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PALEODEMOGRAPHIC RECONSTRUCTION OF THE PRE-COLUMBIAN POPULATION OF GUANAHANÍ (SAN SALVADOR, BAHAMAS)

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ABSTRACT

In addition to the contentious debate regarding the identity of the true Columbus landfall island, scholars also dispute the population size of Guanahaní (San Salvador), with two camps divided into the "low estimate" school (e.g., Hoffman, Kelley, et al.) and the "high estimate" school (e.g., Craton and Saunders, Pickering, et al.). The low estimate school favors a population for Guanahaní in the 500-1000 range, while the high estimate school favors figures between 2000-5700. When examined, the Bahamas consist of ca. 14,183 sq km (ca. 5476 sq miles) with some 390+ prehistoric archaeological sites and approximately 111 cave sites. If the archaeological sites represent habitation sites or villages, then the pre-Columbian population of the Bahamas is estimated to have been ca. 46,000-88,000 people with a population density of between 3.30-6.19 persons per sq km (8.5-16.0 persons per sq mile). These population densities suggest that San Salvador, with ca. 94 sq km of land area, would have had a relatively small prehistoric population of ca. 310-582 people. Population models using modern growth rates of 1.2% to 3.0% per annum indicate modern population growth rates are too high to model prehistoric population growth on San Salvador. More modest population growth rates, such as 0.50% to 0.55% per annum or a population doubling every 100 years, are postulated as more appropriate for an island the size of San Salvador. Using population densities of horticultural and island peoples from the Caribbean, Atlantic, Pacific, and tropical forests of South America, the population of San Salvador is estimated to have been ca. 701-1140 people. Estimates based on the number and sizes of archaeological sites on San Salvador, including the number of houses and persons per house, suggest a pre-Columbian population for San Salvador in the 995-1194 range. When all these calculations are averaged, a figure of ca. 1006 people is estimated for San Salvador. The prehistoric population estimates presented in this research, therefore, are more in line with the findings of the "low estimate" school, and with modern Bahamian census data, than with the calculations of the "high estimate" school which appear to be based on erroneous assumptions regarding the population of the Pigeon Creek archaeological site. The ca. 46,000-88,000 Lucayans, including the ca. 1000 inhabitants of Guanahaní, appear to have been forced into extinction by A.D. 1513 due to Spanish slave raiding expeditions into the Lucayan Isles. However, recent AMS (radiometric) dates from North Storr's Lake (SS-4) on San Salvador suggest that a small Lucayan population may have persisted on San Salvador possibly into the early-to-mid 1500s (ca. 1523-1552).

INTRODUCTION

Since the arrival of Columbus on Guanahaní in October of 1492, the exact island of that historic landfall has been debated in the literature for literally hundreds of years. Archaeological findings by Charles Hoffman (1987a, 1987b) in the 1980s, and interpretations of those artifacts by Robert Brill et al. of the Corning Museum of Glass (1987, Brill and Hoffman 1987, Brill 1988, Brill 2005, Bead Study Trust 1990), have led to a general acceptance that Columbus's "Guanahaní" is indeed today's San Salvador, Bahamas (e.g.,

Keegan 1992, Kelley 1991), although vocal disputants to this claim still remain (e.g., Judge 1986, Pickering 1997). Visual inspection of old navigational charts, captain's diaries, observations, voyage reconstructions, and general histories leaves little doubt that San Salvador is the Columbus landfall location (Albury 1975, Dunn 1985, Dunn and Kelley 1989, Gerace, ed. 1987, Kelley 1991, McElroy 1941, Morison 1942, Murdock 1884, Peck 1992, 1996, Roukema 1959, Scisco 1913). Some of this debate revolves around the physical size of the island Columbus landed upon, as well as the size of the population that Columbus must have encountered there (e.g., Kelley 1991, 1992, Pickering 1994, 1997). This article discusses the nature of the pre-Columbian population of San Salvador from an archaeological perspective and attempts to utilize paleodemographic reconstruction of the island's population as a technique to contribute to this debate.

