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Patterns of paleomobility in the ancient Antilles: an isotopic approach
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CHAPTER 8 CONCLUSIONS

8.1 Introduction

In this final chapter, I present a summary of the most significant findings of this research project. Subsequently, I discuss the implications of these findings for our understanding of human mobility and migration in the circum-Caribbean with reference to specific models and ongoing debates within the archaeology of the region. This is followed by an assessment of the methodological approaches developed and employed for this research project. Lastly, I conclude by presenting some final thoughts concerning several of the more critical questions provoked by this study, and end this dissertation with a discussion of possible avenues for future research including specific suggestions on how to further develop and expand upon this research.

8.2 Biosphere Strontium Isotope Variation in the Caribbean

One of the most important outcomes of this research project is that there appears to be substantial spatial variation of biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ within and across the Caribbean region, indicating that it is possible to use strontium isotope analyses to infer past human migrations. This outcome may seem self-evident, especially based on the relatively diverse geological settings of the region and the fairly heterogeneous $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of geological materials in the Antilles. However, the relative contributions of bedrock weathering versus atmospheric sources to the Sr budgets of local terrestrial ecosystems and thus the nature of spatial variation of biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ in the Antillean biosphere were poorly understood before this study was conducted. The results of the biosphere mapping study have clearly demonstrated that despite highly variable and sometimes substantial contributions of atmospheric Sr to local terrestrial ecosystems in the Antilles,

bedrock weathering remains the primary source. As such, biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ in the Antilles is spatially variable although with considerable overlap in the ranges of $^{87}\text{Sr}/^{86}\text{Sr}$ ratios between some islands and regions.

8.3 Human Strontium Isotope Variation in the Caribbean

In general, there is a high degree of correspondence between the biosphere and human strontium isotope datasets, in terms of the range and dispersion of ratios, and their spatial patterning. The broad similarities between the two datasets are reflected at the scale of the entire region and at the scale of individual sites; although the absolute ranges of $^{87}\text{Sr}/^{86}\text{Sr}$ ratios are larger for the human Sr isotope results at both scales. In fact, the human strontium isotope results from the Caribbean display substantial inter- and intra-population variability but (similar to the biosphere data) with considerable overlap between certain populations. The relatively high degree of intra-population variability in human Sr isotope ratios and particularly the presence of extremely high or low $^{87}\text{Sr}/^{86}\text{Sr}$ ratios for certain individuals relative both to the main cluster(s) of human $^{87}\text{Sr}/^{86}\text{Sr}$ ratios and to the local range of biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, indicates the presence of nonlocals amongst all of the larger burial populations analyzed in this study. Additionally, several individuals possess $^{87}\text{Sr}/^{86}\text{Sr}$ ratios that are substantially elevated relative to the total range of biosphere variation for the Antilles, indicating non-Antillean (e.g., mainland) origins.

In total, 74 individuals out of a total of 360 human samples have been identified as nonlocal amongst the skeletal populations analyzed of this study. The absolute and proportional number of nonlocals is highly variable between the different populations of this study. These results suggest that long-distance or inter-island migrations were fairly common in the pre- and proto-historic periods of the Caribbean. Several caveats concerning this pattern merit further discussion. For most of the populations in this study, both local biosphere and human Sr isotope data were assessed to estimate the local range of $^{87}\text{Sr}/^{86}\text{Sr}$ and to identify nonlocals. For the sample populations for which there are a large number of samples with consistent and similar results, there is a higher degree of

confidence that the overall range of variation is reflected in the resulting dataset. For the sample populations for which available data are limited, the inclusion of future results could theoretically expand the estimated ranges of variation and thus the identification of certain individuals as locals or nonlocals. This is particularly possible for nonlocals with $^{87}\text{Sr}/^{86}\text{Sr}$ ratios that fall outside, but are not extremely different from, the estimated range of local isotope variation. In contrast, the inclusion of more data will not substantially alter the overall structure and pattern of the current dataset and would be unlikely to change the assessment of locality for the vast majority of individuals in this study. In other words, while it is important to note the possible existence of false positives amongst the individuals identified as nonlocals (i.e., the misidentification of locals as nonlocals), the possibility that there are a substantial number of false positives is somewhat unlikely.

Nonetheless, several specific interpretations and more general conclusions can be proposed both from the overall structure and patterning of the Sr isotope data for each population and through comparative analysis of residential (local/nonlocal) origins relative to other specific parameters such as biological sex, age at death, chronological age, grave goods, and dietary practices. These comparative analyses provide the opportunity to investigate some specific questions concerning patterns of human mobility and migration in the region, specifically in reference to the composition of migrant groups and by extension to the types of migration that may have occurred in the ancient Antilles. Analyses of these patterns also permit me to propose some possible relationships between (im)migrants and local groups, and provide the opportunity to offer some suggestions concerning the implications of these for extant models of migration and mobility in the Caribbean. Furthermore, the integration of multiple lines of evidence, including the structure and distribution of the isotope data presented herein, facilitates an exploration of the origins of certain nonlocal individuals within this study and in some cases specific areas of origin can be tentatively proposed.

8.4 Residential Origins and Biological Sex

Amongst the entire dataset, there are roughly equal numbers and proportions of female nonlocals and male nonlocals. Clearly both males and females were migrating to distant

communities. However, at smaller scales there are some potentially interesting trends within this general pattern. For example, there are proportionally more nonlocal males than nonlocal females amongst the (protohistoric) population from El Chorro de Maíta, Cuba and the percentage of nonlocal males is the highest in this study. In contrast, amongst the prehistoric populations in this study (i.e., not including El Chorro de Maíta) there are proportionally more nonlocal females than nonlocal males. This pattern was consistently observed amongst nearly all of the prehistoric populations in this study regardless of the wide variation in their spatial-temporal contexts.

