POPULATION REPLACEMENT ON THE SOUTHERN CHANNEL ISLANDS: NEW EVIDENCE FROM SAN NICOLAS ISLAND

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ABSTRACT

Human habitation of San Nicolas Island, located 60 miles off the coast of Southern California, lasted for over 5,000 years. Today, skeletal remains are one of the few sources of information for reconstructing the lives of the ancient Nicoleños. Anthropological evidence suggests that the people of San Nicolas were both culturally and linguistically isolated from other island and mainland groups. In addition, osteological analyses suggest that two genetically distinct populations occupied the Southern Channel Islands during prehistory. Despite early interest in this issue, recent research has failed to shed new light on the timing of the proposed population replacement. Our research expands upon these earlier studies by focusing on the temporal distribution of a suite of skeletal traits with high heritabilities. The burials analyzed date to a range of time periods, and thus provide a basis for testing earlier hypotheses concerning population interaction and migration in the Channel islands area. Our data suggest that the demographic history of the Southern Channel Islands and San Nicolas Island, in particular, is more complex than has been previously reported.

Keywords: San Nicolas Island, population replacement, osteology, non-metric traits, discrete traits.

INTRODUCTION

At the time of European contact, the eight Channel Islands of southern California were home to at least two native ethnic groups (Figure 1). The Northern Channel Islands off Santa Barbara (Santa Cruz, Santa Rosa, San Miguel and Anacapa) were occupied by the Chumash while the Gabrieliño lived on the Southern Channel Islands off of Los Angeles and San Diego (San Clemente, Santa Catalina, San Nicolas and Santa Barbara islands). The history of these groups has been investigated by archaeologists for over a hundred years, revealing patterns of cultural change on the islands and the nearby mainland of California.

San Nicolas, located 60 miles (102 km) off the coast of southern California, is one of the most intriguing of the Channel Islands. It earned literary fame as the home of Juana Maria, the "Lone Woman," who was found in 1853 after living alone on the island for eighteen years (Heizer and Elsasser 1973; Hudson 1978). Despite years of archaeological investigations, we are only just beginning to understand the lives of the people of San Nicolas.

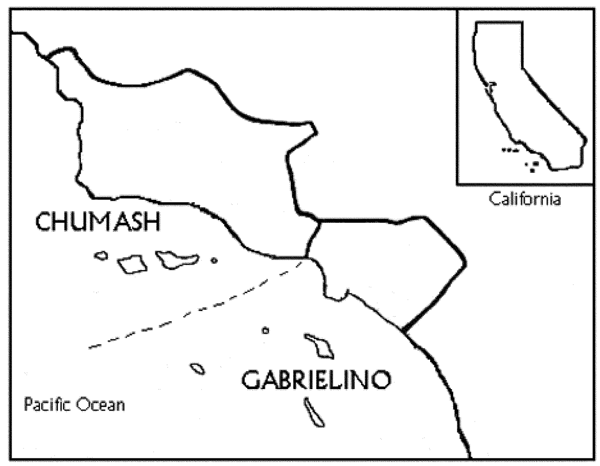

Figure 1. Traditional division of Northern and Southern Channel Island prehistoric culture groups.

Peripheral and Marginal: San Nicolas Island as a Barometer of Change

Recent analyses suggest a unique status for San Nicolas Island in comparison to the other Channel Islands of California. San Nicolas Island is one of the smallest (22 km^2), least accessible, and most resource-depauperate of these islands. It lies not at the center of the Channel Island region, but at its outer limits, and is distant from both neighboring islands and the mainland; San Nicolas Island is 12 miles farther from the mainland and at least 13 miles farther from its nearest neighbor than any of the other Channel Islands. In addition, boat travel between Santa Catalina and San Clemente in the south, and Santa Rosa and Santa Cruz in the north would be facilitated by sea-surface currents (Figure 2), but a strong northerly current runs between San Nicolas and the other southern islands, making travel between these more challenging (Seapy and Littler 1980). In addition to its size and distance from the mainland, San Nicolas is perhaps the most ecologically marginal of the Channel Islands occupied at the time of European contact. As with all of the islands, floral and faunal resources are limited when compared to the mainland. Further, of the Channel Islands, San