ARCHAEOLOGICAL SITES IN THE BAHAMAS AND ON SAN SALVADOR

Recent tabulations of the numbers of archaeological sites in the Bahamian Archipelago have indicated that there are at least some 390+ open-air living sites and some 111+ cave sites in 14,183 sq km (5476 sq miles) of land area in the Bahamas (Keegan 1997:33, Table 3.1). San Salvador Island has about 39 recorded prehistoric sites, including seven cave and sinkhole sites, and at least two shell midden (conch procurement) sites in 94 sq km (36.29 sq miles) of land area (Craton and Saunders 1992:11, Table 1, Keegan 1997:33, Table 3.1; see also Blick 2004-2008, 2009, Blick et al. 2009, Hopkins 2007, Hopkins and Wyatt 2008, Robinson and Davis 1999/2005, Walton, Bunch and Paulette 2006), for a total of about 30 prehistoric habitation (open-air) sites (see the San Salvador Island GIS Database, and the San Salvador Site List updated by Blick 2009). A map created by Robinson and Davis (1999/2005) and updated by Hopkins, Oetter and Blick (this volume) depicts the known prehistoric archaeological sites on San Salvador in Figure 1.

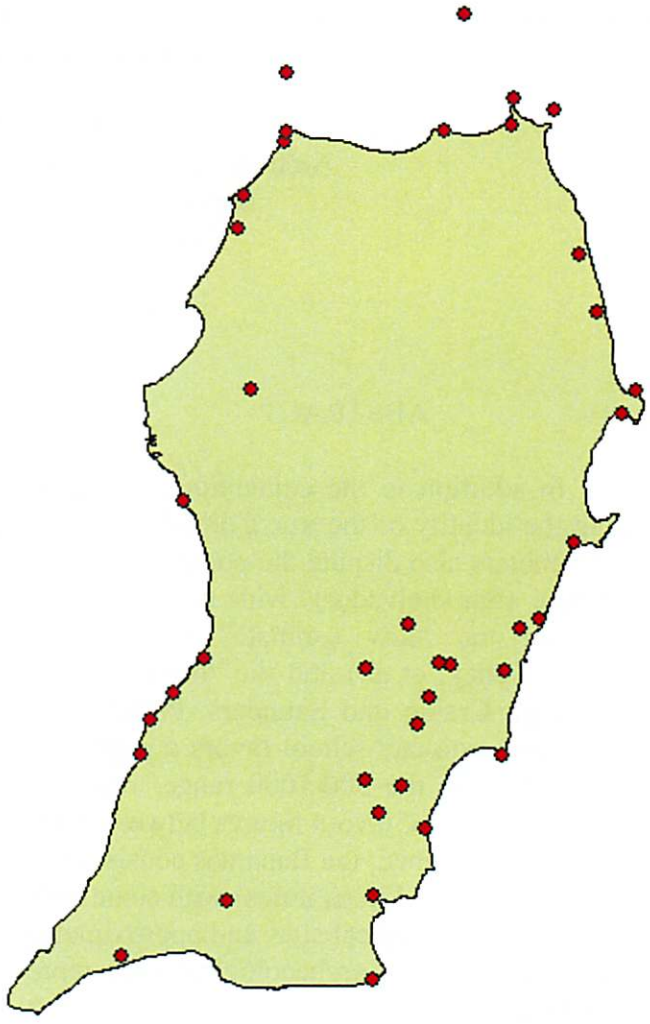

Figure 1. Map of prehistoric archaeological sites on San Salvador, Bahamas (modified from the San Salvador GIS Database, Robinson and Davis 1999/2005). North is at top of figure.