There are multiple possible interpretations of these observed sex-based differences in the proportions of nonlocals. First of all, the observed pattern may simply indicate that multiple types of migration (e.g., cross-community migration; colonization; post-marital residential mobility) by migrant groups composed of both males and females were occurring amongst these populations. Alternatively, if the inferred patterns of residential mobility were primarily the result of post-marital residential relocation then it was not solely structured according to purely matrilineal or patrilineal rules of residence. At face value, this could be taken to provide tentative support for the existence of other forms of residence rules. For example, Keegan and Maclachlan (1989) [see also (Keegan 1991; Keegan et al. 1998)] have proposed that avunculocal residence patterning was characteristic of Taíno elites in the Greater Antilles. Such a system of residence would entail the migration of both males and females from their natal communities at different stages of their life courses and might account for the presence of both male and female nonlocals amongst the different populations in this study. Neil Whitehead has proposed a similar sentiment for the Island Carib and indigenous societies of the Caribbean more generally, "for the Carib, the social basis of chieftancy was the control and distribution of marriage partners. Among these other groups the creation of elite ruling lineages was engineered by the practice of an avunculocal residence rule and so possession of such a residence rule, where combined with evidence as to intermarriage, might be seen as defining a regional polity covering the whole Caribbean" (Whitehead 1995a:96).

The slightly higher proportions of females amongst most of the prehistoric populations studied herein may also indicate that at least in prehistoric times, females were the more mobile sex in terms of long-term or permanent relocation of residence.

One possible explanation for this pattern is that some of the nonlocal females represent captured brides and/or more generally patterns of long-distance, exogamous, marriage exchanges. In fact, the use of marriage exchange between distant communities in the circum-Caribbean region as a political phenomenon (e.g., in the development and maintenance of alliances) embedded within traditional kin-based social structures has been noted by a number of researchers (Boomert 2000; Helms 1988; Helms 1979; Keegan and Maclachlan 1989; Keegan et al. 1998; Whitehead 1995a). The contrasting pattern observed for El Chorro de Maíta, with higher proportions of nonlocal males relative to nonlocal females compared to the other populations, may indicate that the mechanisms and underlying causes of migration may differ for the population of this site relative to the others. Roberto Valcárcel Rojas has proposed that the settlement of El Chorro de Maíta may have been incorporated into the *encomienda* system of labor exploitation and management characteristic of the early colonial period in the West Indies (Valcárcel Rojas, 2012). If true, some of the nonlocals amongst this population may represent examples of forced migration. The observed pattern is consistent with the reported demographic structure of European and African migrating groups and colonies, which were heavily biased towards adult males particularly in the early decades of the colonization of the Caribbean (Sauer 1966).

In contrast, there is conflicting evidence concerning the demographic composition of migrant groups in general, and forced migrants in particular, within the early colonial period. For example, Sued Badillo has critically examined the extant literature on some of the documents pertaining to slave raids and auctions from this period and concluded that females and children were overrepresented amongst the large populations of Amerindian slaves that were brought to the Greater Antilles in the early decades of the Spanish colonization of the region. In particular he notes that "Three lists of captives sold at public auction are known and from its content the following facts can be established: first, that 90 percent of the captives were women and children, that 70 percent of these were natives of Puerto Rico found in Guadeloupe; and third, that they varied in ages from newborn babies to old women" (Sued Badillo 1995:82). Interestingly, one of the nonlocals from El Chorro de Maíta with proposed mainland origins (72B) is an adult female of Amerindian ancestry, while the only individual of African ancestry within

this population (45) is an adult male. Whether or not this is a reflection of a broader pattern of sex-biased migration, the various factors influencing the demographic composition of migrant and local groups and the changes that these underwent throughout the prehistoric era and into the colonial period clearly require more research.

In summary, despite some degree of inter-population differences, the burial populations analyzed for this study generally contain both local and nonlocal males and local and nonlocal females in similar but somewhat variable proportions. At this time, it is not possible, based on the Sr isotope results and the biological sex of these individuals, to determine which types of migration account for these observed patterns. However, some of the patterns concerning the age at death and dating (chronological age) of nonlocals presented in the following sections may shed some light on the likelihood and prevalence of different types of migration, and should permit some initial assessment of the size and composition of migrant groups, the timing of their arrival and, by consequence, the types of migration that best match these observed and inferred patterns.

8.5 Residential Origins and Age at Death

For the entire dataset, a clear correlation exists between natal origins and broad categories of age (adult versus subadult). One possible implication of this pattern is that migration may have been linked to life cycle, life course, or life history processes, including possibly marriage (i.e., if at least some of the nonlocals were exogamous marriage partners). This pattern matches the general pattern revealed through cross-cultural studies of migration, where adults are generally highly overrepresented amongst migrant groups (Manning 2005). In contrast, the identification of at least a few nonlocal juveniles probably indicates that some of the migrating groups may have been composed of families or other kin-based groups (Curet 2005). Migration occurring after marriage (post-marital or marriage-related migration) would be expected to occur at the scale of individuals, while the existence of migrant groups that include subadults (e.g., adults with their dependent children) is more characteristic of other types of migration (e.g., colonization, fissioning, or the cross-community migration of kin-based groups).