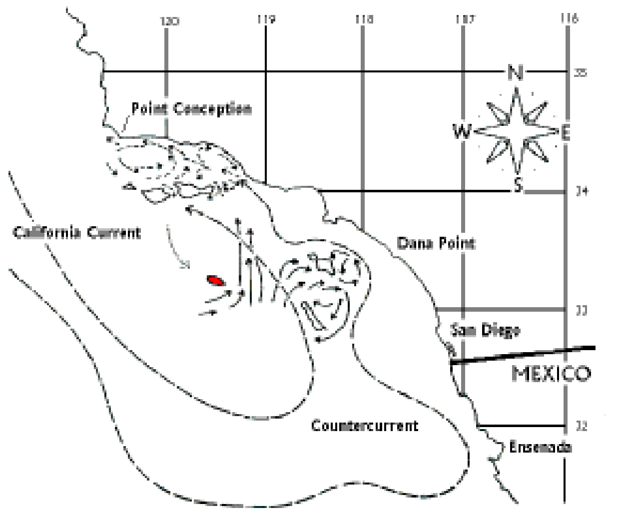

Figure 2. Surface current patterns off southern California illustrating the southerly flow of the California Current to the west of the Channel Islands, and the countercurrent that returns north between San Nicolas Island and the other Southern Channel Islands (adapted from Figure 2 in Seapy and Littler 1980).

Nicolas is the least productive in terms of terrestrial resources (Glassow 1980; Schwartz and Martz 1992).

The unique status of San Nicolas Island can be used to gain insight to the larger patterns of culture change in the Channel Islands region. The authors have conducted the most comprehensive analysis of human skeletal remains from San Nicolas Island to date, and these data allow for new perspectives on previously proposed hypotheses of population replacement in the Southern Channel Islands. Non-metric and metric osteological features are the basis for this analysis.

Population Replacement Hypotheses

The Southern Channel Islands, unlike those in the north, were likely occupied by two different groups of people during prehistory. Archaeologists, linguists, and physical anthropologists have independently gathered evidence for two distinct cultural traditions, languages, and physical types on the islands. These data have often been used to support the hypothesis that the Southern Channel Islands were occupied in the distant past by speakers of Hokan languages, and were later replaced by speakers of Takic (Uto-Aztecan family) languages as this group penetrated into Southern California from the eastern deserts (Gifford 1926; Koerper 1979; Kroeber 1925; Moratto 1984). However, researchers disagree on the date of the proposed population replacement. Martz (1994) summarizes the differing hypotheses on the timing of the Takic expansion by breaking them into three groups—those who believe the evidence indicates an early replacement around 5,000 to 6,000 BP (Howard and Raab 1993; Vellanoweth 1995), those who believe the replacement occurred between 2,500 to 4,000 BP (Kowta 1969:42; Lauter 1982:87; Rozaire 1959), and a third group who believe that the Takic group arrived in the late prehistoric period—around 1,500 BP (Wallace 1962; Titus 1987). Each of these proposals is supported by evidence from different subdisciplines in anthropology—archaeological, linguistic, and osteological.

Early Arrival

Howard and Raab (1993) infer a population replacement on the Southern Channel Islands from evidence of an "interaction sphere" based on the distribution and dating of *Olivella* grooved rectangle beads (Class N, Bennyhoff and Hughes 1987). These beads have so far been found on the Southern Channel Islands, in Orange County, and the Great Basin (but not on the Northern islands or Santa Barbara mainland). The bead data indicate that, "the Southern Channel Islands and adjacent coast were culturally distinct from the Santa Barbara Channel region at least as early as 5,000 calendar years BP" (Howard and Raab 1993:7-8). Further, Howard and Raab (1993) suggest that the presence of these beads is indicative of the arrival of the Takic peoples into Southern California.

