	1	0	1	0	E 15 S	6	1	S		Y	90
B009	1	0	0	0	Due N	1	1	S		Y	70
B010	1	0	1	0	--	--	0	S		Y	95
B011	1	0	--	0	E 30 S	6	1	S		N	50
B012	1	0	1	0	N 60 E Due E	5	1	S		N	2
B013	1	0	1	0	W 0	4	0	M	B13a/B50	Y	95
B014	1	0	0	0	Due E	3	1	S		N	85
B015	1	0	1	0	E 20 S	6	1	S		N	75
B016	1	0	1	0	Due S	2	0	S		N	85
B017	1	0	0	0	E 30 S Due S	6	0	S		N	70

B018	1	0	1	0	0 E	3	U	S		Y	50
B019	1	0	0	0	N 60 W Due N	1	1	S		N	90
B020	1	1	1	0	--	--	0	S		N	100
B021	1	0		0	--	--	U	S		Y	100
B022-Elk Burial	--	--	--	--	--	--	--	--		--	--
B023	1	0	1	0	W 40 S	8	0	S		Y	75
B024	1	1	1	0	N 30 W	7	1	S		N	100
B025	1	1	1	1	N 88 E	5	0	S		N	75
B026	1	0	1	0	N 60 W	7	1	S		N	90
B027	1	0	1	0	Due W	4	1	S		N	90
B028	1	0	1	0	NE	5	0	S		Y	85
B029	1	0	1	0	N 5 W	7	1	S		N	85
B030	1	0	1	0	N 60 W	7	1	D	B30A	N	45
B031	1	0	1	0	N 30 E	5	0	S		Y	85
B032	1	0	0	0	Due S	2	0	S		N	85
B033	1	0	0	0	Due W	4	0	S		N	90
B034	1	0	0	0	N 45 W	7	0	S		N	75
B035	1	0	0	0	Due W	4	0	S		Y	85
B036	1	0	0	0			1	S		N	100
B037	1	0	1	0	W 60 S	8	0	S		Y	90
B038	1	0	1	0	N 40 E	5	1	S		Y	85
B039	1	0	0	0	S 10 W	8	0	S		N	65
B040	1	1	1	0			0	S		N	100
B041	1	0	1	0	N 45 W	7	1	S		N	50

B042	1	0	0	0	N 45 E	5	1	S		Y	80
B043	1	0	0	0	N 15 W	7	0	S		Y	80
B044	1	0	0	0	N 80 E	5	0	S		Y	80
B045	1	0	0	0	Due S	2	0	S		Y	80
B046	1	0	0	0	N 60 W	7	0	S		Y	80
B047	1	0	0	0	E 30 S	6	0	D	B47A	N	90
B048	1	0	0	0	Due E	3	0	S		Y	75
B049	1	0	0	0			0	S		N	95
B050	1	0	0	0	N 50 E	5	0	M	B13	N	75
B051	1	0	1	0	E 40 S	6	0	S		Y	80
B052	1	0	0	0	W 30 S	8	0	D	B53	Y	75
B053	1	0	0	0	270 degrees		0	D	B52	Y	80
B054	1	0	0	0	South	2	0	S		N	65
B055	1	0	0	0	N 30 W	7	0	S		N	95
B056	1	0	1	0	E 40 S	6	0	S		Y	85
B057	1	0	0	0	N 0	1	0	S		N	90
B058	1	0	0	0	60 N/NE	5	1	S		Y	50
B059	4	0		0			0	S		N	100
B060	1	0	1	0	N 60 W	7	1	S		N	75
B061	1	0	1	0	W 30 S	8	0	D	B61A	N	90
B062	1	0	0	0	N 30 W	7	0	S		N	50
B063	1	0	0	0	S 40 W	8	0	S		Y	75
B064	1	0	0	0	S 15 E	6	0	S		Y	95
B065	1	0	0	0	W 60 S		0	S		Y	25
B066	1	0	0	0	W 60 S	8	0	S		Y	40
B067	1	0	1	0	N 80 E	5	0	S		Y	95

B068	3	0	0	0	N 25 E	5	1	S		Y	50
B069	1	0	1	0	E 50 S	6	0	S		Y	90
B070	1	0	1	0	E 60 S	6	0	S		N	95
B071	1	0	1	0	W 10 N	7	0	S		Y	75
B072	1	0	1	0	W 0	4	0	S		Y	100
B073	1	0	0	0	N 5 E	5	0	S		Y	90
B074	1	0	0	0	W 70 S	8	0	S		N	95
B075	1	0	1	0	W 20 S	8	0	S		N	80
B076	1	0	0	0	N 60 E	5	0	D	B76A	N	75
B077	1	1	1	0			1	S		N	100
B078	1	1	1	0	N 0	1	0	S		N	90
B079	1	0	1	0	N 60 W	7	0	S		N	70
B080	1	0	1	0	S 20 W	8	0	S		Y	85
B081	1	0	1	0	E 0	3	0	S		Y	90
B082	1	0	1	0	S 30 W	8	0	S		Y	98
B083	2	1	1	0	N 30 W	7	0	S		N	100
B084	1	0	1	0	N 30 E	5	0	S		Y	85
B085	3	0	1	0	N 225	1	1	S		Y	20
B086	1	0	1	0	E 0	3	0	S		Y	90
B087	1	0	0	0	E 70 S	6	0	S		Y	97
B088	1	0	0	0	90 E 270 W 90 VSC		0	S		Y	95
B089	1	1	1	0	E 0	3	0	S		N	100
B090	1	0		0			0	D	B90A	Y	95
B091	4	1	1	0	N 60 W	7	0	S		Y	100
B092	1	0	1	0	N 30 E	5	0	S		Y	95

B093	1	0	1	0	S 30 W	8	0	S		N	85
B094	1	1	1	0	W 0	4	0	S		Y	65
B095	1	0	1	0	E 60 S	6	0	D	B95a	Y	95
B096	4	1	1	0	W 40 S	8	U	S		N	100
B097	1	0	0	0	N 60 E	5	0	S		Y	90
B098	1	0	1	0	W 0	4	0	S		N	65
B099	2	0	1	0	--	--	0	D	B101	Y	50
B100	4	1	1	0	--	--	0	S		N	5
B101	2	0	1	0	--	--	0	D	B99	N	50
B102	3	0		0	--	--	1	S		N	100
B103	1	0	1	0	N 30 W	7	1	S		N	45
B104	1	0		0			1	S		N	10
B105	1	0	1	0	N 70 W	7	0	D	B105A	Y	90
B105A	4	0		0	--	--	0	D	B105	N	5
B106	3	0	1	0	--	--	1	S		N	1
B107	1	0	1	0	N 50 E	5	0	S		Y	99
B108	1	0	1	0	N 15 E	5	1	S		Y	20
B109	1	0	1	0	E 30 S	6	0	S		N	75
B110	1	0	1	0	W 0	4	1	S		N	50
B111	1	0	1	0	N 60 E	5	0	S		N	75
B112	1	0	0	0	S 10 W	8	U	S		N	80
B113	1	0	1	0	W 60 S	8	1	S		N	65
B114	4	0	1	0	--	--	1	S		N	2
B115	4	0	1	0	--	--	1	S		Y	5
B116	1	0	1	0	S 15 E	6	1	S		Y	25
B117	2	1	1	0	--	--	0	S		Y	5

B118	1	0	1	0	E 0	3	0	S		N	90
B119	1	0	1	0	--	--	1	D	B120	Y	5
B120	1	0	0	0	S 50 E	6	0	D	B119	Y	90
B121	1	0	0	0	N 45 E	5	0	S		N	95
B122	1	0	0	0	N 80 E	5	1	S		N	45
B123	1	1	1	0	E 10 S	6	1	S		N	25
B124	1	0	1	0	S 10 W	8	1	S		N	25
B125	1	0	1	0	--	--	1	S		Y	60
B126	1	0	1	0	S 0	2	0	S		N	90
B127	3	0	0	0	--	--	1	S		Y	100
B128	1	0	1	1	W 0	4	1	S		Y	65
B129	1	0	1	0	E 20 S	6	1	S		Y	90
B130	1	0	1	0	S 40 W	8	1	S		Y	50
B131	1	0	1	0	N 60 E	5	0	S		N	85
B132	1	0	0	0	W 0	4	0	S		Y	98
B133	1	0	1	0	S 60 E	6	0	S		N	75
B134	1	0	1	0	N 25 E	5	1	D	B160	Y	75
B135	1	1	1	0	N 40 E	5	0	S		Y	50
B136	1	0	1	0	N 10 W	7	0	S		Y	30
B137	4	0	0	0	N 40 W	7	0	D	B159	Y	100
B138	1	0	0	0	N 30 E	5	0	S		N	99
B139	1	1	1	0	W 30 S	8	0	S		N	50
B140	1	0	1	0	--	--	U	S		Y	80
B141	1	0	1	0	S 10 E	6	0	M	B141-B144	Y	85
B142	1	0	1	0	E 10 S	6	0	M	B141-B144	Y	90
B143	1	0	1	0	E 0	3	0	M	B141-B144	Y	90