PREVIOUS PRE-COLUMBIAN POPULATION ESTIMATES FOR SAN SALVADOR

There are basically two schools of thought on the issue of the size of the contact-era population of Guanahaní (San Salvador). Ever since the days of the first systematic, stratigraphic excavation on San Salvador, Charles Hoffman has hypothesized that the island was inhabited by about 1000 people (Hoffman 1967, 1970). This appears to be the first such population estimate for San Salvador in the modern scientific literature and marks the beginning of the "low estimate" school in the population debate. Of course, the Quincen-

tennial of the Columbus arrival resulted in much research, including an incisive book review by James Kelley (1992) in which he proceeded to discount Henige's (1991) "historical hypercriticism" of the Columbus log and suggested that, yes, indeed, there is useful information to be derived from the second-hand copy that remains of Columbus's original *Diario*. Kelley (1992), using a couple of different techniques, such as counting the number of children described and counting the number of native canoes mentioned in Columbus's logbook, extrapolated that the island of Guanahaní would have had some 634-945 or 776-1156 people, respectively. Alejandro Pérez (1995), in an unpublished work that was recorded as part of the Columbus Round Robin debate, estimated that Guanahaní would have been home to some 500-1000 people. In my own work to estimate the prehistoric and contact-era population of San Salvador, I have calculated that as few as several hundred people (310-582) may have occupied San Salvador based on an estimate of the total population density of the Bahamas, extrapolating that density to San Salvador, and that the island may have held as many as 535-1008 or 555-1125 people, based on various parameters (see discussion below). These low population estimates are relatively in line with each other (especially considering some work was done independently of the others), and are also nicely concordant with modern Bahamian Census records for the period 1970-2000 which indicate San Salvador's population has fluctuated between 465-970 inhabitants over the last 40 years or so (Bahamas Government 2005).

The "high estimate" school of thought on the prehistoric and contact-era population of San Salvador is dominated by two parties: Craton and Saunders (1992) and Keith Pickering (1997). Craton and Saunders extrapolate a population for San Salvador in the 1000-2000 person range (1500 average). This is based on the erroneous assumption, or misinterpretation, that half of the island's population would have resided at the large Pigeon Creek site on the southeast coast of the island near the head of the Pigeon Creek tidal creek system. Granted, the Pigeon Creek site is seemingly the largest archaeological site on the island, measuring some 8-10 ha in size (Rose 1987, Blick, unpublished data). But it seems highly unlikely that ca. 500-750 people would have resided at Pigeon Creek at any one time as this would have resulted in a population density at Pigeon Creek of 62.5-93.75 persons per ha. Keith Pickering, basing his estimates on these erroneous Pigeon Creek figures proposed by Craton and Saunders, and relying upon a Pacific island model of population density (note: the Pacific islands were typically more densely populated than most Caribbean/Bahamian islands, with the comparative exceptions of the Greater Antilles), estimated that Columbus's Guanahaní would have had to have been populated by something on the order of 2200-4400 people up to a maximum of 1300-5700 people (with an average of 2700 people) according to various parameters in Pickering's Pacific island model, as applied to Guanahaní. It should be noted here that Pickering is a supporter of the Plana Cays as the landfall site and argues that Guanahaní most certainly had to be larger (in both size and population) than the San Salvador as described by Columbus.

PALEODEMOGRAPHY AND ITS APPLICATION TO THE PREHISTORIC BAHAMAS AND SAN SALVADOR

Paleodemography is the study of ancient populations, the causes and effects of ancient population growth and decline, and often includes human skeletal analysis to gauge the general health of an ancient population (Curet 2005, Denevan 1992). This study will concentrate on the first aspect of paleodemography as mentioned above. It should be noted that paleodemography is not an exact science, but typically one that yields ranges of population sizes depending on the parameters or formulas used to estimate ancient populations. In my experience, I have been impressed with paleodemography as a technique to make inferences about prehistoric and contact-era populations, for example, based on the extensive work and testing of models performed in the pre-Hispanic Basin of Mexico (Sanders, Parsons and

Santley 1979), Valley of Oaxaca (Kowalewski et al. 1989), and Valle de la Plata, Colombia (Drennan, ed. 2006). One specific case I can cite from personal experience is the Late Period estimate for the population of the western survey region of the Valle de la Plata, Colombia. Drennan's (2006:75, Table 3.3) estimate of the late pre-Hispanic population was ca. 18,180 people; library research by Blick revealed an early colonial Spanish document (reprinted in Jijón y Caamaño 1938, Vol. II:162) that recorded more than 17,000 people in an area roughly corresponding to, but not exactly the same as, the area that had been systematically surveyed (Blick, unpublished data, Drennan, ed. 2006). Despite the sometimes wide ranges of population estimates reached by paleodemography (e.g., Denevan 1992), if used properly and conservatively, the technique of paleodemography can yield very accurate results (Denevan 1992, Drennan, ed. 2006, Kowalewski et al. 1989, Sanders, Parsons and Santley 1979).