The general tendency for adults to be more mobile than subadults amongst the entire dataset also holds true at smaller scales. The differences between adults and subadults in terms of residential origins for most of the populations in this study are not statistically significant. However, this lack of significance at the scale of individual populations is probably the result of small population sizes. For example, the only population with a statistically significant difference in this regard is El Chorro de Maíta, which did not possess substantially larger proportions of nonlocal adults but is simply a larger sample population overall. An additional caveat concerning attempts to compare residential origins with age at death is that the age at migration remains an unknown factor. In other words, nonlocal adults could have migrated anytime after the mineralization of the sampled tooth. For most teeth analyzed in this study, this would roughly reflect infancy to middle childhood (~birth to 8 years of age). Thus it is not possible to determine (at least based on the analysis of a single element) the age(s) at which migration(s) occurred. In fact, even for the nonlocal adults identified in this study, migration could have occurred anytime between approximately middle childhood and death (or even post-mortem, see below).

Although it is difficult, based on demographic data alone, to determine the size and composition of migrating groups and hence to distinguish between different types of migration, the structure and patterning of the Sr isotope data are potentially insightful in this regard. For most of the populations of this study, the $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of nonlocal individuals were not only distinct from the local population but tended to be highly variable as a group. For example, some of the nonlocals possess $^{87}\text{Sr}/^{86}\text{Sr}$ ratios that were higher than the local range and others possess $^{87}\text{Sr}/^{86}\text{Sr}$ ratios that were lower. Furthermore, even amongst these migrants there was substantial heterogeneity of $^{87}\text{Sr}/^{86}\text{Sr}$ ratios that would preclude similar origins for all of the nonlocals at these sites. In other words, most nonlocals at each site appear to have rather diverse origins and even when nonlocals shared similar $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, and thus possibly similar foreign origins, these were generally few in number. Therefore, overall, the available evidence seems to be consistent with a general pattern of migration characterized more by the movement of individuals or relatively small migrant groups than by the movement of large migrant groups. This suggests that these migrations may have been the result of a combination of

different types of migration including possibly colonization and the cross-community of small groups but that they were likely dominated by the cross-community migration of individuals. These individuals were probably primarily adults migrating as settlers, itinerants, marriage partners, forced migrants, or a combination of these. The chronological evidence presented in the following section also lends some support to this interpretation.

8.6 Residential Origins and Chronological Age

There is a clear and statistically significant difference in the proportions of nonlocals dating to the Early and Late Ceramic Ages for the entire dataset as a whole. Specifically, the proportion of nonlocals was much larger during the Early Ceramic Age. In terms of assessing the chronology of migration(s) at the scale of specific populations, some differences between dating and natal origins were observed. Most notably, for the site of Maisabel, there is also a statistically significant difference between the proportions of nonlocals amongst the Early Ceramic Age and Late Ceramic Age populations. These differences clearly have potential implications for models and hypotheses concerning settlement histories, demography, and patterns of regional interaction at multiple scales (macro-regional and site-level).

At Maisabel, the larger proportions of nonlocals from the earlier component of the burial population would be consistent with the presence of initial colonists within this group or possibly longer migration distances during the early period. As very few of these nonlocals from the early period date to the initial occupation of the site, the latter interpretation is perhaps more likely. If so, this would be in agreement with proposed models of Early Ceramic Age (especially Saladoid) interaction, which was generally more regionally focused possibly owing to low population densities and more dispersed settlement patterns. In reference to the hypothesized transition from a more regional to a more localized focus of exchange systems throughout the course of the Ceramic Age in the Antilles, Boomert notes "While there is no reason to assume that during the Early Cedrosan epoch this system of ceremonial exchange encompassed the entire West Indies,

by the end of this era interaction waned, leading to lessening of the previously shared high degree of symbolic communication and, moreover, cessation of the long-distance trade patterns... In Late Cedrosan times trade and interaction took a somewhat less region-wide character, allowing the development of localized interaction spheres” (Boomert 2000:438) [see also (Hofman et al. 2007a; Hofman et al. 2011)]. Under such circumstances, larger migration and marriage distances, might be expected to result simply from relatively larger inter-village distances [see specific discussions in (Keegan and Maclachlan 1989; Keegan 2010; Oliver 2009)]. If patterns of marriage exchange and associated marriage-related mobility were even partly conditioned by demographic factors (Moore 1991), then it would not be overly surprising to find fewer migrants (nonlocals) with less diverse origins amongst populations from later periods. Nonetheless, explorations for both the temporal trend noted for Maisabel and the general lack of such a trend at other sites spanning this time period (e.g., Tutu) clearly merit further research.

As discussed above, except for Maisabel, there is little chronological clustering of nonlocals at each site. This lack of clustering also has implications concerning the possible size and composition of migrating groups and the nature of relationships between donor, migrant, and local communities. For example, in the previous section, I noted that the generally low proportions of nonlocal subadults and the relatively high variance of Sr isotope signals amongst nonlocals did not support a pattern of migration characterized by the movement of larger migrant groups (e.g., colonization or village fissioning). The general lack of chronological clustering, particularly amongst nonlocal individuals with similar $^{87}\text{Sr}/^{86}\text{Sr}$ ratios, would seem to be the final piece of evidence enabling the refutation of the idea that migrant groups of substantial size characterized patterns of migration in the prehistoric Caribbean (at least for the populations included in this study). In other words, the combination of the strontium isotope results (namely the variance and dispersion of $^{87}\text{Sr}/^{86}\text{Sr}$ ratios amongst nonlocals), with demographic and chronological evidence is much more consistent with an overall pattern of migration characterized by the movement of individuals (or very small groups) from disparate origins, arriving to the sites in question over several generations or centuries (i.e., a ‘trickle model’ of prehistoric migration in the ancient Antilles).