B144	1	0	1	0	W	4	0	M	B141-B144	Y	90
B145	1	0	1	0	S 40 W	8	1	D	B145A	N	80
B146	1	0	1	0	W 0	4	0	S		Y	95
B147	2	1	1	0	W 0	4	0	S		N	100
B148	1	0	0	0	E 50 S	6	0	C	B161-B169/B184	Y	95
B149	1	1	1	0	N 60 W	7	0	M	B150,B151	N	100
B150	4	1	1	0	S 0	2	0	M	B149,B151	N	100
B151	4	1	1	0	S 30 W	8	0	M	B149,B150	N	100
B152	1	0		0	E 10 S	6	0	S		Y	95
B153	2	1	1	0	--	--	U	S		N	100
B154	1	0	1	0	--	--	U	S		N	100
B155	1	0	1	0	N 30 E	5	0	D	B156	N	80
B156	1	0	1	0	N 30 E	5	0	D	B155	Y	75
B157	1	0	0	0	N 50 W	7	0	S		N	75
B158	1	0	0	0	--	--	1	S		N	1
B159	1	0	0	0	N 15 E	5	0	D	B137	Y	85
B160	1	0	0	0	E 10 S	6	0	D	B134	Y	80
B161	1	0	1	0	N 60 E	5	0	C	B148,B161-B169,B184	Y	95
B162	1	0	0	0	W 30 S	8	0	S	B148,B161-B169,B184	N	90
B163	1	1	1	0	W 20 S	8	0	S	B148,B161-B169,B184	N	5
B164	1	0	1	0	N 40 W	7	0	C	B148,B161-B169,B184	Y	95
B165	1	0	0	0	N 30 E	5	0	S	B148,B161-B169,B184	N	90

B166	1	0	1	0	N 10 W	7	0	C	B148,B161-B169,B184	Y	90
B167	1	0	1	0	E 0	3	0	C	B148,B161-B169,B184	Y	95
B168	1	0	1	0	N 30 W	7	0	C	B148,B161-B169,B184	Y	98
B169	1	0	0	0	N 80 W	7	0	C	B148,B161-B169,B184	Y	50
B170	1	0	1	0	N 30 E	5	0	S		N	95
B171	1	0	0	0	S 0	2	0	S		Y	95
B172	1	0	1	0	E 20 S	6	0	S		Y	95
B173	1	1	1	0	W 50 S	8	1	S		N	70
B174	2	0	1	0			0	S		N	1
B175	1	0	1	0	E 30 S	6	0	S		Y	90
B176	1	0	1	0	N 40 E	5	0	S		Y	90
B177	1	0	1	0	N 40 W	7	0	S		Y	80
B178	1	0	1	0	S 30 W	8	0	S		N	75
B179	1	0	1	0	N 60 E	5	1	S		Y	95
B180	1	0	0	0	S 30 W	6	1	S		N	85
B181	2	1	1	0	N 60 E	5	0	S		N	100
B182	1	0	0	0	N 60 E	5	1	S		Y	45
B183	1	0	1	0	N 15 W	7	0	S		Y	90
B184	1	0	0	0	S 50 E	6	0	C	B148,B161-B169	Y	90
B185	1	0	0	0	--	--	1	S		N	25
B186	3	0		0	N 20 E	5	1	S		Y	100
B187	1	0	0	0	S 30 W	8	0	S		N	75
B188	2	0	1	1	S	2	1	S		Y	45

B189	1	0	0	0	N 10 E	5	1	S		N	75
B190	1	0	1	0	N 10 W	7	1	S		N	25
B191	1	0	1	0	E 40 S	6	1	S		N	45
B192	2	1	1	0	--	--	1	S		N	100
B193	2	0	1	0	N 15 E	5	1	S		N	75
B194	1	0	1	0	W 5 E	4	0	D	B194a	Y	75
B194A	1	0	1	0	S 10 W	8	0	D	B194	Y	15
B195	3	0	0	0	--	--	1	D	B195a	Y	50
B196	1	0	1	0	N 20 E	5	0	S		Y	85
B197	1	0	1	0	N 80 W	7	0	S		Y	90
B198	1	0	1	0	E 40 S	6	0	S		Y	80
B199	3	0	--	0	--	--	1	O		N	--
B200	3	0	--	0	--	--	1	O		N	--
B201	1	0	1	1	N 50 E	5	1	S		Y	85
B202	1	0	0	1	S 30 W	8	1	S		Y	100
B203	2	0	1	1	--	--	0	S		Y	100
B204	3	1	1	1	--	--	1	S		N	100
B205	4	0	1	0	270	--	1	D	B205A	N	75
B206	1	0	--	0	N 60 E	5	1	S		N	70
B207	1	0	1	0	S 30 W	8	1	S		Y	90
B208	4	0	1	0			1	S		N	100
B209	1	0	1	0	Due S	2	1	S		Y	60
B210	1	0	1	0	S 20 E	6	1	S		Y	70
B211	1	0	0	0	E 20 S	6	1	S		N	30
B212	1	0	0	0	N 70 W	7	0	S		Y	90
B213	1	0	0	0	N 80 W	7	1	S		N	100

B214	1	0	1	0	N 70 W	7	0	S		Y	85
B215	1	0	1	0	Due W	4	1	S		N	60
B216	1	1	1	0	--	--	1	S		N	100
B217	1	0	1	1	E 0	3	0	S		Y	85
B218	1	0	1	0	S 10 E	6	0	S		Y	75
B219	1	0	0	0	W 0	4	1	D	B220	Y	80
B220	1	0	0	0	N	1	0	D	B219	Y	100
B221	1	0	0	0	S 10 W	8	0	S		Y	97
B222	1	1	1	0	W 30 S	8	1	S		Y	30
B223	1	1	1	0	S 0	2	0	D	B223A	N	50
B224	1	1	1	0	W 5 S	8	0	S		N	90
B225	1	1	1	0	N 60 E	5	1	S		Y	45
B226	1	0	0	0	E 10 S	6	1	D	B227	Y	90
B227	1	0	1	0	N 60 W	7	0	D	B226	Y	90
B228	1	0	1	0	E 10 E	3	1	S		Y	75
B229	3	0	--	0	--	--	1	D	B229A	N	25
B230	1	1	1	0	N 50 W	7	0	D	B230A	Y	90
B231	1	0	0	0	N 45 E	5	0	S		N	80
B232	1	0	1	0	N 40 E	5	0	S		N	90
B233	3	0	0	0	--	--	1	S		Y	90
B234	1	0	0	0	N 15 E	5	1	S		Y	50
B235	4	0	1	0	S 30 W	8	1	D	B235a	Y	25
B236	1	0	0	0	S 45 E	6	0	S		Y	80
B237	1	0	0	0	W 10 S	8	1	S		Y	95
B238	1	0	0	0	E 30 S	6	0	D	B238A	N	75
B239	2	1	1	0	N 60 W	7	0	S		N	30

B240	2	1	1	0	N 20 W	7	0	S		N	100
B241	1	0	1	0	S 50 E	6	0	S		N	95
B242	3	1	1	0	--	--	1	D	B243	N	25
B243	3	1	1	0	--	--	1	D	B242	N	100

****Coding Key**
Interment Type: P = Primary=1; S= Secondary=2; D = Disturbed=3; U = Unknown=4; N/A = Not applicable (non-human) =5
Cremation: 1=YES; 0=NO
Other Burning: 1=YES; 0=NO
Rock cairn: 1=YES; 0=NO
Orientation-cardinal: 1=NORTH; 2=SOUTH; 3=EAST; 4=WEST; 5=NORTHEAST; 6=SOUTHEAST; 7=NORTHWEST; 8=SOUTHWEST
Orientation: 1=NORTH; 2=SOUTH; 3=EAST; 4=WEST
Burial Type : Burial type codes: S = Single, D = Double, M = Multiple, C = Cluster, O = Other (non-human)
Associated burials: burial # provided
Isotope Study: 1=YES; 0=NO
Spatial Cluster: number=spatial cluster
Percent complete: number=% complete

Appendix E. Burial Data-Shellfish, Faunal, and Botanical Remains.**

Burial	Shellfish	Snails	*Ostrea* lurida (oysters)	Bent nose clams	*Mytilus* (mussels)	Abalone Shell Whole	Crab Claw	Fish Bone	Faunal remains	Botanical Remains	Bird Bone
B001	1	1	0	0	0	0	0	0	1	0	0
B002-Bear burial	--	--	--	--	--	--	--	--	--	--	--
B003	1	1	1	1	0	0	0	0	1	0	0
B004	0	0	0	0	0	0	0	0	1	0	0
B005	1	1	1	1	0	0	0	0	1	0	0
B006	1	1	1	0	0	0	0	0	1	0	0
B007	1	1	1	0	0	0	0	0	1	0	0
B008	1	1	1	0	0	0	0	0	1	0	0
B009	1	1	0	0	0	0	0	0	0	0	0
B010	1	1	0	0	0	0	0	0	0	0	0
B011	1	1	0	0	0	0	0	0	0	0	0
B012	1	1	1	0	0	0	0	0	0	0	0
B013	1	1	1	1	0	0	0	0	1	1	0
B014	1	1	0	1	0	0	0	0	0	0	0
B015	1	1	1	1	0	0	0	0	1	0	0
B016	1	1	1	1	0	0	0	1	1	0	0
B017	1	1	1	0	0	0	0	0	0	0	0
B018	1	1	1	1	0	0	1	0	1	0	0
B019	1	1	1	1	0	0	0	0	1	0	0
B020	1	1	1	1	1	0	0	0	1	0	1
B021	1	1	1	1	0	0	1	0	1	0	0

B022-Elk Burial	--	--	--	--	--	--	--	--	--	--	--
B023	1	1	1	1	0	0	0	0	0	0	1
B024	1	1	1	1	0	0	0	0	1	1	1
B025	1	1	1	1	0	0	0	0	1	0	0
B026	1	0	0	0	0	0	0	0	0	0	0
B027	1	1	0	0	0	0	0	0	0	0	0
B028	1	1	1	0	0	0	0	0	1	0	0
B029	1	1	1	1	1	0	0	0	0	0	0
B030	1	1	1	0	0	0	0	0	1	0	0
B031	1	0	0	0	0	0	0	0	1	0	0
B032	1	1	0	0	0	0	0	0	0	0	0
B033	1	1	0	0	0	0	0	0	1	0	0
B034	1	1	0	0	0	0	0	0	1	0	0
B035	1	1	1	0	0	0	0	1	1	0	0
B036	0	0	0	0	0	0	0	0	0	0	0
B037	1	1	1	0	0	0	0	0	1	0	0
B038	1	1	1	0	0	0	0	0	1	0	0
B039	1	1	1	1	0	0	0	0	1	0	0
B040	1	1	1	0	0	0	0	0	1	0	0
B041	1	1	1	1	0	0	0	0	0	0	1
B042	1	0	1	1	0	0	0	0	1	0	1
B043	1	1	1	0	0	0	0	0	0	0	0
B044	1	1	1	0	0	0	0	0	0	0	0
B045	1	1	1	1	0	0	0	1	1	0	0
B046	1	1	1	0	0	0	0	1	0	0	0
B047	1	1	1	1	0	0	0	1	1	0	0
B048	0	0	0	0	0	0	0	0	1	0	0
B049	0	0	0	0	0	0	0	0	0	0	0
B050	1	1	1	1	0	0	0	0	1	0	1