Intermediate Arrival

Trade patterns, burial practices, and basketry techniques on the Southern Channel Islands suggest a population change at approximately 2,500 to 4,000 BP. Both trade in Santa Catalina Island steatite and the practice of cremation (Kowta 1969:42) by the ethnographic Gabrieliño of the Los Angeles basin (Takic) are similar to patterns seen in the Southern Channel Islands at this time, and are significantly different from those found in the Northern Channel region. In addition, Rozaire (1959) and Lauter (1982:87) have both found S-twined weaving on the Southern Channel Islands during this time frame, different from the Z-twining found in Northern Channel basketry and weavings. Rozaire (1959:148) proposes that this difference between the Southern and Northern Channel Islands is indicative of the presence of the Takic peoples on the Southern Channel Islands.

Late Arrival

In a summary of his work on San Nicolas Island, Rogers (1993) submits that the Southern Channel Islands show evidence of Early, Canaliño, and Takic (his "Shoshonean") patterns. Canaliño is very similar to the pattern found during the later periods in the Santa Barbara region (Hokan territory), while "Shoshonean" (Takic) is characterized by a later adoption of cremations, obsidian projectile points and other attributes. This general statement is supported by linguistic and archaeological evidence presented by Warren (1968) and more recently by osteological data indicating the presence of two physical types on the Southern Channel Islands.

Titus (1987) proposes that two distinct physical types are present on San Clemente Island, those with taller, rounder crania (brachycephalic) and those with longer, narrow crania (dolichocephalic). Titus suggests that the brachycephalic type is indicative of the ancestral Hokan groups while the dolichocephalic is similar to the Takic type. She found that the brachycephalics were present in sites dating to 5,400 to 5,000 BP, while the dolichocephalics were found in sites that dated much later (approximately 1,500 BP).

There is also good osteological evidence for divergent behavioral patterns in the later periods on the Southern Channel Islands. Reinman and Townsend (1960), Titus and Walker (1986), and Titus (1987) each found that earlier populations (5,000 BP) possessed a greater frequency of auditory exostoses (bony projections within the ear canal) than the later (1,500 BP) populations. These projections, which are often related to diving in cold water (DiBartolomeo 1979; Kennedy 1986), may indicate a shift in the subsistence strategy that included more diving in earlier time periods (Titus and Walker 1986; Titus 1987). These differences may be the result of changing food preferences, or may indicate a change in the population itself. Titus (1987) also found fewer cranial vault injuries in the later populations on San Clemente Island, perhaps indicative of the intrusion of the Takic peoples and a concomitant shift to warfare with the bow and arrow rather than clubs (introduced approximately 1,500 BP). Of course, these data can be used to support either in situ cultural evolution and adoption of new techniques, or the intrusion of a new population with new technology.

Implications of Population Change Hypotheses

For each of the proposed population replacement models, expectations can be drawn that have strict implications for the San Nicolas Island skeletal material data. Each proposed period of arrival should be distinguished by the original presence of brachycephalic individuals, then the gradual or distinct replacement by individuals with dolichocephalic crania. This replacement should also be correlated with the appearance of the Takic pattern of cremations, obsidian tools and S-twining on San Nicolas Island. Last, if the current suite of archaeological data has incorrectly suggested that a population replacement occurred on the Southern Channel Islands, we expect that there will be no difference in physical types and non-metric traits among the people of San Nicolas.

OSTEOLOGICAL AND ARCHAEOLOGICAL METHODS

Standard osteological techniques were employed in this analysis, (Buikstra and Ubelaker 1994). Sex determinations were made in a hierarchical fashion with pelvic bone sex (c.f., Buikstra and Ubelaker 1994) given highest priority. Discriminant function formulas derived from the pelvic sexes helped predict the sex of those whose sex is dependent on cranial features or long bone length (Walker et al. 1996:5). Age was also determined through a hierarchical system. Adult ages were determined primarily from observation of the pubic symphysis (Suchey 1979; Katz and Suchey 1986). In the absence of the symphysis, ages were predicted from molar wear scores using multiple regression equations (Walker et al. 1996). Subadult ages were based primarily on tooth development, and secondarily on long bone length. Fragmentary remains were put into gross categories based on size (i.e., subadult and adult).