To summarize, the overall lack of chronological clustering amongst nonlocals in general suggests that the individuals identified as migrants (amongst each population) do not represent a single episode or event of migration such as the contemporaneous arrival of a colonizing group. The totality of the available evidence seems to indicate that for the most part migrating groups were relatively small and that migration flows can be characterized more as ‘trickles’ than ‘waves’ or even ‘streams’ [see also (Bright 2003)]. Based on the available demographic information, the living (contemporaneous) population(s) of the sites in this study must have been fairly modest (tens, not hundreds, of individual residents). As such, if migrants were spread out over many generations, at most only a few individuals of every generation probably had nonlocal (or foreign) natal origins. Given the relatively small population sizes, the origins of individuals (both local and nonlocal) were probably widely known to most if not all members of the resident community. If so, this has implications for the observed correlations between the origins of specific nonlocals and the associated material remains of their burial contexts, as discussed in the following section.

8.7 Residential Origins and Grave Goods

In general, there are no clear correlations between natal residence and the *presence or absence* of grave goods as noted in the previous chapter. However, there are some very intriguing correlations between nonlocal residence and certain *types* of grave goods, especially at the site of Anse à la Gourde, and to a lesser extent at Manzanilla and El Chorro de Maíta. One possible interpretation of this pattern is that specific foreign materials and/or objects were purposefully interred with nonlocal residents. Interestingly, there also appears to be some tentative evidence for the opposite pattern at the site of Anse à la Gourde, where ceramic vessels placed over the face or upper torso of the deceased are almost exclusively associated with local individuals. There are multiple implications of these patterns in reference to the treatment of nonlocals vis-à-vis locals [see also (Hoogland et al. 2010)]. For example, it is possible that local individuals may have been purposely interred with pottery vessels if these objects were associated with

specific crafts or wares of local production, a hypothesis that could be further tested through characterization and sourcing of these specific vessels [see e.g., (Isendoorn et al. 2008) for relevant research in this vein].

The association between specific types of nonlocal materials or artifacts may also symbolize nonlocal origins via associations with specific markers of supralocal status [*sensu* (Peebles and Kus 1977)] or alternatively to more general associations with the far-away, distant, exotic, or esoteric [*sensu* (Helms 1988; Helms 1979); see also (Boomert 2000; Mol 2007) on the roles of primitive valuables in the ancient Caribbean]. The fact that females are primarily associated with exotic grave goods is very interesting and may reflect the role of "women as producers and distributors of high status goods" (Keegan and Maclachlan 1989:91) [see also discussions in (Las Casas 1951; Oliver 2009)] as observed for the Taíno in the contact period. The unique roles of females in Amerindian societies of this region, in terms of their activities concerning mediations between the local and nonlocal, both in the natural and supernatural worlds, may also be reflected in their representations in 'female figurines' that have been documented in a wide variety of contexts in this region during the Late Ceramic Age (Bright 2011; Bullen and Bullen 1970; Hofman and Branford 2011). In reference to the possible position of women amongst Amerindians of the circum-Caribbean, Neil Whitehead notes "Participation in such a [sic] Arawakan macro-polity is also reflected in regard of women's status within an avunculocal marriage system. Such a post-marriage residence rule is held to produce, as it did among the Iroquois, female chiefs or situations where 'clan-mothers' have considerable power, as in the disposal of war captives" (Whitehead 1995a:99).

In terms of other aspects of mortuary treatment, no significant correlations were found between residential origins and burial type (primary/secondary) or burial orientation. Several other lines of evidence would seem to further diminish the possibility that there were systematic differences in the overall mortuary treatment of locals versus nonlocals (with the exception of the types of associated grave goods just discussed). First, preliminary demographic data seems to indicate that the burial populations are most likely not representative of living populations. This is evidenced most clearly by the general absence or under-representation of infants and young juveniles amongst most of the populations in this study. Thus at least some members of the larger community,

namely the very young, seem to have frequently received differential treatment in death in terms of the location of their interment. Hoogland (2010) has proposed that this may reflect a different social status for children amongst Amerindian societies of the region. However, the presence of nonlocals within most of the burial populations studied herein provides evidence that a nonlocal natal origin did not preclude burial in the same spatial context as locally-born individuals. Furthermore, many of the nonlocals were buried not only in very close spatial proximity to locals but they were also generally received similar mortuary treatments in terms of burial type, positioning and orientation. However, this overall lack of patterning at the group level may be somewhat misleading, as the Sr isotope evidence seems to clearly indicate that at least for some of the populations in this study the nonlocal individuals possess diverse origins and thus probably should not be pooled into a single group. In fact, patterning between mobility (and origins more specifically) and mortuary treatment, at least in terms of types of grave goods (and their origins), is most apparent at the scale of specific individuals. The similarities in the origins of specific grave goods and the possible origins of the nonlocals with which they are interred are probably not coincidental but the specific mechanisms or processes conditioning such patterning are difficult to assess. The foreign objects and materials found in association with specific nonlocals may be personal possessions (for example brought with them when they migrated); symbols representing their association(s) with specific (and possibly well known) distant locations; general symbols of their status as nonlocals, immigrants, or foreigners; objectification of their status as possessors of esoteric knowledge of distant lands or peoples; and/or material manifestations of social relationships or interactions with other groups, just to name a few (non-mutually exclusive) possibilities.

8.8 Residential Origins and Dietary Practices

The spatial patterning of human collagen carbon and nitrogen isotope values in the Antilles is probably at least partially reflective of biogeographic principles in terms of differential resource availability related to local geographic and ecological conditions

(Stokes 1998). In the Antilles, there is clear spatial structure and patterning of human dietary practices, especially in terms of protein sources and the relative contribution of marine versus terrestrial protein. In general, populations from the smaller islands of the Lesser Antilles and Bahamas have elevated carbon and nitrogen (collagen) values relative to populations from the larger islands of the Greater Antilles (de Vos 2010; Keegan and DeNiro 1988; Laffoon and de Vos 2011; Norr 2002; Pestle 2010; Stokes 1998, 2005). These inter-population differences are distinct with relatively little overlap in the dispersion of these isotope ranges (at 1 sigma).