B051	1	1	1	0	0	0	0	0	1	0	0
B052	0	0	0	0	0	0	0	0	0	0	0
B053	1	1	1	0	0	0	0	0	1	0	0
B054	1	1	1	0	0	0	0	0	1	0	0
B055	1	1	1	0	0	0	0	0	0	0	0
B056	0	0	0	0	0	0	0	0	0	0	0
B057	0	0	0	0	0	0	0	0	1	0	0
B058	1	1	1	0	0	0	0	0	1	0	0
B059	0	0	0	0	0	0	0	0	0	0	0
B060	1	1	1	0	0	0	0	0	1	0	0
B061	1	1	1	1	0	0	0	0	1	0	0
B062	1	1	1	1	0	0	0	0	1	0	0
B063	1	1	1	0	0	0	0	0	1	1	1
B064	1	1	1	0	0	0	0	0	0	0	0
B065	1	1	1	1	0	0	0	0	0	0	1
B066	1	1	1	0	0	0	0	0	1	0	0
B067	1	0	1	0	0	0	0	0	1	0	0
B068	1	1	1	1	0	0	0	0	1	0	0
B069	1	1	1	1	0	0	0	0	1	0	0
B070	1	1	0	0	0	0	0	0	1	0	0
B071	1	1	0	0	0	0	0	1	0	0	0
B072	1	1	0	0	0	0	0	0	0	0	0
B073	1	1	0	0	0	0	0	0	1	0	0
B074	0	0	0	0	0	0	0	0	0	0	0
B075	1	1	1	1	0	1	0	0	1	0	0
B076	1	1	0	0	0	0	0	0	1	0	0
B077	0	0	0	0	0	0	0	0	0	0	0
B078	1	1	0	0	0	0	0	0	1	0	0
B079	1	1	1	1	0	0	0	0	1	0	0
B080	1	1	1	1	0	0	0	0	0	0	0

B081	1	1	0	0	0	0	0	0	0	0	0
B082	1	1	0	0	0	0	0	0	0	0	0
B083	0	0	0	0	0	0	0	0	0	0	0
B084	1	1	0	0	0	0	0	0	1	0	0
B085	1	1	1	0	0	0	0	0	1	0	0
B086	1	1	1	1	0	0	0	0	1	0	0
B087	1	1	1	1	0	0	0	1	1	0	1
B088	1	1	1	1	0	0	0	0	1	0	0
B089	1	0	1	0	0	0	0	0	1	0	0
B090	1	1	0	0	0	0	0	0	1	0	0
B091	1	1	1	0	0	0	0	0	1	0	0
B092	1	1	1	0	0	0	0	0	0	0	0
B093	1	1	1	1	0	1	0	0	1	0	0
B094	1	1	1	0	0	0	0	0	1	0	1
B095	1	1	1	0	0	0	0	0	1	0	1
B096	0	0	0	0	0	0	0	0	0	0	0
B097	1	1	0	1	0	0	0	0	1	0	1
B098	1	1	1	1	0	0	0	0	1	0	0
B099	1	1	1	1	0	0	0	0	1	1	0
B100	1	1	0	1	0	0	0	0	1	0	1
B101	1	1	1	1	1	0	0	0	1	0	0
B102	1	1	1	0	0	0	0	0	1	0	1
B103	1	1	1	0	0	0	0	0	1	0	0
B104	1	1	1	1	0	0	0	0	1	0	0
B105	1	0	0	0	0	0	0	0	0	0	1
B105A	1	1	0	0	0	0	0	0	1	0	0
B106	1	1	1	0	0	0	0	0	0	0	1
B107	1	1	0	1	1	0	0	1	1	1	1
B108	1	0	1	0	0	0	0	0	1	1	0
B109	1	1	1	0	0	0	0	0	1	0	0

B110	1	1	1	1	0	0	0	0	1	0	0
B111	1	1	1	0	0	0	0	0	1	0	0
B112	1	1	0	0	0	0	0	0	1	0	0
B113	1	1	1	0	0	0	0	0	1	0	0
B114	0	0	0	0	0	0	0	0	1	0	0
B115	1	0	1	0	0	0	0	0	0	0	0
B116	1	1	1	0	0	0	0	1	1	0	0
B117	1	1	1	0	1	0	0	0	1	0	0
B118	0	0	0	0	0	0	0	0	1	1	0
B119	1	0	1	0	0	0	0	0	1	0	0
B120	0	0	0	0	0	0	0	0	0	0	0
B121	0	0	0	0	0	0	0	0	1	0	0
B122	1	1	1	0	0	0	0	0	0	0	1
B123	1	1	1	0	0	0	0	0	1	0	0
B124	0	0	0	0	0	0	0	0	0	0	0
B125	1	1	1	1	0	0	0	0	1	1	1
B126	1	1	1	1	0	0	0	0	1	0	0
B127	1	0	1	0	0	0	0	0	1	0	1
B128	1	1	0	1	0	0	0	0	0	1	0
B129	0	0	0	0	0	0	0	1	1	0	0
B130	1	1	0	0	0	0	0	0	1	0	0
B131	1	1	0	0	0	0	0	0	1	0	0
B132	0	0	0	0	0	0	0	0	1	1	0
B133	1	0	0	1	0	0	0	0	1	1	0
B134	1	0	0	0	0	1	0	0	1	0	1
B135	1	1	1	0	0	0	0	0	0	0	0
B136	1	1	1	1	0	0	0	0	1	0	1
B137	0	0	0	0	0	0	0	0	0	0	0
B138	1	1	1	0	0	0	0	0	1	0	0
B139	1	0	1	0	0	0	0	0	0	0	0

B140	0	0	0	0	0	0	0	0	0	0	0
B141	1	1	0	0	0	0	0	0	1	0	0
B142	1	1	1	0	0	0	0	0	1	0	0
B143	0	0	0	0	0	0	0	0	0	0	0
B144	1	1	1	0	0	0	0	0	1	0	1
B145	1	1	1	1	0	0	0	0	1	0	0
B146	1	1	0	0	0	0	0	0	0	0	0
B147	1	1	0	0	0	0	0	0	1	0	1
B148	0	0	0	0	0	0	0	0	0	0	0
B149	0	0	0	0	0	0	0	0	0	0	0
B150	1	1	1	0	0	0	0	0	1	0	0
B151	0	0	0	0	0	0	0	0	0	0	0
B152	1	1	0	0	0	0	0	0	1	0	0
B153	1	1	1	1	0	0	0	0	1	0	0
B154	1	1	1	0	0	0	0	0	0	0	0
B155	0	0	0	0	0	0	0	0	0	0	0
B156	0	0	0	0	0	0	0	0	0	0	0
B157	1	1	0	0	0	0	0	0	0	0	0
B158	1	1	0	0	0	0	0	1	0	0	0
B159	0	0	0	0	0	0	0	0	0	0	1
B160	0	0	0	0	0	0	0	0	1	0	1
B161	1	1	1	0	0	0	0	0	0	0	0
B162	1	1	0	0	0	0	0	0	0	0	0
B163	1	1	0	1	0	0	0	0	0	0	0
B164	1	1	0	0	0	0	0	0	0	0	0
B165	0	0	0	0	0	0	0	0	1	0	0
B166	1	1	0	0	0	0	0	0	1	0	0
B167	1	1	1	0	0	0	0	0	1	0	1
B168	1	1	0	0	0	0	0	0	1	0	0
B169	0	0	0	0	0	0	0	0	0	0	0

B170	0	0	0	0	0	0	0	0	0	0	0
B171	1	1	1	1	0	0	0	0	1	0	1
B172	1	1	1	0	0	0	0	0	1	0	0
B173	1	1	0	0	0	0	0	0	0	0	0
B174	1	1	1	0	0	0	0	0	1	1	0
B175	0	0	0	0	0	0	0	0	1	0	0
B176	1	0	1	0	0	0	0	0	1	0	0
B177	1	0	1	1	0	0	0	0	1	0	1
B178	0	0	0	0	0	0	0	1	0	0	0
B179	1	1	0	0	0	0	0	0	0	0	0
B180	1	1	1	0	0	0	0	1	1	0	0
B181	0	0	0	0	0	0	0	0	0	0	0
B182	1	0	0	0	0	0	0	0	1	0	0
B183	0	0	0	0	0	0	0	0	1	0	0
B184	0	0	0	0	0	0	0	0	--	0	0
B185	1	1	0	0	0	0	0	0	1	0	0
B186	1	1	1	0	0	0	0	0	1	0	0
B187	1	1	1	0	0	0	0	0	1	0	0
B188	1	1	1	0	0	0	0	0	1	0	0
B189	1	1	1	0	0	0	0	0	1	0	0
B190	1	1	1	0	0	0	0	0	0	0	0
B191	1	1	1	0	0	0	0	0	1	0	0
B192	1	1	1	0	0	0	0	1	1	0	0
B193	1	1	0	0	0	0	0	0	1	0	0
B194	1	1	1	0	0	0	0	0	1	0	0
B194A	1	1	1	0	0	0	0	0	0	0	0
B195	1	1	1	0	0	0	0	0	1	0	0
B196	1	1	1	0	0	0	0	1	1	0	0
B197	0	0	0	0	0	0	0	0	0	0	0
B198	1	1	1	0	0	0	0	0	1	0	0