We know that villages were relatively small in the Bahamian Archipelago with some 120-225 people living in 12-15 houses per village (Rouse 1992:17-18, citing Columbus's *Diario* [Dunn and Kelley 1989:94-95]). This estimate for number of houses fits nicely with the number of Household Clusters detected by Blick (2004) estimated to have been present at the village of Minnis-Ward on San Salvador (ca. 15-18 houses).

Basing our large-scale paleodemographic estimates of the entire Bahamian Archipelago on the assumption that each open air site (n=390+) represents a village or habitation site, then the population of the entire Bahamian Archipelago would have ranged from 46,800-87,750 people. Peter Martyr d'Anghera (aka Pietro d'Anghiera or Pedro Mártir de Anglería), summarizing Spanish colonial documents, calculated that more than 40,000 Indians of both sexes (children are not mentioned) had been taken out of the Islas Lucayas (Bahamas), mostly during the peak of the slave raiding days between ca. 1509 and 1512/1513 (Sauer 1966:160; see also Romero 2003, Romero, Chilbert, and Eisenhart 1999). Thus, the 40,000 figure represents a minimum population estimate for the contact-era Bahamas.

Some scholars estimate the population of the Bahamas to have been as high as 120,000-140,000 (Sauer 1966), while others have suggested as few as 10,000-60,000 individuals (Craton and Saunders 1992, Fuson 2000, Muilenburg 1991, Rose 1987). These numbers are both apparently too high and too low, respectively, according to the population suggested by the Spanish chronicles, indicating a mid-range estimate is more likely (ca. 82,500).

The population numbers of ca. 46,800-87,750 equal some 3.30-6.19 people per sq km (8.5 to 16.0 people per sq mile). This is a range that is fairly typical for horticultural peoples growing root crops such as manioc (*Manihot esculenta*) (O'Neil 2006), although recent work by Berman and Pearsall (2008) may force us to rethink the nature of the staple crops relied upon by the Lucayans of San Salvador.

The population densities above suggest that San Salvador would have had a relatively small population of ca. 310-582 people, near recently recorded population levels. In fact the Bahamas Government (2005) in its censuses for the years 1970-2000 reported some 465-970 people on the island, a fact that may reflect changing modern working conditions on the island (the opening and closing of Club Med due to tourist demand, etc.), and also perhaps due to some as-yet-undetermined limitation on the fresh water supply of the island (suggesting a carrying capacity limit that affects both modern and pre-Columbian population levels).

DEMOGRAPHIC RECONSTRUCTIONS OF THE PRE-COLUMBIAN POPULATION OF SAN SALVADOR

Ideally, the best ways to estimate prehistoric populations using archaeological data include: 1) estimating the size of archaeological sites (in ha) and using a standard population figure, such as ca. 5-10 persons per ha (as has been proven to be reliable in Mexico, Oaxaca, Colombia, and elsewhere); or 2) by using the density of potsherds collected from archaeological sites to use as an indicator of duration and density of occupation. Unfortunately, the Commonwealth of

the Bahamas Archaeological Site Forms for San Salvador do not include such information on site size and other critical variables (see criticisms by Keegan 1992), and only about a half dozen sites of the ca. 39 prehistoric sites on San Salvador have been systematically studied.

In the absence of such information, a variety of demographic growth models have been used to estimate what the pre-Columbian population of San Salvador may have been like. Using the world's highest recorded population growth rate of ca. 2.2% per annum (which occurred during the decade of 1960-1969), and beginning with a small human colony of 12 individuals arriving on San Salvador in the year A.D. 650 (a date comparable to some of the earliest radiocarbon dates from the island), by the year 1492 San Salvador would have had a population in excess of one billion people. Clearly 2.2% per annum is an unrealistic rate of growth for the prehistoric Lucayans of San Salvador.