Non-metric traits were scored using a modified version of Buikstra and Ubelaker's (1994) format. Modifications included dental patterns determined to be of significance for the specific populations under study. Dental non-metrics were scored when possible (occlusal surfaces of teeth are often missing in prehistoric California assemblages due to extensive attrition) using the format in Buikstra and Ubelaker (1994). A fifty-five percent sample of mandibles exhibiting congenital absence of the third molar was x-rayed by Alex G. Mizraji, D.D.S. of Ventura, California. The x-rays were used to confirm determinations based upon visual examination.

Metrical observations were made for every possible cranial, postcranial and dental measurement (Yoshida, in prep.). Most metrics were drawn from Buikstra and Ubelaker (1994), but some specialized metrics were taken from Walker et al. (1996). The specific cranial metrics and metrical transformations used in this research are defined in Table 1.

Table 1. Definitions of cranial measurements and index used in this research.

Metric or Index	Definition
Maximum Cranial Length (MAXCL)	Distance between glabella and opisthocranion in the midsagittal plane, measured in a straight line.
Maximum Cranial Breadth (MAXCB)	Maximum width of skull perpendicular to the midsagittal plane wherever it is located, with the exception of the inferior temporal lines and the area immediately surrounding them.

Osteological Sample

A total of 611 adult crania from the California Channel region are included in this analysis. The San Nicolas Island collections are held at the Santa Barbara Museum of Natural History, San Diego Museum of Man, Fowler Museum of Cultural History at UCLA, Los Angeles County Natural History Museum, the Southwest Museum, and the Environmental Division of the US Air Weapons Station at Point Mugu. Our comparative samples for the metric portion of this study come from both the Northern (SCRI-3 and 100) and Southern Channel Islands (SCLI-1215), shown in Table 2. For the non-metric portion of the study we added data from the Northern Channel Islands (SCRI-83, SRI-2, SRI-3 and SRI-41) San Clemente Island (SCLI-43 B and C), and the Santa Barbara mainland (SBa-60 and SBa-52). The authors measured and examined the San Nicolas Island sample for non-metric traits. The data for the Santa Cruz Island, Santa Rosa Island and Santa Barbara mainland sites

Table 2. Temporal context for Santa Cruz Island and San Clemente Island sites used in this analysis.

Site	Time Designation	Radiocarbon Date
SCRI-3	Early	7,200-3,440 BP[a]
SCRI-100	Late	800-300 BP[b]
SCLI-1215	Late	1,500 BP[b]

[a]Erlandson and Colten 1991; [b]Breschini et al. 1996

were provided by Phillip Walker (personal communication 1998), the San Clemente Island data were derived from Titus and Walker (1986).

Chronological information for the Southern Channel island burials is very limited. Radiocarbon dates from burial context are rare for San Nicolas Island (Table 3). Recent excavations are primarily focused on the development of an island-wide chronology and detailed analyses of site constituents in order to reconstruct subsistence and other lifeways (Schwartz and Martz 1995). For this reason, these excavations have failed to further our understanding of burial patterns or the chronology of burial areas on the island. For the purpose of this analysis, the presence or absence of time-sensitive materials found with the burials are used to increase our sample beyond those sites with radiocarbon dates (Table 3). Cremation burial is primarily a Late Period manifestation on the mainland and on other Southern Channel Islands (Bryan 1970; Martz unpublished 1998). Raab et al. (1995) has dated the widespread appearance of *Haliotis* fishhooks to 3,300 BP on San Clemente Island, while Martz (unpublished 1998) indicates that dog burials are present mostly in Late Period sites on San Nicolas Island. Finally, shell bead analysis and comparison to King's (1981, 1990) patterns of change for the Northern Channel Islands offers a gross chronology for specific bead types on San Nicolas Island.