B199	0	0	0	0	0	0	0	0	0	0	0
B200	0	0	0	0	0	0	0	0	0	0	0
B201	0	0	0	0	0	0	0	0	1	0	0
B202	1	1	0	0	1	0	0	0	1	0	0
B203	1	1	1	0	0	0	0	0	0	0	0
B204	1	1	1	0	0	0	0	0	1	0	0
B205	1	1	1	0	0	0	0	0	1	0	0
B206	1	1	1	0	0	0	0	0	0	0	0
B207	1	1	1	0	0	0	0	0	1	0	0
B208	0	0	0	0	0	0	0	0	0	0	0
B209	1	1	0	0	0	0	0	0	0	0	0
B210	1	1	0	1	0	0	0	0	0	0	1
B211	0	0	0	0	0	0	0	0	0	0	0
B212	0	0	0	0	0	0	0	0	0	0	0
B213	0	0	0	0	0	0	0	0	0	0	0
B214	1	1	1	0	0	0	0	0	1	0	0
B215	0	0	0	0	0	0	0	0	0	0	0
B216	1	0	1	0	0	0	0	0	0	0	0
B217	1	1	0	0	0	0	0	0	1	0	0
B218	1	0	1	1	0	0	0	0	0	0	1
B219	1	0	1	0	0	0	0	0	0	0	0
B220	1	0	1	0	0	0	0	0	1	0	0
B221	1	1	0	0	0	0	0	0	1	0	0
B222	1	1	0	0	0	0	0	0	1	0	0
B223	1	1	1	0	0	0	0	0	1	0	0
B224	1	0	1	0	0	0	0	0	0	0	1
B225	1	1	1	0	0	1	0	0	0	0	0
B226	1	0	1	0	0	0	0	0	0	0	0
B227	1	1	0	0	0	0	0	0	1	0	0
B228	0	0	0	0	0	0	0	0	0	0	0

B229	0	0	0	0	0	0	0	0	0	0	0
B230	1	1	1	0	0	0	0	0	1	0	0
B231	1	1	1	0	0	0	0	0	0	0	0
B232	1	1	1	0	0	0	0	0	1	0	0
B233	1	1	1	0	0	0	0	0	0	0	0
B234	1	1	1	0	0	0	0	0	0	0	0
B235	1	1	1	0	0	0	0	0	1	0	0
B236	1	1	1	1	0	0	0	0	0	0	0
B237	1	1	1	1	0	0	0	0	0	0	0
B238	1	1	1	1	0	0	0	0	1	1	0
B239	1	1	1	0	0	0	0	0	1	0	0
B240	1	1	1	0	0	0	0	0	1	0	0
B241	0	0	0	0	0	0	0	0	0	0	0
B242	0	0	0	0	0	0	0	0	0	0	0
B243	0	0	0	0	0	0	0	0	0	0	0

**Coding Key

Shellfish	1=YES; 0=NO
Snails	1=YES; 0=NO
Ostrea lurida (oysters)	1=YES; 0=NO
Bent nose clams	1=YES; 0=NO
Mytilus mussels	1=YES; 0=NO
Abalone Shell Whole	1=YES; 0=NO
Crab Claw	1=YES; 0=NO
Fishbone	1=YES; 0=NO
Turtle Carapace	1=YES; 0=NO
Faunal remains	1=YES; 0=NO
Botanical Remains	1=YES; 0=NO

Appendix F. Totemic Animal, Mineral, and Stone Artifacts/Ecofacts.**

Burial	Stingray Points	Antler	Claws Faunal Teeth	Stone Pipes	Stone Spoons	Charmstones	Magic stones	Cinnabar Ochre
B001	0	0	0	0	0	0	0	0
B002-Bear burial	--	--	--	--	--	--	--	--
B003	0	0	0	0	0	0	0	0
B004	0	0	0	0	0	0	0	0
B005	0	0	0	0	0	0	0	0
B006	0	0	0	0	0	0	0	0
B007	0	0	0	0	0	0	0	0
B008	0	0	0	0	0	0	0	0
B009	0	0	0	0	0	0	0	0
B010	0	0	0	0	0	0	0	0
B011	0	0	0	0	0	0	0	0
B012	0	0	0	0	0	0	0	0
B013	0	0	0	0	0	1	0	0
B014	0	0	0	0	0	0	0	0
B015	0	0	0	0	0	0	0	0
B016	0	0	0	0	0	0	0	0
B017	0	0	0	0	0	0	0	0
B018	0	0	0	0	0	0	0	0
B019	0	0	0	1	0	0	0	0

B020	0	1	2	0	0	0	0	0
B021	7	0	0	0	0	0	2	0
B022-Elk Burial	--	--	--	--	--	--	--	--
B023	0	0	0	0	0	0	0	0
B024	0	0	0	0	0	0	0	0
B025	0	0	0	0	0	0	0	0
B026	0	0	0	0	0	0	0	0
B027	0	0	0	0	0	0	0	0
B028	0	0	0	0	0	0	0	0
B029	0	0	0	0	0	0	0	0
B030	0	0	0	0	0	0	0	0
B031	0	0	0	0	0	0	0	0
B032	0	0	0	0	0	0	0	0
B033	0	1	0	1	0	0	0	0
B034	0	0	0	0	0	0	0	0
B035	0	0	0	0	0	0	0	0
B036	0	0	0	0	0	0	0	0
B037	0	0	0	0	0	0	0	0
B038	0	0	0	0	0	0	0	0
B039	0	0	0	0	0	0	0	0
B040	0	0	0	0	0	0	0	0
B041	0	0	0	0	0	0	0	0
B042	0	0	0	0	0	0	0	0
B043	0	0	0	0	0	0	0	0
B044	0	0	0	0	0	0	0	0

B045	0	0	0	0	0	0	0	0
B046	0	0	0	0	0	0	0	0
B047	0	0	0	0	0	0	0	0
B048	0	0	0	0	0	0	0	0
B049	0	0	0	0	0	0	0	0
B050	0	0	0	0	0	0	0	0
B051	0	0	0	0	0	0	0	0
B052	0	0	0	0	0	0	0	0
B053	0	0	0	0	0	0	0	0
B054	0	0	0	0	0	0	0	0
B055	0	0	0	0	0	0	0	0
B056	0	0	0	0	0	0	0	0
B057	0	0	0	0	0	0	0	0
B058	0	0	0	0	0	0	0	0
B059	0	0	0	0	0	0	0	0
B060	0	0	0	0	0	0	0	0
B061	0	0	0	0	0	0	0	1
B062	0	0	0	0	0	0	0	0
B063	0	0	1	0	1	0	0	0
B064	0	0	0	0	0	0	0	0
B065	0	0	0	0	0	0	0	0
B066	0	0	0	0	0	0	0	0
B067	0	0	0	0	0	0	0	0
B068	0	0	0	0	0	0	0	0
B069	0	0	0	0	0	0	0	0
B070	0	0	0	0	0	0	0	0

B071	0	0	0	0	0	1	0	0
B072	0	0	0	0	0	0	0	0
B073	0	0	0	0	0	6	0	3
B074	0	0	0	0	0	0	0	0
B075	0	0	0	0	0	0	0	0
B076	0	0	0	0	0	0	0	0
B077	0	0	0	0	0	0	0	0
B078	0	0	0	0	0	0	0	0
B079	0	0	0	0	0	0	0	0
B080	0	0	4	0	0	0	0	0
B081	0	0	0	0	0	0	0	0
B082	0	0	0	1	0	0	0	0
B083	0	0	0	0	0	0	0	0
B084	0	0	0	0	0	0	0	0
B085	0	0	0	0	0	0	0	0
B086	0	0	0	0	0	0	0	0
B087	0	0	0	0	0	0	0	0
B088	0	0	0	0	0	0	0	0
B089	0	0	0	0	0	0	0	0
B090	0	0	0	0	0	0	0	0
B091	0	0	0	0	0	3	0	0
B092	0	0	0	0	0	0	0	0
B093	0	0	0	1	0	6	0	1
B094	0	0	0	0	0	0	0	0
B095	0	0	0	0	0	0	0	0
B096	0	0	0	0	0	0	0	0

B097	0	0	0	1	0	1	0	0
B098	0	0	0	0	0	0	0	0
B099	0	1	0	0	0	0	0	0
B100	0	0	1	0	0	0	0	0
B101	--	--	--	--	--	--	--	--
B102	0	0	0	0	0	0	0	0
B103	0	0	0	0	0	0	0	0
B104	0	0	0	0	0	0	0	0
B105	0	0	0	0	0	0	0	0
B105A	0	0	0	0	0	0	0	0
B106	0	0	0	0	0	0	0	0
B107	0	0	0	0	0	0	0	0
B108	0	0	0	0	0	0	0	0
B109	0	0	0	0	0	0	0	0
B110	0	0	0	0	0	0	0	0
B111	0	0	0	0	0	0	0	0
B112	0	0	0	0	0	0	0	0
B113	0	0	0	0	0	0	0	0
B114	0	0	0	0	0	0	0	0
B115	0	0	0	0	0	0	0	0
B116	0	0	0	0	0	0	0	0
B117	0	0	0	0	0	0	0	0
B118	0	0	0	0	0	0	0	0
B119	0	0	0	0	0	0	0	0
B120	0	0	0	0	0	0	0	0
B121	0	0	0	0	0	0	0	0