At the scale of site populations, systematic differences between locals and nonlocals in terms of overall dietary practices was most clear for Maisabel, where nonlocals as a group have a statistically significantly lower mean $\delta^{15}\text{N}$ (~1%) than locals. Chronological differences cannot account for this pattern as there are more nonlocals amongst the early group and yet the early group is characterized by higher (not lower) mean $\delta^{15}\text{N}$ values. However, the possible causes of this correlation are unclear at present as these may simply indicate that nonlocals retained distinct dietary practices after migration. An alternative, but not mutually exclusive, hypothesis is that at least some of the nonlocals originated from regions with distinct dietary patterns and that the isotopic composition of their bones had not yet equilibrated to the 'local' dietary pattern.

At the scale of pooled groups (locals and nonlocals), there are little or no systematic differences for most of the other populations in this study (with the exception of Maisabel). There are multiple possible interpretations of the lack of such a pattern, including that most of the nonlocals either originated from a region with similar dietary practices or that they had resided amongst the local population long enough for their bone values to isotopically equilibrate to the local pattern. However, at the scale of individuals, for the three populations for which we have extensive dietary isotope data, the most distinctive and extreme carbon and nitrogen isotope values are more common amongst nonlocal individuals. Based on this premise, the geographic origins of certain nonlocal individuals could potentially be explored based on comparisons of their distinctive carbon and isotope values with the range of published dietary isotope values for different sites and islands within the Caribbean.

If this overall pattern is also characteristic of other populations of the region, then it is possible that intra-site (population) variation in dietary practices in the prehistoric Antilles is more homogenous, and inter-site (population) differences more distinct, than previously recognized. In other words, it might be possible to establish the existence of one of the basic tenets of the ‘provenance postulate’, namely that differences between sources exceed the variation within them (Weigand et al. 1977). The implication of this proposed scenario is that carbon and nitrogen isotope data may also be very useful for human provenance studies by permitting assessments of individual geographic origins, in addition to their traditional use for dietary reconstructions, as has already been demonstrated for colonial period populations in the Antilles (Schroeder et al. 2009) [see also (Sparkes et al. in press)] and has been suggested for prehistoric populations as well (Pestle 2010:350).

8.9 Multiple Isotopes and Individual Origins

The main findings of the carbon and oxygen isotope analyses are summarized in this section. With the exception of a few outliers, $\delta^{18}\text{O}_{\text{ca}}$ values display limited variability and a large degree of overlap in $\delta^{18}\text{O}_{\text{ca}}$ values between different islands. The overall pattern of limited intra-Caribbean variation in enamel $\delta^{18}\text{O}$ may indicate that oxygen isotope data may be of limited utility for tracking intra-Antillean mobility. However, our understanding of oxygen isotope variation within human skeletal tissues in the Caribbean is still in its infancy and will require additional research on larger sample populations from different regions to determine if the initial lack of spatial patterning revealed by this study holds true at larger scales.

Most $\delta^{13}\text{C}$ values reported herein also display limited variability, indicating relatively modest levels of C_4 consumption overall and relatively limited spatial patterning of $\delta^{13}\text{C}$ values with the possible exception of Manzanilla, Trinidad. Several individuals from Manzanilla possess slightly elevated $\delta^{13}\text{C}$ values indicating a somewhat greater reliance on either marine protein sources or C_4 plant resources (or both) relative to other Antillean populations. The ranges of enamel $\delta^{13}\text{C}_{\text{ca}}$ in this study were also generally

in good agreement with previously published bone $\delta^{13}\text{C}_{\text{ap}}$ from the Antilles. For a small number of individuals it was possible to make direct comparisons between enamel and bone $^{13}\text{C}_{\text{ca}}$ values. In general these results are fairly similar with most individuals possessing enamel (childhood) and bone (adult) $^{13}\text{C}_{\text{ap}}$ values that are within ~2% of each other. However, a few individuals possess much larger differences between their bone and enamel $\delta^{13}\text{C}_{\text{ap}}$ values. For a few of these nonlocals this difference is larger than what could be explained simply by age-related changes to diet and thus might indicate migration from an area with distinct dietary practices. As a corollary, this may also tentatively indicate a substantial period of local residence during which the bone values equilibrated to the local dietary pattern.

The preliminary oxygen and carbon isotope results additionally seem to indicate that in certain cases these may be successfully employed in the identification of extra-Antillean migrants and the investigation of their possible origins. The strongest case in this regard pertains to three individuals from the site of El Chorro de Maíta, Cuba that are depleted in $\delta^{18}\text{O}_{\text{ca}}$ and enriched in $\delta^{13}\text{C}_{\text{ca}}$ relative to local Caribbean populations. The $\delta^{18}\text{O}$ signals of two of these individuals (CM72B and CM45) are more consistent with foreign origins than with Antillean origin(s). The extremely high (less negative) $\delta^{13}\text{C}$ values of these two individuals (which are two of the highest $\delta^{13}\text{C}_{\text{ca}}$ values recorded to date for this region) probably indicate a much greater reliance on C_4 resources than is the case for indigenous Antillean populations. Specifically, the very high $\delta^{13}\text{C}_{\text{ca}}$ value of CM72B is more similar to published $\delta^{13}\text{C}_{\text{ca}}$ values from Mesoamerican populations and is consistent with an origin from a region where maize was a staple crop and a primary source of dietary carbon, for example amongst the ancient Maya (Johannessen and Hasdorf 1994). The highly elevated $\delta^{13}\text{C}_{\text{ca}}$ value of individual CM45 on the other hand is enriched in ^{13}C relative to published $\delta^{13}\text{C}_{\text{ca}}$ of African born slaves from a Caribbean cemetery population in Barbados (Schroeder et al. 2009), and most likely reflects an origin from a region of West Africa where C_4 plants, such as millet or sorghum, were traditional staple crops. In both cases, comparisons of these individuals' $^{87}\text{Sr}/^{86}\text{Sr}$, $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ signatures with published isotope results from Mesoamerican and African-born populations permit more nuanced explorations of their natal origins.