Despite the increased numbers of dated burials as a result of artifact analysis, the sample of San Nicolas Island burials that date to the earliest of the three proposed population replacement periods (5,000 to 6,000 BP) is still too small to derive statistically significant comparisons. As a result, at this time it is impossible to perform fine-grained temporal analyses based on the San Nicolas Island data alone. Despite this, we believe information pertinent to the question at hand is still available from San Nicolas Island. The burials have been placed into arbitrarily defined Early (6,000 BP to 2,500 BP) or Late (2,500 BP to historic period) groups for analysis; this combines the two earliest of the original arrival periods, and preserves the division between these and the later arrival date (Table 3; Figure 3). Analysis of the data in these two periods reveals the broad patterns of possible population shifts on the Southern Channel Islands

Genetic Basis of Non-metric and Metric Traits

Metric and non-metric data are both potential indicators of genetic heritage. Although early analyses of cranial morphology were often taken too far in terms of determining relationships (Berry and Berry 1967; Hauser and DeStefano 1989), the basic hypothesis that cranial morphology is a genetically inherited characteristic holds true. As such, general population identities may be inferred from differences in cranial shape. Gifford (1926) identified three distinct physical types in prehistoric California that correlate with ethnographically recognized populations. The principle evidence for a genetic basis of the occurrence of non-metric traits is indirect: 1) traits occur at different frequencies in human populations of different genetic stock, and 2) the association of select traits with particular inherited syndromes (Hauser and DeStefano, 1989).

RESULTS

Metric Data

In this study we follow Titus and Walker (1986), who rely primarily on the maximum cranial length measurement as their unit of analysis. We also include maximum cranial breadth (Table 1).

Skeletal populations from the Northern Channel Islands (SCRI-3 and 100) are useful as a "control" group since there is no evidence for a population shift on these islands. As a result, all Northern Channel people are of Gifford's (1926) "California" group, and have tall, round crania. Samples from San Clemente Island (SCLI-1215) are also included in this study in order to decipher possible differences between the Southern Channel Islands.

The San Nicolas islanders (n=89) have an overall mean maximum cranial length of 182.05 mm, which is longer than those found in the Santa Barbara Channel area (n=117), but is similar to San Clemente Island (n=9) cranial lengths (189.42 mm). Mean maximum cranial breadth means are more complex, and San Nicolas (135.56 mm), San Clemente (136.56 mm) and Santa Cruz (135.60 mm) islands have comparable measurements.

As a group, the Southern Channel Islands (represented by San Nicolas and San Clemente in this analysis), change from rounder crania to longer crania through time (Table 4; Figure 4). According to two-tailed t-tests, the late sample from the Southern Channel Islands (SNI-18, SNI-25, SNI-51, SNI-214, and SCLI-1215) is significantly longer than that from the Northern Channel Islands (t=7.85, sig 0.00).

Intra-island analysis of mean cranial length is also revealing. For instance, the Early Period sites of SNI-16, SNI-40, SNI-55, SNI-56, SNI-170, and SNI-171 have mean cranial lengths that nearly approach those from the Santa Barbara area. In contrast, the Late Period San Nicolas Island crania have a much greater mean length (Table 5 and Figure 5), (t=4.78, sig 0.00). While these data clearly reveal an increase in cranial length through time, there are still some results that seemingly deviate from this pattern. Two Early Period sites (SNI-40 and SNI-56) have wide ranges in their maximum cranial lengths. The minimum cranial lengths are 170.50 mm (SNI-40) and 175.50 mm (SNI-56), well within the mean length of the samples with only round crania, while

Table 3. Temporal context for San Nicolas Island sites used in this analysis. Radiocarbon dates or time-sensitive materials are the basis for time designation determination.

Site	Time Designation*	Radiocarbon Date	Time Sensitive Materials
SNI-16	Early	2,960 (2830) 2,740 cal BP[a]	
		4,250-3,840 cal BP[a]	
SNI-18	Late	415 (115) 80 cal BP[a]	Haliotis fishhooks, dog burial, and treasure box .[b]
SNI-25	Late	None	Cremations, Haliotis fishhooks, house depressions, and dog burial.[b]
SNI-40	Early	3,820 (3675) 3,550 cal BP[a]	
SNI-51	Late	2,040 (1930) 1,830 cal BP[a]	Cremation, S-twined sea grass matting found with inhumation[d], and Haliotis fishhooks on surface.[b]
		2,120 (1990) 1,870 cal BP[a]	
		2,720 (2470) 2,350 cal BP[a]	
		2,790 (2730) 2,670 cal BP[a]	
SNI-55	Early	None	Clam disks, numerous Olivella barrel beads, and inlay beads.[c]
SNI-56	Early	None	Spire-lopped Olivella beads, fish gorges.[c] Haliotis fishhooks absent.[b]
SNI-170	Early	4,330 (4070) 3,830 cal BP[b]	
SNI-171	Early	4,280 (4040) 3,810 cal BP[b]	
SNI-214	Late	500 (310) 0 BP[b]	Dog burial[b]

[a] Schwartz and Martz 1992; [b] Martz unpublished 1998; [c] King 1990; [d] Bryan 1970; *Early and Late designations do not correlate with defined temporal divisions, such as King (1981).