B122	0	0	0	0	0	0	0	0
B123	0	0	0	0	0	0	0	0
B124	0	0	0	0	0	0	0	0
B125	0	0	0	0	0	0	0	0
B126	0	0	0	0	0	0	0	0
B127	0	0	0	0	0	0	0	0
B128	0	0	0	0	0	0	0	0
B129	0	0	0	0	0	0	0	0
B130	0	0	0	0	0	3	0	0
B131	0	0	0	0	0	0	0	0
B132	0	0	0	0	0	0	0	48
B133	0	0	0	0	0	0	0	0
B134	0	0	0	0	0	2	0	0
B135	0	0	0	0	0	0	0	1
B136	0	0	0	0	0	0	0	0
B137	0	0	0	0	0	0	0	0
B138	0	0	0	0	0	0	0	0
B139	0	0	0	0	0	0	0	0
B140	0	0	0	0	0	3	0	0
B141	0	0	0	0	0	0	0	0
B142	0	0	0	0	0	0	0	0
B143	0	0	0	0	0	0	0	0
B144	0	0	0	0	0	0	0	0
B145	0	0	0	0	0	0	0	0
B146	0	0	0	0	0	0	0	0
B147	0		0	0	0	0	0	0

B148	0	0	0	0	0	1	0	0
B149	0	0	0	0	0	0	0	0
B150	0	0	0	0	0	0	0	0
B151	0	0	0	0	0	0	0	0
B152	0	0	0	0	0	0	0	0
B153	0	0	0	0	0	0	0	0
B154	0	0	0	0	0	0	0	0
B155	0	0	0	0	0	0	0	0
B156	0	0	0	0	0	0	0	0
B157	0	0	0	0	0	0	0	0
B158	0	0	0	0	0	0	0	0
B159	0	0	0	0	0	0	0	0
B160	0	0	0	0	0	1	0	0
B161	0	0	0	0	0	0	0	0
B162	0	0	0	0	0	0	0	0
B163	0	0	0	0	0	0	0	0
B164	0	0	0	0	0	0	0	0
B165	0	0	0	0	0	0	0	0
B166	0	0	0	0	0	0	0	0
B167	0	0	0	1	0	0	0	0
B168	0	0	0	0	0	0	0	0
B169	0	0	0	0	0	0	0	0
B170	0	0	0	1	0	0	0	0
B171	0	0	0	0	0	0	0	0
B172	0	0	0	0	0	0	0	0
B173	0	0	0	0	0	0	0	0

B174	0	0	0	0	0	0	0	0
B175	0	0	0	0	0	8	1	0
B176	0	0	0	0	0	0	0	0
B177	0	0	0	0	0	0	0	0
B178	0	0	0	0	0	1	0	P
B179	0	0	0	0	0	0	0	0
B180	0	0	0	0	0	0	0	0
B181	0	0	0	0	0	0	0	0
B182	0	0	4	0	0	0	0	0
B183	0	0	0	0	0	0	0	0
B184	0	0	2	0	0	0	0	0
B185	0	0	0	0	0	0	0	0
B186	0	0	0	0	0	0	0	0
B187	0	0	0	0	0	0	0	0
B188	0	0	0	0	0	0	1	0
B189	0	0	0	0	0	0	0	0
B190	0	0	0	0	0	0	0	0
B191	0	0	0	0	0	0	0	0
B192	0	0	0	0	0	0	0	0
B193	0	0	0	0	0	0	0	0
B194	0	0	0	0	0	0	0	0
B194A	0	0	0	0	0	0	0	0
B195	0	0	0	0	0	0	0	0
B196	0	0	0	0	0	0	0	0
B197	0	0	0	0	0	0	0	0
B198	0	0	0	0	0	0	0	0

B199	0	0	0	0	0	0	0	0
B200	0	0	0	0	0	0	0	0
B201	0	0	0	0	0	0	0	0
B202	0	0	0	0	0	0	0	0
B203	0	0	0	0	0	0	0	0
B204	0	0	0	0	0	0	0	0
B205	0	0	0	0	0	0	0	0
B206	0	0	0	0	0	0	0	0
B207	0	0	0	0	0	0	0	0
B208	0	0	0	0	0	0	0	0
B209	0	0	0	0	0	0	0	0
B210	0	0	0	0	0	0	0	0
B211	0	0	0	0	0	0	0	0
B212	0	0	0	0	0	0	0	0
B213	0	0	0	0	0	0	0	0
B214	0	0	0	0	0	0	0	0
B215	0	0	0	0	0	0	0	0
B216	0	0	0	0	0	0	0	0
B217	0	1	0	0	0	0	0	0
B218	0	0	0	0	0	0	0	0
B219	0	0	0	0	0	0	0	0
B220	0	0	0	0	0	0	0	0
B221	0	0	0	0	0	0	0	0
B222	0	0	0	0	0	0	0	0
B223	0	0	0	0	0	0	0	0
B224	0	0	1	0	0	0	0	0

All
of

B225	0	0	0	0	0	0	0	0
B226	0	0	0	0	0	0	0	0
B227	0	0	0	0	0	0	0	0
B228	0	0	0	0	0	0	0	0
B229	0	0	0	0	0	0	0	0
B230	0	0	0	0	0	0	0	0
B231	0	0	0	0	0	0	0	0
B232	0	0	0	0	0	0	0	0
B233	0	0	0	0	0	0	0	0
B234	0	0	0	0	0	0	0	0
B235	0	0	0	0	0	0	0	0
B236	0	0	0	0	0	0	0	0
B237	0	0	0	0	0	0	0	0
B238	0	0	0	0	0	0	0	0
B239	0	0	0	0	0	0	0	0
B240	0	0	0	0	0	0	0	0
B241	0	0	0	0	0	0	0	0
B242	0	0	0	0	0	0	0	0
B243	0	0	0	0	0	0	0	0

****Coding Key**
categories denote total number
item found with each burial.

Appendix G. Groundstone, Bone, and Shell Artifacts.**

Burial	Groundstone	Pestles	Manos	Abraders	Stone Beads	*Haliotis* pendants	Clam Shell Pendants	Bone Pendants	Shell beads	Bead Class	Bird Bone Tubes	Whistles
B001	N	0	0	0	0	0	0	0	0	0	0	0
B002-Bear burial	--	--	--	--	--	--	--	--	--	--	--	--
B003	N	0	0	0	0	1	0	0	1	1	0	0
B004	N	0	0	0	0	0	0	0	0	0	0	0
B005	N	0	0	0	0	0	0	0	0	0	0	0
B006	N	0	0	0	0	0	0	0	0	0	0	0
B007	N	0	0	0	0	0	0	0	0	0	0	0
B008	N	0	0	0	0	0	0	0	0	0	0	0
B009	N	0	0	0	0	0	0	0	312	4	0	0
B010	N	0	0	0	0	0	0	0	0	0	0	0
B011	N	0	0	0	0	0	0	0	0	0	0	0
B012	N	0	0	0	0	0	0	0	0	0	0	0
B013	Y	0	0	0	0	3	0	0	934	5	0	0
B014	N	0	0	0	0	0	0	0	0	0	0	0
B015	N	0	0	0	0	0	0	0	0	0	0	0
B016	N	0	0	0	0	0	0	0	0	0	0	0
B017	N	0	0	0	0	0	0	0	0	0	0	0
B018	N	0	0	0	0	0	0	0	0	0	0	0

B019	N	0	0	0	0	0	0	0	0	0	0	0
B020	N	0	0	0	0	0	0	0	2	1	0	0
B021	Y	0	1	2	0	1	0	0	53	3	0	0
B022-Elk Burial	--	--	--	--	--	--	--	--	--	--	--	--
B023	N	0	0	0	0	0	0	0	0	0	0	0
B024	N	0	0	0	0	0	0	0	2	1	0	0
B025	N	0	0	0	0	0	0	0	0	0	0	0
B026	N	0	0	0	0	0	0	0	0	0	0	0
B027	N	0	0	0	0	0	0	0	0	0	0	0
B028	N	1	0	0	0	0	0	0	0	0	0	0
B029	N	0	0	0	0	0	0	0	0	0	0	0
B030	N	0	0	0	0	0	0	0	0	0	0	0
B031	N	0	0	0	0	0	0	0	0	0	0	0
B032	N	0	0	0	0	0	0	0	0	0	0	0
B033	N	0	0	0	0	0	0	0	0	0	0	25
B034	N	0	0	0	0	0	0	0	0	0	0	0
B035	Y	1	0	0	0	0	0	0	97	3	0	0
B036	N	0	0	0	0	0	0	0	0	0	0	0
B037	N	1	0	0	0	0	0	0	543	5	0	0
B038	N	0	0	0	0	0	0	0	1	1	0	0
B039	Y	0	0	0	0	0	0	0	0	0	0	0
B040	Y	1	0	0	0	1	0	0	7	1	0	0
B041	N	0	0	0	0	0	0	0	109	4	0	0
B042	N	0	0	0	0	0	0	0	0	0	11	0
B043	N	0	0	0	0	3	0	0	0	0	0	0

B044	N	0	0	0	0	0	0	0	0	0	0	0
B045	Y	0	0	0	0	0	0	0	324	4	0	0
B046	N	0	0	0	0	0	0	0	1	1	0	0
B047	N	0	0	0	0	0	0	0	1	1	0	0
B048	N	0	0	0	0	0	0	0	0	0	0	0
B049	N	0	0	0	0	0	0	0	0	0	2	0
B050	Y	0	0	0	0	3	0	0	1446	6	0	0
B051	N	0	0	0	0	4	0	0	1133	6	0	0
B052	Y	1	0	0	0	21	0	0	3	1	1	0
B053	N	0	0	0	5	35	0	0	835	5	0	0
B054	N	0	0	0	0	0	0	0	167	4	0	0
B055	N	0	0	0	0	0	0	0	0	0	0	0
B056	N	0	0	0	0	0	0	0	0	0	0	0
B057	N	0	0	0	0	0	0	0	0	0	0	0
B058	N	0	0	0	0	30	0	0	0	0	0	0
B059	N	0	0	0	0	0	0	0	0	0	0	0
B060	N	0	0	0	0	0	0	0	1	1	0	0
B061	N	0	0	0	0	0	0	0	391	4	0	0
B062	N	0	0	0	0	0	0	0	5	1	0	5
B063	N	0	0	0	0	8	0	1	5	1	2	1
B064	Y	1	0	0	0	35	0	0	329	4	0	0
B065	N	0	0	0	1	4	0	0	434	4	0	0
B066	N	0	0	0	0	0	0	0	0	0	0	0
B067	Y	0	0	0	0	1	0	0	356	4	0	1
B068	N	0	0	0	0	0	0	0	3	1	0	0
B069	N	0	0	0	0	0	0	0	3574	6	0	0