8.10 Summary and Implications of Main Findings

In a recent critical review of interaction studies in Caribbean archaeology, and more specifically concerning migration studies, Curet noted that "the use of the concept of migration tends to be very superficial and normally simply involves the movement of people. At best some speculative discussion about the reasons of migration is included in the discourse. Most of the time arguments shine for the lack of details on the type of migration, who migrated, the steps involved in the process of migration, and the relationship between the parent, migrant, and local communities" (Curet and Hauser 2011:7). In the course of this chapter, I have attempted to address this poignant and timely critique, although the extent to which certain details could be explored was highly variable.

In some cases, I have been able to address some of these concerns and propose tentative (and in some cases admittedly speculative) interpretations. For example, in regard to who migrated (e.g., the size and composition of migrating groups) I have proposed that the totality of evidence is more consistent with the migration of individuals or very small migrant groups. I have also proposed certain types of migrations that would be most amenable to the inferred patterns of migrations, particularly in light of who migrated as these two topics (e.g., who migrated and the types of migration) are inextricably intertwined. In particular, I have suggested that the broad-scale pattern of human migrations identified in this study is probably more consistent with a combination of different types of migration, characterized primarily by multiple cross-community migrations of individuals occurring over long periods of time. Of the different types of cross-community migrants proposed by Patrick Manning, the migrants identified in this study probably comprise a mixture of colonists, sojourners, itinerants, and settlers with a particular emphasis on the latter, i.e., "those who move to join an existing community that is different from their own, with the intention of remaining at their destination" (Manning 2005:9).

Despite a few notable exceptions discussed in the previous sections, the overall pattern for most site populations is of a lack of statistically significant differences

between local and nonlocal *groups* in terms of demography, dating, burial practices, or dietary patterns. The absence of systematic differences at this scale is most likely the result of pooling individuals of diverse origins into a single category (nonlocals or locals) and indicates that the individual is probably the more appropriate unit of analysis. In other words, the general lack of correlations probably arises primarily from treating nonlocals for example as a coherent and unit of analysis, which may not be appropriate considering the multiple lines of evidence indicating diverse origins for many nonlocals even within a single burial population. This point may be equally valid for local populations which are potentially more heterogeneous than the Sr isotope results indicate owing to the possible presence of false negatives (i.e., nonlocals possessing similar Sr isotope ratios as the local population) amongst the isotopically local groups, as previously discussed. As such, it is perhaps not overly surprising that at least some of the individuals identified as nonlocal within this study are highly diverse, and in some cases as different from each other as they are from the local population(s) with whom they were ultimately interred (in terms of diet, chronology, and grave goods).

In summary, all of the larger sample populations studied herein contained individuals with nonlocal origins, and in most cases these nonlocal individuals possess relatively variable Sr isotope signals indicating potentially diverse origins. In fact, the general lack of correlation between origins and certain other variables further illustrates the relatively high degree of variation at the individual level. This suggests the presence of plural communities comprised of complex combinations of locally-born individuals and individuals with diverse nonlocal origins amongst the populations of the prehistoric and protohistoric Caribbean region. In some cases, it was possible to explore the possible origins of nonlocals based on a wide variety of evidence. These patterns indicate that migration most likely occurred at multiple scales ranging from intra-island; inter-island; inter-archipelagic, and Mainland-Antillean (possibly including individual origins from the Guiana Shield Region, the Venezuelan littoral, lowland Mesoamerica, and West Africa).

Thus, the high degree of cultural and social diversity or plurality that has been previously noted as a possible characteristic of indigenous peoples of the Caribbean (Whitehead 1995a; Wilson 1993, 2001) may also extend to smaller scales, such that even local communities were comprised of an eclectic mix of locally born residents, and

nonlocally born residents who migrated from near and far, and ultimately resided (or at least were interred) in the same settlement or village. The diversity of origins revealed via isotope analysis may reflect the existence of diverse communities in general, which would be consistent with Heckenberger's (Heckenberger 2005:61) characterization of Xinguano (and by extension Arawak) *habitus* "predisposed to reproduce... regional integration (particularly coupled with a social preoccupation with exchange and a cultural aesthetic that places great symbolic value upon foreign things including not only objects, but also relationships, names, songs, dances, among other esoteric knowledge) and a foreign policy commonly characterized by *accommodation and acculturation of outsiders*" [emphasis mine].

Here, I take the opportunity to make several suggestions concerning the possible steps involved in the process of migration and the potential relationships between parent and local communities. In the majority of cases, the Sr isotope ratios of nonlocal individuals are consistent with (although not definitive of) natal origins within the same region or same island as the local populations. For a relatively small number of nonlocals the Sr isotope results indicate extra-insular origins, in that they fall well outside the range of biosphere Sr ratios for the island in question. For a few individuals (two or three from Cuba, one from Trinidad, and possibly one from Aruba) multiple lines of evidence point to likely non-Antillean origins.