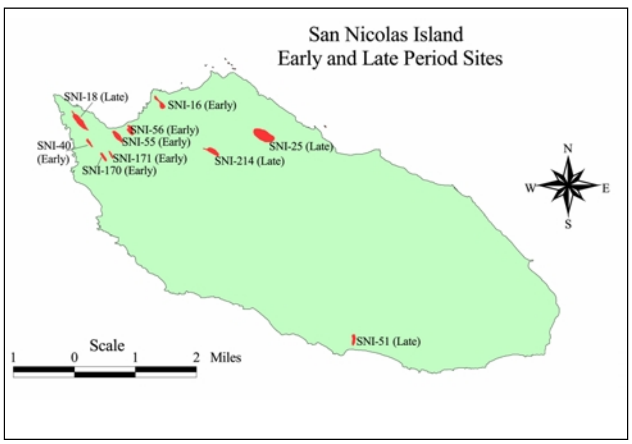

Figure 3. San Nicolas Island Early and Late Period Sites. Source: University of Arizona 1997.

the maximum cranial lengths are 192.75 mm (SNI-40) and 191.75 (SNI-56), in the range of the samples with greater cranial length.

Non-metric Data

Twenty-six non-metric traits were included in the full analysis (n=145 individuals). Chi-square tests were conducted on all traits, comparing early and late period sites. Late period sites had a low number of individuals and thus low cell counts for chi-square tests. In this case, comparing percentages of positive expression of each trait was more profitable.

Four traits revealed a high rate of difference between Early and Late sites: the presence of auditory exostosis (32% Early; 71% Late) and the congenital absence (hypodontia) of the mandibular third molar (20% Early; 50% Late) increase through time, while the persistence of a metopic suture (19% Early; 0% Late) and incomplete closure of the tympanic plate (tympanic dehiscence) (31% Early; 0% Late) both decrease through time (Table 6).

Table 4. Select maximum cranial lengths (mm) for Channel region sites.

Site	No. of Individuals	Mean (s.d.)	Min.	Max.
SNI-16	6	177.00 (8.16)	166.00	189.00
SNI-18	4	196.38 (9.01)	184.00	205.50
SNI-25	1	191.50 (0)	191.50	191.50
SNI-40	9	181.89 (7.32)	170.50	192.75
SNI-55	2	174.73 (1.06)	174.00	175.50
SNI-56	2	(11.49)	175.50	191.75
SNI-170	1	170.50 (0)	170.50	170.50
SNI-171	1	181.50 (0)	181.50	181.50
SNI-214	1	197.50 (0)	197.50	197.50
SCRI-3	77	179.89 (6.60)	157.00	190.00
SCRI-100	40	177.68 (5.67)	165.00	189.00
SCLI-1215	9	193.00 (7.36)	186.00	206.00

DISCUSSION

The genetic relationships of the people on the Southern Channel Islands of California are more complex than has been previously proposed. While there is clearly a difference in cranial lengths in peoples from different islands