B070	Y	0	0	0	0	0	0	0	0	0	0	0
B071	N	0	0	0	0	27	0	0	3	1	0	0
B072	Y	3	0	0	0	0	0	0	105	4	0	0
B073	N	0	0	0	0	2	0	0	59	3	0	0
B074	N	0	0	0	0	0	0	0	0	0	0	0
B075	N	1	0	0	0	0	0	0	21	2	1	0
B076	N	0	0	0	0	6	0	0	0	0	0	0
B077	N	0	0	0	0	0	0	0	0	0	0	0
B078	N	0	0	0	0	1	0	0	0	0	0	0
B079	N	0	0	0	0	0	0	0	0	0	0	0
B080	N	0	0	0	0	0	0	0	427	4	0	0
B081	N	0	0	0	0	9	0	0	0	0	0	0
B082	N	0	0	0	0	0	0	0	247	4	0	0
B083	N	0	0	0	0	0	0	0	227	4	0	0
B084	N	0	0	0	0	83	0	0	790	5	0	0
B085	N	0	0	0	0	0	0	0	1	1	0	0
B086	N	0	0	0	0	23	0	0	700	5	0	0
B087	N	0	0	0	0	1	0	0	472	4	0	0
B088	N	0	0	0	0	14	0	0	814	5	0	0
B089	N	0	0	0	0	0	0	0	0	0	0	0
B090	N	0	0	0	0	0	0	0	446	4	0	15
B091	N	0	0	0	0	0	0	0	1	1	0	0
B092	N	0	0	0	0	0	0	0	309	4	0	0
B093	N	0	0	0	0	12	0	0	615	5	2	3
B094	N	0	0	0	0	4	0	0	753	5	0	18
B095	N	0	0	0	0	7	0	0	105	4	0	0

B096	N	0	0	0	0	0	0	0	1	1	0	0
B097	N	0	0	0	0	0	0	0	1522	6	0	3
B098	N	0	0	0	0	2	0	0	0	0	0	0
B099	N	0	0	0	0	1	0	0	0	0	0	0
B100	N	0	0	0	0	1	0	0	0	0	0	0
B101	N	0	0	0	0	0	0	0	--	--	--	--
B102	N	0	0	0	0	0	0	0	0	0	0	0
B103	N	0	0	0	0	0	0	0	0	0	6	0
B104	N	0	0	0	0	0	0	0	0	0	0	0
B105	N	0	0	0	0	13	0	0	1152	6	0	2
B105A	N	0	0	0	0	0	0	0	80	3	0	0
B106	Y	0	1	0	0	0	0	0	8	1	0	0
B107	N	0	0	0	0	0	0	0	0	0	0	0
B108	N	0	0	0	0	0	0	0	0	0	0	0
B109	N	0	0	0	0	0	0	0	0	0	0	0
B110	N	0	0	0	0	0	0	0	6	1	0	0
B111	Y	1	0	0	0	0	0	0	0	0	0	0
B112	N	0	0	0	0	0	0	0	104	4	0	0
B113	N	0	0	0	0	0	0	0	0	0	0	0
B114	N	0	0	0	0	0	0	0	0	0	0	0
B115	N	0	0	0	0	0	0	0	0	0	0	0
B116	N	0	0	0	1	4	0	0	0	0	0	0
B117	N	0	0	0	0	0	0	0	52	3	0	0
B118	N	0	0	0	0	0	0	0	0	0	0	0
B119	Y	1	0	0	0	0	0	0	1	1	0	0
B120	Y	0	0	1	0	0	0	0	3	1	0	0

B121	Y	1	0	0	0	0	0	0	0	0	0	0
B122	N	0	0	0	0	0	0	0	0	0	0	0
B123	N	0	0	0	0	0	0	0	0	0	0	0
B124	N	0	0	0	0	0	0	0	53	3	0	0
B125	Y	0	1	0	0	2	0	0	200	4	0	0
B126	N	0	0	0	0	0	0	0	0	0	0	0
B127	N	0	0	0	0	0	0	0	0	0	0	0
B128	N	0	0	0	0	0	0	0	0	0	0	0
B129	Y	3	0	0	0	0	0	0	0	0	0	0
B130	N	0	0	0	0	7	0	0	286	4	0	0
B131	N	0	0	0	0	0	0	0	0	0	0	0
B132	N	0	0	0	0	6	0	0	27	2	0	0
B133	N	0	0	0	0	6	0	0	0	0	0	0
B134	N	3	0	0	0	1	0	0	0	0	0	13
B135	N	0	0	0	0	0	0	0	0	0	0	0
B136	Y	2	0	0	0	0	0	0	0	0	0	0
B137	N	0	0	0	0	5	0	0	381	4	0	0
B138	N	0	0	0	0	0	0	0	0	0	0	0
B139	N	0	0	0	0	7	0	0	0	0	0	0
B140	N	0	0	0	0	1	0	0	16	2	0	0
B141	N	0	0	0	0	0	0	0	0	0	0	0
B142	N	0	0	0	0	0	0	0	0	0	0	0
B143	N	0	0	0	0	0	0	0	0	0	0	0
B144	N	0	0	0	0	0	0	0	0	0	0	0
B145	N	0	0	0	0	0	0	0	0	0	0	0
B146	N	0	0	0	0	0	0	0	0	0	0	0

B147	N	0	0	0	0	7	0	0	3	1	0	0
B148	N	0	0	0	0	2	0	0	0	0	0	0
B149	N	0	0	0	0	0	0	0	15	2	0	0
B150	N	0	0	0	0	0	0	0	0	0	0	0
B151	N	2	0	0	0	0	0	0	0	0	0	0
B152	N	0	0	0	0	0	0	0	0	0	0	0
B153	N	0	0	0	0	0	0	0	1	1	0	0
B154	N	0	0	0	0	0	0	0	0	0	0	0
B155	N	0	0	0	0	0	0	0	100	3	0	0
B156	N	1	0	0	0	12	0	0	0	0	0	0
B157	N	0	0	0	0	0	0	0	0	0	0	0
B158	N	0	0	0	0	0	0	0	0	0	0	0
B159	N	0	0	0	0	3	0	0	8	1	0	0
B160	N	0	0	0	0	0	0	0	0	0	0	0
B161	N	0	0	0	0	0	0	0	0	0	0	0
B162	N	0	0	0	0	1	1	0	865	5	0	1
B163	N	0	0	0	0	26	0	0	261	4	0	0
B164	N	0	0	0	0	13	0	0	554	5	0	4
B165	N	0	0	0	0	0	0	0	2	1	0	0
B166	Y	1	0	0	0	0	0	0	4091	6	0	2
B167	N	0	0	0	0	0	17	0	377	4	0	0
B168	N	0	0	0	0	1	0	0	1056	6	0	0
B169	Y	1	0	0	0	0	0	0	2	1	0	0
B170	Y	7	0	0	0	0	0	0	239	4	0	0
B171	N	0	0	0	0	46	0	0	0	0	0	0
B172	N	0	0	0	0	0	0	0	0	0	0	0

B173	N	0	0	0	0	0	0	0	15	2	0	0
B174	Y	1	0	0	0	0	0	0	0	0	0	0
B175	N	0	0	0	0	34	0	0	0	0	0	0
B176	N	0	0	0	0	0	0	0	679	5	0	0
B177	Y	1	0	0	0	0	0	0	0	0	0	0
B178	N	0	0	0	0	1	0	0	299	4	0	0
B179	Y	1	0	0	0	0	0	0	2091	6	0	0
B180	N	0	0	0	0	0	0	0	57	3	0	0
B181	N	0	0	0	0	0	0	0	0	0	0	0
B182	N	0	0	0	0	0	0	0	1135	6	0	24
B183	N	0	0	0	0	0	0	0	0	0	0	0
B184	N	0	0	0	0	0	0	1	2	1	0	0
B185	N	0	0	0	0	0	0	0	0	0	0	0
B186	N	0	0	0	0	0	0	0	0	0	0	0
B187	N	0	0	0	0	0	0	0	0	0	0	0
B188	Y	0	0	0	0	0	0	0	0	0	0	0
B189	N	0	0	0	0	3	0	0	0	0	0	0
B190	N	0	0	0	0	0	0	0	49	2	0	0
B191	N	0	0	0	0	0	0	0	0	0	0	0
B192	N	0	0	0	0	0	0	0	0	0	0	0
B193	N	0	0	0	0	0	0	0	0	0	0	0
B194	N	0	0	0	0	1	0	0	0	0	0	0
B194A	N	0	0	0	0	0	0	0	0	0	0	0
B195	N	0	0	0	0	0	0	0	0	0	0	0
B196	N	0	0	0	0	0	0	0	0	0	0	0
B197	Y	0	0	0	0	0	0	0	0	0	0	0