In reference to extra-insular (and of course extra-Antillean) origins, migration process must have included travel over open seas, thus necessitating the possession or at least the use of watercraft (and the requisite knowledge of seafaring) as a means of transportation. Possibly, many of the intra-insular migrations may have also utilized watercraft as well, as travel via inland waterways (streams and rivers) and along coasts may have been faster and easier than overland travel in much of the Antilles, particularly in regions with rugged terrain. Some of the types of watercraft used for inter-insular voyages may have been fairly large (Bérard et al. 2011; Callaghan 1993, 1995, 1999; Keegan 1985, 1992), requiring the cooperative efforts of a substantial number of rowers to successfully navigate on open seas. This possibility raises certain questions concerning the size of migrating groups relative to the size of the groups required to operate such vessels. For example, if larger vessels were the sole or primary means of inter-island

voyaging then it may not have been possible for smaller migrant groups (such as households, nuclear families, or individuals) to independently decide to migrate in the absence of the cooperation of others. In reference to possible political aspects of emigration, Curet (2005:53) has proposed that “people can vote with their feet”. Although certainly true to some extent, the distance that such a vote can take someone on a small island is somewhat limited and migrations over longer distances requiring sea voyaging might necessitate that ‘people vote with their paddle’. If larger vessels were being used, this would also require the collaboration of larger groups of people and perhaps even the tacit approval and cooperation of elites or members of society with direct access to, or control of, transportation technologies and associated knowledge. In other words, the social logistics and political implications of ancient seafaring in the Caribbean have yet to be fully explored and represent topics deserving of increased research attention [see for example the work of (Altschul and Grenda 2002) in the Channel Islands of southern California].

In reference to relationships of interaction between parent and local communities, if, as I have proposed, most of the migrants identified in this study represent cases of individuals or small groups immigrating into extant communities (e.g., the cross-community migration of settlers, *sensu* Manning), this would presuppose an existing relationship between the parent and local communities based on current anthropological theories on migration. As previously discussed (in chapter two), cross-cultural studies of contemporary cases of migration indicate that people rarely, if ever, migrate to places of which they have no preexisting knowledge (Duff 1998) except possibly in extreme cases of refugees. As such, it is likely that there was some degree or form of social interaction (and direct or indirect knowledge) between parent and local communities prior to migration between them. There may, in fact, be some evidence to support this contention for several of the populations in this study (e.g., the consistency between possible natal origins and the origins of specific grave goods).

There are numerous archaeological implications of these inferred patterns of migration, and the widespread presence of nonlocally born individuals within prehistoric communities of the Caribbean more specifically that are beyond the scope of this dissertation [see e.g., (Curet and Hauser 2011b; Curet 2005; Hofman et al. 2011)]. For

example, there are some indications that migrations had an impact on the migrants themselves in terms of adaptation to, or learning of, different dietary, environmental, and perhaps most importantly, social contexts (Rockman and Steele 2003). The arrival of migrants, whether as individuals or groups, also has obvious demographic consequences for both parent and local communities. An example of this is well illustrated by Alistair Bright who noted in reference to Windward Island communities “In this sense, idiosyncratic processes, such as the character of individual immigrants and/or the composition of small migratory groups could have had large seemingly random effects on the composition and diversity of various material culture assemblages throughout the islandscape” (Bright 2011:231). Thus, the potential cultural, material, social, political, economic, and demographic consequences and implications of the migrations discussed herein are many and varied and will require much additional future research to disentangle.

8.11 Methodological Assessment

In this section, I take the opportunity to briefly evaluate four aspects of the methodological approach taken in this study, namely: sample sizes, biosphere mapping, analytical precision, and contextual information. First, in terms of sample sizes, we attempted to include as many individuals as possible for the skeletal populations sampled in this study. This intensive sampling strategy permitted the exploration of patterns of mobility for as much of the burial population(s) as possible and allowed us to avoid extrapolating broader patterns based on a relatively few number of samples from each site (Pestle 2010). This is a potentially important consideration, as partial sampling of site populations could potentially miss a small number of individuals with distinct Sr isotope ratios. As a whole, the human Sr isotope dataset generated for the present work represents one of the largest databases of its kind worldwide and has substantially increased our understanding of human Sr isotope variation in the Caribbean Region.

Second, in terms of the biosphere mapping project (Laffoon et al. 2012a), the overall correspondence between the human and biosphere Sr isotope datasets both as a

whole and at the site scale; the degree of spatial variation within the biosphere data; and the lack of correspondence between the geological and biosphere data for some locations and regions have certainly validated the enormous investment of time, energy, and resources invested in this endeavor. In many cases, the interpretation of the human Sr isotope data would not have been possible without the associated biosphere Sr data and in more than a few cases, a reliance on published geological Sr isotope data would have led to different (and apparently incorrect) interpretations and conclusions. Additionally, it could be argued that this aspect of the project has the greatest potential for a broader scientific impact from the perspective that the generated database is potentially useful for a broad array of different types of provenance studies in the region. These include not only implications within the field of archaeology, but also to studies of animal migration, environmental patterns and processes, and even forensic applications.

Third, in terms of analytical precision, the strontium isotope measurements obtained via TIMS have extremely low standard errors relative to the inter-individual, and intra- and inter-population variance of our sample populations. This provides some reassurance that the observed variation is 'real' and not simply an artifact of the analytical method employed. In fact, the small standard errors for individual sample measurements are essentially invisible at the scale of most of the figures included in the present work. Additionally, the relatively low standard deviation of repeat measurements of the international reference standard and the small differences obtained for repeat measurements of a small subset of the samples provide further indications of the overall consistency and reproducibility of the results presented herein. In other words, the extra investment of time required by TIMS measurements (versus other methods) were justified by the greater degree of confidence that can be placed upon the obtained results.