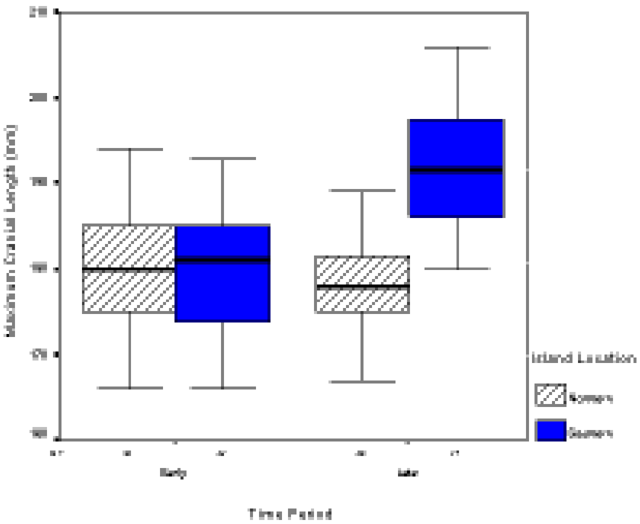

Figure 4. Mean maximum cranial length comparison for Early and Late Period sites on Northern and Southern Channel Islands.

Table 5. Temporal distribution of maximum cranial length (mm) on San Nicolas Island.

Time Designation	No. of Individuals	Mean	Min.	Max.
Early	22	179.49	166	192.75
Late	6	195.75	184	205.5

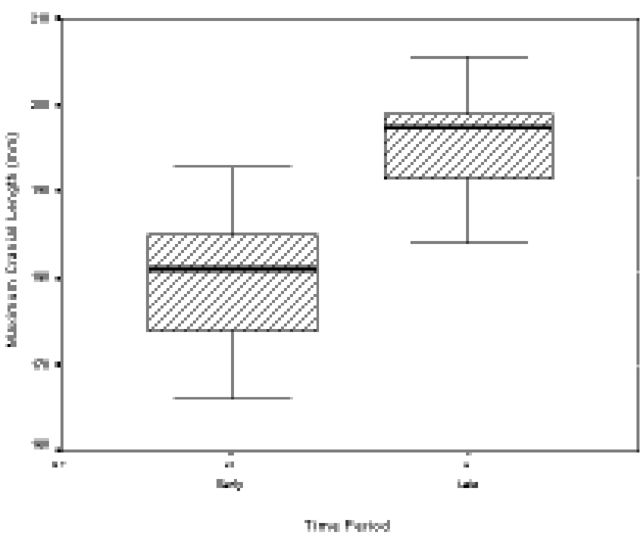

Figure 5. Mean maximum cranial lengths for Early and Late Periods on San Nicolas Island.

as well as on the same island through time, the possible mixing of people with very different cranial lengths in single sites limits our ability to distinguish between one population and another. These sites with mixed metric data may represent periods of time in which there was contemporaneous occupation by Hokan and Takic groups either as peaceful co-habitants, or during a period of hostile transition. Future research on evidence of violent behavior may reveal how peaceful the interactions of these groups truly were. Alternatively, multiple populations may have intermittently occupied the island.

The frequencies of certain non-metric traits which were used by Titus and Walker (1986) to show differences in behavior are more likely a result of different cultural and subsistence habits. The contrast between San Nicolas and the other islands and mainland may be explained by San Nicolas' isolation and unique environmental conditions.

Of the twenty-six non-metric traits included in this study, four showed notable differences in frequency through time. Suchey (1975) found the rate of tympanic dehiscence in prehistoric California populations to be variable, noting a significant drop in frequency from Early to Late Periods on Santa Cruz Island. The San Nicolas Island occupants appear to exhibit a similar pattern for this trait (Table 6). Metopism carries a low frequency in some prehistoric California populations (Suchey 1975, Titus and Walker 1986), but San Nicolas Island Early sites show a more notable frequency.

Congenital absence of the mandibular third molar falls within a suite of tooth morphologies referred to as hypodontia. Hypodontia of the mandibular third molar ranges from 10 to 35 percent in modern populations, and has shown a dominant inheritance pattern in prehistoric New World populations (Pindborg 1989). The San Nicolas data show a slightly higher frequency of cases of hypodontia in the Late sites compared to the Early sites, which could tentatively support the two-population hypothesis. The San Nicolas Island figures do fall within the expected modern range, but currently there are no data available for prehistoric occurrence of this trait on either the other islands or at mainland sites.