B198	N	0	0	0	0	1	0	0	0	0	0	0
B199	N	0	0	0	0	0	0	0	0	0	0	0
B200	N	0	0	0	0	0	0	0	0	0	0	0
B201	N	0	0	0	0	0	0	0	0	0	0	0
B202	N	0	0	0	0	0	0	0	0	0	0	0
B203	N	0	0	0	0	0	0	0	0	0	0	0
B204	N	1	0	0	0	0	0	0	0	0	0	0
B205	N	0	0	0	0	0	0	0	0	0	0	0
B206	N	0	0	0	0	0	0	0	0	0	0	0
B207	N	0	0	0	0	0	0	0	0	0	0	0
B208	N	0	0	0	0	0	0	0	0	0	0	0
B209	N	0	0	0	0	0	0	0	0	0	0	0
B210	N	0	0	0	0	0	0	0	1	1	0	0
B211	N	0	0	0	0	0	0	0	0	0	0	0
B212	N	0	0	0	0	0	0	0	0	0	0	0
B213	N	0	0	0	0	0	0	0	0	0	0	0
B214	N	0	0	0	0	0	0	0	0	0	0	0
B215	N	0	0	0	0	0	0	0	0	0	0	0
B216	N	0	0	0	0	0	0	0	0	0	0	0
B217	Y	1	0	0	0	0	0	0	0	0	0	0
B218	N	0	0	0	0	0	0	0	3	1	0	0
B219	N	0	0	0	0	1	0	0	0	0	0	0
B220	Y	1	0	0	0	0	0	0	0	0	0	0
B221	N	0	0	0	0	3	0	0	1	1	0	0
B222	N	0	0	0	0	0	0	0	0	0	0	0
B223	N	1	0	0	0	0	2	0	1	1	0	0

B224	N	0	0	0	0	0	0	0	77	3	0	10
B225	N	0	0	0	0	3	0	0	1	1	0	9
B226	N	0	0	0	0	0	0	0	0	0	0	0
B227	N	0	0	0	0	0	0	0	0	0	0	0
B228	N	0	0	0	0	0	0	0	0	0	0	0
B229	Y	0	0	0	0	0	0	6	0	0	0	0
B230	Y	1	0	0	0	2	0	0	1	1	0	0
B231	N	0	0	0	0	0	0	0	36	2	0	0
B232	N	0	0	0	0	4	0	0	1	1	0	0
B233	Y	1	0	0	0	0	0	0	0	0	0	0
B234	N	0	0	0	0	0	0	0	0	0	0	0
B235	N	0	0	0	0	0	0	0	0	0	0	0
B236	N	0	0	0	0	0	0	0	0	0	0	0
B237	N	0	0	0	0	0	0	0	0	0	0	0
B238	N	0	0	0	0	0	0	0	0	0	0	0
B239	N	0	0	0	0	0	0	0	0	0	0	0
B240	Y	0	0	0	0	0	0	0	0	0	0	0
B241	N	0	0	0	0	0	0	0	1	1	0	0
B242	N	0	0	0	0	0	0	0	0	0	0	0
B243	N	0	0	0	0	0	0	0	0	0	0	0

****Coding Key**
Groundstone: Y=Yes; N=No
All other categories denote total number of item found with each burial.

Appendix H. Bone and Lithic Utilitarian Artifacts. **

Burial	Bone Tools	Scapula Saws	Bone Awls	Bone Needles	Antler Wedges	Other Bone Artifacts	Debitage	Assc Points	Embedded Points	Stone Tool
B001	0	0	0	0	0	0	0	1	0	0
B002- Bear burial										
B003	0	0	0	0	0	0	0	0	0	0
B004	0	0	0	0	0	0	0	1	0	0
B005	1	1	0	0	0	0	0	0	0	1
B006	0	0	0	0	0	0	0	0	0	0
B007	0	0	0	0	0	0	0	0	0	1
B008	0	0	0	0	0	0	0	0	0	0
B009	0	0	0	0	0	0	0	0	0	0
B010	0	0	0	0	0	0	0	1	0	0
B011	0	0	0	0	0	0	0	0	0	0
B012	0	0	0	0	0	0	1	0	0	0
B013	0	0	0	0	0	0	5	0	0	0
B014	0	0	0	0	0	0	0	0	0	1
B015	0	0	0	0	0	0	2	0	0	1
B016	0	0	0	0	0	0	0	0	0	0
B017	0	0	0	0	0	0	0	0	0	0
B018	0	0	0	0	0	0	0	0	0	0
B019	0	0	0	0	0	0	0	0	0	0
B020	0	0	0	0	0	0	3	0	0	0
B021	0	0	0	0	0	0	4	1	0	11

B022-Elk Burial										
B023	0	0	0	0	0	0	0	0	0	0
B024	0	0	0	0	0	0	3	0	0	0
B025	0	0	0	0	0	0	1	0	0	0
B026	0	0	0	0	0	0	0	0	0	1
B027	0	0	0	0	0	0	1	0	0	0
B028	0	0	0	0	0	0	0	0	0	0
B029	1	1	0	0	0	0	0	0	0	0
B030	0	0	0	0	0	0	0	0	0	0
B031	0	0	0	0	0	0	0	0	0	0
B032	0	0	0	0	0	0	0	0	0	0
B033	0	0	0	0	0	0	1	0	0	0
B034	0	0	0	0	0	0	0	0	0	0
B035	3	0	3	0	0	0	0	0	0	0
B036	0	0	0	0	0	0	0	0	0	0
B037	0	0	0	0	0	0	0	0	0	0
B038	0	0	0	0	0	0	0	0	0	0
B039	0	0	0	0	0	0	0	0	0	0
B040	0	0	0	0	0	0	0	0	0	0
B041	0	0	0	0	0	0	1	0	0	0
B042	10	0	10	0	0	0	4	1	0	0
B043	0	0	0	0	0	0	0	0	0	0
B044	0	0	0	0	0	0	0	0	0	0
B045	2	0	2	0	0	0	1	0	0	0
B046	0	0	0	0	0	0	0	0	0	0
B047	0	0	0	0	0	0	0	0	0	1
B048	0	0	0	0	0	0	0	0	0	0
B049	0	0	0	0	0	0	0	0	0	0
B050	1	0	0	0	1	0	2	0	0	0

B051	0	0	0	0	0	0	1	0	0	0
B052	0	0	0	0	0	0	0	0	0	0
B053	1	0	0	0	1	0	1	0	0	0
B054	1	1	0	0	0		0	0	0	0
B055	0	0	0	0	0	0	0	0	0	0
B056	0	0	0	0	0	0	0	0	0	0
B057	0	0	0	0	0	0	0	0	0	0
B058	0	0	0	0	0	0	3	0	0	0
B059	0	0	0	0	0	0	0	0	0	0
B060	0	0	0	0	0	0	0	0	0	0
B061	0	0	0	0	0	0	0	0	0	1
B062	0	0	0	0	0	0	5	0	0	0
B063	1	0	0	0	0		1	0	0	0
B064	0	0	0	0	0	0	1	0	0	0
B065	0	0	0	0	0	0	1	0	0	0
B066	0	0	0	0	0	0	1	0	0	0
B067	2	1	0	0	0		0	0	0	0
B068	0	0	0	0	0		3	0	0	2
B069	0	0	0	0	0	1	0	0	0	0
B070	0	0	0	0	0	0	0	0	0	0
B071	0	0	0	0	0	0	1	0	0	0
B072	0	0	0	0	0	0	0	1	0	0
B073	0	0	0	0	0	0	0	1	0	1
B074	0	0	0	0	0	0	0	0	0	0
B075	0	0	0	0	0	0	1	0	0	1
B076	0	0	0	0	0	0	0	0	0	0
B077	0	0	0	0	0	0	0	0	0	1
B078	0	0	0	0	0	0	0	0	0	0
B079	0	0	0	0	0	0	0	0	0	0
B080	1	0	1	0	0	0	0	0	0	0

B081	0	0	0	0	0	0	0	0	0	1
B082	0	0	0	0	0	0	0	1	0	0
B083	1	0	0	0	1	0	0	0	0	0
B084	1	0	1	0	0	0	0	0	0	1
B085	0	0	0	0	0	0	4	0	0	0
B086	0	0	0	0	0	0	1	2	0	0
B087	0	0	0	0	0	0	1	0	0	0
B088	0	0	0	0	0	0	1	0	0	0
B089	0	0	0	0	0	0	0	0	0	0
B090	0	0	0	0	0	0	0	0	0	0
B091	0	0	0	0	0	0	1	0	1	0
B092	0	0	0	0	0	0	1	1	0	0
B093	11	8	1	0	1	0	2	0	0	0
B094	0	0	0	0	0	0	0	0	0	0
B095	0	0	0	0	0	0	0	0	0	1
B096	0	0	0	0	0	0	0	0	0	0
B097	0	0	0	0	0	1	0	0	0	0
B098	0	0	0	0	0	0	1	0	0	0
B099	0	0	0	0	0	0	1	0	0	0
B100	0	0	0	0	0	0	4	0	0	0
B101	0	0	0	0	0	0	0	0	0	0
B102	0	0	0	0	0	0	0	0	0	0
B103	0	0	0	0	0	0	0	0	0	0
B104	0	0	0	0	0	0	0	0	0	0
B105	0	0	0	0	0	0	0	0	0	0
B105A	0	0	0	0	0	0	0	0	0	0
B106	0	0	0	0	0	0	1	0	0	0
B107	0	0	0	0	0	0	0	0	0	0
B108	0	0	0	0	0	0	1	0	0	0
B109	0	0	0	0	0	0	1	0	0	0