Lastly, our sampling design primarily focused on human skeletal populations for which a broad array of relevant, contextual, archaeological data was available. Nonetheless, there is a high degree of variation in the availability of this information across the different assemblages of this study. It became evident throughout the course of this work that the possibility of deriving nuanced and contextualized interpretations, and drawing inferences more generally, was highly dependent on the quality and quantity of this data. The extent or degree to which possible geographic origins could be explored,

and interpretations of patterns of migration proposed, generally co-varied with the amount and degree of detailed information available for the sample populations, and in particular with the availability of relevant data at the scale of individuals. Investigations of possible origins clearly benefited in cases where different lines of evidence (mortuary, osteological, and multiple isotope data) could be integrated. In contrast, these explorations were fairly limited in cases where such data were sparse or unavailable. Nonetheless, the isotope results from the smaller sample populations, for which relatively little contextual data exist provide an important contribution to the development of baseline human strontium isotope variation for this region. I have also included the results from these smaller populations in the present work not only for the sake of general assessments of Sr isotope variation in the region but also in the hope that the acquisition of relevant contextual information in the future may permit a more thorough appraisal of these data.

8.12 Future Research Directions

I conclude this final chapter by offering some proposals for future research directions. In reference to the spatial mapping of biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ for the circum-Caribbean region, two direct actions can be taken to substantially improve upon the work generated in the course of this study. First, spatial coverage should be greatly expanded in the Antilles themselves. This will require extensive collection and analysis of biosphere samples, particularly from regions and islands that were not included in this study (for example in the northwestern Antilles). Additionally, while fairly robust databases and maps of biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ now exist for much of the Antilles and Mesoamerica, the spatial variation of biosphere $^{87}\text{Sr}/^{86}\text{Sr}$ in most of Central America and northern South America is still poorly understood. Furthermore, the development and testing of models of spatial variation of $^{87}\text{Sr}/^{86}\text{Sr}$ in circum-Caribbean ecosystems that explicitly incorporate multiple sources of strontium to local environments provide the opportunity to improve our understanding of the various parameters influencing the variation of $^{87}\text{Sr}/^{86}\text{Sr}$ in the

biosphere and our ability to predict this variation based on these principles (Bataille and Bowen 2012; Bataille et al. in press).

In reference to obtaining more human isotope data from Antillean contexts, not only of strontium but also of other isotope systems (particularly oxygen but also carbon and nitrogen), some initial proposals can be put forward. First, isotope studies would greatly benefit from expanded temporal coverage. The results generated from this study are heavily biased to the Late Ceramic Age while later (protohistoric and colonial) and earlier (Early Ceramic Age and Archaic) contexts are under- or unrepresented. To date, only a few isotope studies have been conducted on protohistoric and colonial contexts in the Antilles [for notable exceptions see (Laffoon et al. 2012b; Schroeder et al. 2009; Sparkes et al. in press; Varney 2003, 2007)]. This is somewhat surprising, as the current evidence would seem to suggest that these are the very contexts that would be most amenable to study via isotope methods given the known high variability in the geographic origins of migrants during these time periods, the potentially large differences in dietary practices both between the different regions of origin and between them and local Antillean populations, and the proposed rapid changes to Caribbean ecosystems and foodways associated with the Columbian Exchange (Crosby 2003; Mann 2011; Valcárcel Rojas et al. 2011). Second, to date, skeletal populations from the Antilles that have been analyzed for strontium isotopes are also somewhat unequally distributed spatially. This study represents the first application of this method for most of the islands of the Antilles and many of the islands remain unstudied in this regard.

One recommendation that our research group has already initiated is the analyses of these skeletal collections for non-metric dental traits. Such data are possibly informative of the morphological variation within and between prehistoric populations of the Antilles and thus can be used, in conjunction with isotope data, to assess the biological ancestry of nonlocals with proposed long-distance origins. In fact, previous biodistance studies in this region have revealed a considerable degree of phenotypic heterogeneity amongst the indigenous populations of the Caribbean (Coppa et al. 2008; Ross 2004).

The feasibility of using multiple isotopes, other than strontium, for human provenance studies in the Caribbean formed an explicit component of this research

project. Specifically, the preliminary dataset of oxygen isotopes indicates that they may be particularly useful for identifying long-distance migrants originating from outside of this region (Laffoon et al. 2012b). The high degree of spatial clustering of bone stable isotope values and the relatively distinct dietary patterns amongst many of the nonlocal individuals identified in this study seem to indicate the substantial, and largely unexplored, potential of carbon and nitrogen isotope systems for human mobility and provenance studies in the Caribbean region. Several other isotope systems, including lead (Pb) and sulphur (S) also offer much unexplored potential for both paleomobility and provenance studies in this region.

One of the many questions raised by the present study is the timing or age at which migration(s) occurred within the lifetime of a nonlocal individual. More refined estimates of the age(s) at which migration occurred should be possible based on multiple isotope analyses and serial sampling of different skeletal elements from the same individual, for example by comparing an earlier (M1) and later forming tooth (M3). A pilot project utilizing this approach has been initiated and by focusing on individuals that have already been identified as nonlocals (as part of this study) enables time and resources to be used most efficiently.

Lastly, a large number of teeth from larger animals, particularly animal tooth pendants of exotic or non-endemic species, were analyzed in conjunction with the research project presented in this study. The isotope results from this pilot project have shown great promise not only for identifying nonlocal faunal remains and for examining the geographic origins of these social valuables (teeth pendants) but also for inferring patterns of exchange and trade within and between the prehistoric island and mainland communities of the circum- Caribbean region and beyond (Laffoon et al. in prep).

On a final note, throughout the course of conducting this study and presenting the preliminary results to audiences in the Caribbean and beyond, I have been more than gratified by the degree of enthusiasm and the lively discussions generated by this research. I sincerely hope that I have demonstrated some of the potentials and pitfalls of applying isotope analyses to the study of ancient human migrations in the Caribbean, and that this work has provided some insights into the histories of individuals that once inhabited the ancient Antilles.