The genetic determination of exostoses of the auditory canal is high, but appears to require either chemical or mechanical causes to trigger the genesis of the bony tumor (Hauser and De Stefano 1989). DiBartolomeo (1979) treated modern day swimmers and surfers on the Santa Barbara coast and found that prolonged exposure to cold water was the probable catalyst for trait development. DiBartolomeo (1979), Kennedy (1986), and Frayer (1988) have found a positive correlation between cold water and the development of exostoses of the auditory canal. Due to the colder ocean currents around San Nicolas, Nicoleños diving for abalone (and perhaps fish) would have encountered water temperatures between 2 and 4 degrees F colder than their counterparts on Santa Cruz Island and the mainland (DiBartolomeo 1979) (Table 7).

Diving for the procurement of marine resources may explain the higher incidence of auditory exostoses on San Nicolas than on the other Channel Islands or the mainland. It is interesting to note that while we found an increase in this trait frequency over time, the pattern of this change is the opposite of Titus and Walker's 1986 findings on San Clemente Island. It may be that the Nicoleños were likely forced to rely more heavily that either their Northern or

Table 6. Early and Late Period occurrence of retention of metopic suture, mandibular hypodontia, tympanic dehiscence and auditory exostosis.

Time Designation	Site Number	Metopic Suture Retained	Third Mandibular Molar Hypodontia	Tympanic Dehiscence Present	Auditory Exostosis Present
Early	SNI-16	3 of 7	1 of 6[a]	3 of 7	2 of 7
Early	SNI-40	1 of 10[a]	2 of 9[a]	2 of 12	5 of 12
Early	SNI-55	0 of 1[a]	0 of 2	1 of 2	0 of 2
Early	SNI-56	0 of 3[a]	1 of 2[a]	1 of 4	1of 4
Early	SNI-171	N/A[b]	N/A[b]	1 of 1	
		% Positive for Trait	% Positive for Trait	% Positive for Trait	% Positive for Trait
Early		**19%**	**20%**	**31%**	**32%**
Late	SNI-18	N/A[b]	1 of 1	0 of 1[a]	4 of 5
Late	SNI-51	N/A[b]	N/A[b]	0 of 1	0 of 1
Late	SNI-214	0 of 1	0 of 1	0 of 1	1 of 1
		% Positive for Trait	% Positive for Trait	% Positive for Trait	% Positive for Trait
Late		**0%**	**50%**	**0%**	**71%**

[a]Skeletal elements missing from one or more burials in site sample

[b]Skeletal elements missing from all burials in site sample

Table 7. Occurrence of auditory exostosis on select islands and mainland.

Location	N Burials	Auditory Exostosis Present	%
San Nicolas	**115**	**34**	**30%**
San Clemente (SCLI-1215, 43B & 43C)	15	2	3%
Santa Cruz (SCRI-83, 100 & 3)	206	11	5%
Santa Rosa Island (SRI-2, 41, & 3)	203	4	2%
Santa Barbara (SBa-60 & SBa-52)	72	8	11%

Southern counterparts on marine foods for basic subsistence (Kerr, S.L. unpublished 1999).

The degree of genetic isolation can be used to determine if there is mixing of the original population and the intrusive one. Osteological analyses reveal that the occupants of San Nicolas Island exhibit features that are unique to the island, some of which may be the result of genetic isolation.

At present, the metric and non-metric data are not in full agreement as to the presence of two distinct genetic populations on San Nicolas Island. The non-metric data demonstrate inter-island genetic differences, and an Early-Late Period dichotomy for select traits. Metric cranial information does suggest a change in the cranial type from Early to Late periods, although some variability in these data makes it impossible to determine the exact timing of this replacement. Further, there is currently no statistically significant correlation between the metric and non-metric data that would lend additional support to the hypothesis of a prehistoric population change on San Nicolas Island. As with most ongoing archaeological research projects, additional data and better chronological resolution will further reveal the patterns of change on San Nicolas Island. Also, a planned series of mitochondrial DNA analyses will offer an independent test of both the cranial metrics and non-metrics as useful tools in determining genetic relationships of human populations.

ACKNOWLEDGMENTS

The authors would like to thank Phillip Walker for the generous donation of metric and non-metric data from the Northern Channel Islands. Thanks also go to our spouses Nelson Siefkin and Thomas Swan for their support during the process of research and publication.

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