B110	0	0	0	0	0	0	0	0	0	0
B111	0	0	0	0	0	0	0	0	0	0
B112	0	0	0	0	0	0	0	0	0	0
B113	0	0	0	0	0	0	1	0	0	0
B114	0	0	0	0	0	0	0	0	0	0
B115	0	0	0	0	0	0	0	0	0	0
B116	0	0	0	0	0	0	0	0	0	0
B117	0	0	0	0	0	0	0	0	0	0
B118	0	0	0	0	0	0	1	0	0	0
B119	0	0	0	0	0	0	0	0	0	0
B120	0	0	0	0	0	0	0	0	0	0
B121	0	0	0	0	0	1	0	0	0	0
B122	0	0	0	0	0	0	1	0	0	0
B123	0	0	0	0	0	0	0	0	0	0
B124	0	0	0	0	0	0	0	0	0	0
B125	0	0	0	0	0	0	0	0	0	0
B126	0	0	0	0	0	0	0	0	0	0
B127	0	0	0	0	0	0	0	0	0	0
B128	0	0	0	0	0	0	1	0	0	0
B129	0	0	0	0	0	0	3	0	0	1
B130	0	0	0	0	0	0	0	0	0	0
B131	2	0	2	0	0	0	1	0	0	0
B132	0	0	0	0	0	0	0	0	0	0
B133	0	0		0	0	0	1	0	0	0
B134	0	0	0	0	0	0	0	0	0	0
B135	0	0	0	0	0	0	0	0	0	0
B136	0	0	0	0	0	0	0	0	0	0
B137	0	0	0	0	0	0	0	0	0	0
B138	0	0	0	0	0	0	0	0	0	0
B139	0	0	0	0	0	0	0	0	1	0

B140	0	0	0	0	0	0	0	0	0	0
B141	0	0	0	0	0	0	1	0	1	1
B142	0	0	0	0	0	0	0	0	1	0
B143	0	0	0	0	0	0	3	0	1	0
B144	0	0	0	0	0	0	1	0	0	0
B145	0	0	0	0	0	0	0	0	0	0
B146	3	3	0	0	0		0	0	0	0
B147	0	0	0	0	0	0	0	0	0	0
B148	0	0	0	0	0	0	0	1	0	0
B149	0	0	0	0	0	0	0		0	0
B150	0	0	0	0	0	0	0	1	0	0
B151	0	0	0	0	0	0	0	0	1	0
B152	0	0	0	0	0	0	0	0	0	0
B153	0	0	0	0	0	0	0	0	0	0
B154	0	0	0	0	0	0	0	0	0	1
B155	0	0	0	0	0	0	0	0	0	0
B156	0	0	0	0	0	0	0	0	0	0
B157	0	0	0	0	0	0	0	0	0	0
B158	0	0	0	0	0	0	0	0	0	0
B159	0	0	0	0	0	0	1	0	0	0
B160	0	0	0	0	0	0	0	0	1	0
B161	0	0	0	0	0	0	0	0	0	2
B162	3	1	2	0	0	0	0	0	0	0
B163	0	0	0	0	0	0	0	0	0	1
B164	0	0	0	0	0	0	0	0	0	0
B165	0	0	0	0	0	0	0	0	0	0
B166	0	0	0	0	0	0	0	0	0	0
B167	0	0	0	0	0	0	0	1	0	0
B168	0	0	0	0	0	0	0	0	0	0
B169	0	0	0	0	0	0	0	0	0	0

B170	0	0	0	0	0	0	2	1	0	1
B171	0	0	0	0	0	0	0	0	0	0
B172	0	0	0	0	0	0	0	0	0	0
B173	0	0	0	0	0	0	0	0	0	0
B174	2	0	1	1	0	0	7	0	0	1
B175	1	1	0	0	0	0	1	0	0	0
B176	0	0	0	0	0	0	3	0	0	1
B177	0	0	0	0	0	0	0	0	0	0
B178	2	0	0	2	0	0	0	0	0	0
B179	0	0	0	0	0	0	0	0	0	0
B180	0	0	0	0	0	0	0	0	0	0
B181	0	0	0	0	0	1	0	0	0	0
B182	0	0	0	0	0	0	0	0	0	0
B183	0	0	0	0	0	0	0	0	0	0
B184	0	0	0	0	0	0	2	0	0	1
B185	0	0	0	0	0	0	1	0	0	0
B186	1	0	0	1	0	0	0	0	0	1
B187	0	0	0	0	0	0	1	0	0	0
B188	0	0	0	0	0	0	0	0	0	1
B189	0	0	0	0	0	0	1	0	0	0
B190	0	0	0	0	0	0	1	0	0	0
B191	0	0	0	0	0	0	0	0	0	0
B192	0	0	0	0	0	0	0	0	0	0
B193	0	0	0	0	0	0	0	0	0	1
B194	0	0	0	0	0	0	0	0	0	0
B194A	0	0	0	0	0	0	0	0	0	0
B195	0	0	0	0	0	0	0	0	0	0
B196	0	0	0	0	0	0	0	0	0	0
B197	0	0	0	0	0	0	0	0	0	0
B198	0	0	0	0	0	0	0	0	0	0

B199	0	0	0	0	0	0	0	0	0	0
B200	0	0	0	0	0	0	0	0	0	0
B201	0	0	0	0	0	0	1	0	0	1
B202	0	0	0	0	0	0	0	0	0	0
B203	0	0	0	0	0	0	4	0	0	0
B204	0	0	0	0	0	0	0	0	0	1
B205	0	0	0	0	0	0	0	0	0	0
B206	0	0	0	0	0	0	0	0	0	0
B207	0	0	0	0	0	0	0	0	0	0
B208	0	0	0	0	0	0	0	0	0	0
B209	0	0	0	0	0	0	0	0	0	0
B210	0	0	0	0	0	0	0	0	0	0
B211	0	0	0	0	0	0	0	0	0	0
B212	0	0	0	0	0	0	0	0	0	0
B213	0	0	0	0	0	0	0	0	0	0
B214	0	0	0	0	0	0	0	0	0	0
B215	0	0	0	0	0	0	0	0	0	0
B216	0	0	0	0	0	0	0	0	0	0
B217	0	0	0	0	0	0	0	1	0	0
B218	1	0	1	0	0	0	0	0	0	0
B219	0	0	0	0	0	0	0	0	0	0
B220	0	0	0	0	0	0	0	0	0	0
B221	0	0	0	0	0	0	0	0	0	0
B222	0	0	0	0	0	0	0	0	0	0
B223	0	0	0	0	0	0	1	0	0	1
B224	2	0	1	0	0	0	1	1	0	0
B225	0	0	0	0	0	0	0	0	0	0
B226	0	0	0	0	0	0	0	0	0	0
B227	0	0	0	0	0	1	0	0	0	0
B228	0	0	0	0	0	0	0	0	0	0

B229	0	0	0	0	0	0	0	0	0	0
B230	2	2	0	0	0	0	0	0	0	0
B231	0	0	0	0	0	0	0	0	0	1
B232	0	0	0	0	0	0	0	0	0	0
B233	0	0	0	0	0	0	2	0	0	0
B234	0	0	0	0	0	0	0	0	0	0
B235	0	0	0	0	0	0	0	0	0	0
B236	0	0	0	0	0	0	0	0	0	0
B237	0	0	0	0	0	0	0	0	0	0
B238	0	0	0	0	0	0	0	0	0	0
B239	0	0	0	0	0	0	0	0	0	0
B240	0	0	0	0	0	0	1	0	0	1
B241	0	0	0	0	0	0	0	0	0	0
B242	0	0	0	0	0	0	0	0	0	0
B243	0	0	0	0	0	0	0	0	0	0

****Coding Key**

All categories denote total number of item found with each burial.

Appendix I SEQUENCE DATA

		16042	16084	16086	16092	16093	16111	16124	16126	16131	16142	16150	16164	16175	16183	16184	16189	16192	16193 i	16207	16217	16223	16234	16244	16248	16260	16264	16270	16278	16290	16293	16298	16299	16311	16319	16325	16327	16362
CRS Reference	Haplogroup	G	G	T	T	T	C	T	T	T	C	C	A	A	A	C	T	C	-	A	T	C	C	G	C	C	C	C	C	C	A	T	A	T	G	T	C	T
B001	A	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B016	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B025	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B043	A	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B071	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B072	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B108	A	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B115	A	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B141	A	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B143	A	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B182	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	T	.	.	.	.	A	.	.	C
B003	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B013	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B023	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B028	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B034	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B039	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

B047	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B053	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B057	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B061	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	C	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B063	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B075	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B078	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B085	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B103	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B105	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B105a	B	B.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B111	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B114	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B116	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	C	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B119	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B120	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B123	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B130	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B148	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B164	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B165	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B172	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B173	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B185	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B188	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B195	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.

B196	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B201	B	A	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.
B203	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B206	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B210	B	.	.	.	.	.	.	.	C	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B215	B	.	.	.	.	.	.	.	.	.	.	.	.	G	C	.	C	.	.	.	C	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	.	.
B229	B	.	.	.	.	.	.	.	.	.	.	.	.	.	C	A	C	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
B004	C	.	.	.	.	.	.	.	.	C	.	.	G	.	.	.	.	.	.	T	.	T	T	A	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B005	C	.	.	.	.	.	.	.	.	C	.	.	G	.	.	.	.	.	.	T	.	T	T	A	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B031	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	.	T	.
B032	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B035	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B042	C	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B046	C	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B051	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	.	T	.
B052	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B054	C	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B062	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	.	.
B064	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B065	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B069	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B077	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B079	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	G	C	.	.	.	C	T	C
B082	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B086	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	G	.	.	C	T	.
B088	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.

B092	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B095	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B096	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B100	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	T	.	.	.	.	.	.	C	.	.	.	.	T	.
B104	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B110	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B118	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B129	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B132	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	.	T	.
B138	C	.	.	.	.	.	.	.	.	.	C	.	.	G	.	.	.	.	.	T	.	T	T	A	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B140	C	.	.	.	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	T	.	T	T	A	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B144	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B153	C	.	.	.	.	.	.	.	.	.	C	.	.	G	.	.	.	.	.	T	.	T	T	A	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B156	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B163	C	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B178	C	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	T	.	.	.	.	C	.	C	.	C	T	.
B179	C	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B180	C	.	.	.	.	C	.	.	.	.	C	.	.	.	.	.	.	.	.	T	.	T	T	A	.	.	.	.	.	.	.	C	.	.	.	C	T	.
B183	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	.	.	.	.	.	.	.	.	C	.	C	.	C	T	.
B190	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T	.	.	.	.	.	.	.	.	.	C	.	.	.	C	T	.
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