Substituting a more reasonable figure, the world's current population growth rate of 1.2% per annum, and beginning with a small human colony of 12 individuals arriving on San Salvador in the year A.D. 650, by the year 1492 San Salvador would have had a population of ca. 276,168 people, a number greater than the number of inhabitants of New Providence (Nassau) in 2000. Clearly, even this much more reasonable growth rate is too high for prehistoric San Salvador.

Using another model based upon a small human colony of 4-5 individuals (a "nuclear" family, say), and a growth rate producing a population doubling every 100 years, the population of San Salvador would reach ca. 1530-1920 people by the year 1492. Even this relatively slow growth rate results in a fairly large population for San Salvador, although I would assert that the figure of 1530 people might represent a possible maximum population estimate, although some might argue the number of original colonists is quite small to begin with (i.e., colonization would likely require more than one "nuclear" family).

Since our population estimates so far appear to be too high, or based on growth rates that are too fast for a small prehistoric island, I decided to input population growth rate figures of 0.50% and 0.55% per annum with an initial human colony of 12 individuals arriving on San Salvador in A.D. 650. Using these lower population growth rates, we arrive at contact-era population estimates of ca. 800-1216 people by 1492. These relatively low population growth rates appear to result in much more realistic estimates for pre-Columbian San Salvador than modern growth rates or even the population doubling model.

A review of the literature, including information on the population densities for 29 different horticultural and island peoples from the Amazon, Caribbean, Atlantic, and Pacific (AP 1984, Bologna and Flores 2008, Harner 1973, IRD 2008, ISTAC 2006, Johnson and Earle 1987, Keegan 1992, Kelley 1992, Mongabay 2006, Murphy and Murphy 1985, O'Neil 2006, Than 2006, D. Wilson 1999, S. Wilson 1989, Zyga 2008), at population densities ranging from 7.45-12.13 persons per sq km, suggests that the population of San Salvador (ca. 94 sq km of land area) should have ranged between ca. 700-1140 people, figures that are highly comparable to those derived from the 0.50-0.55% per annum growth rates discussed previously.

The final arbiter of this debate regarding the pre-Columbian/contact-era population size of Guanahaní/San Salvador should be the archaeological record itself. Despite the shortcomings of the information available from the Commonwealth of the Bahamas Archaeological Site Forms regarding prehistoric/Lucayan sites on San Salvador, we know that there are about 39 prehistoric archaeological sites on San Salvador, 30 of which are habitation sites. Based on the information contained in the Site Forms, review of the literature, visits to many of the sites, and interviews with other archaeologists who have worked on these sites, habitation sites on San Salvador can be divided into the following size classes with a postulated number of prehistoric houses per size class: very small (n=5 sites, 1 house each); small (n=14 sites, 3 houses each); medium (n=5 sites, 6 houses each); large (n=1 site, 12 houses); and very large (n=4 sites, 25 houses each). These calculations result in an average of 6.3 prehistoric houses per habitation site. At 5-6 persons per house (a num-

ber in fitting with the ethnohistoric and archaeological literature, especially Ramcharan 2004:86; see also Drennan, ed. 2006, Kowalewski et al. 1989, Sanders, Santley and Parsons 1979), we calculate a population range of 945-1134 inhabitants during the pre-Columbian/contact-era on the island of San Salvador.

Of course, a number of assumptions are built into these prehistoric population estimates including: 1) the assumption that population growth rates were constant from ca. A.D. 650-1492 (i.e., that there were no major immigrations or emigrations to or from the island and that there were no major population abandonments); and 2) that the prehistoric habitation sites listed were all occupied at the same time. Keegan (1985, 1992) has addressed this latter point and suggested that if pre-Columbian population was growing as we believe it was in the late prehistoric period, then most of the population in the Bahamas (and thus most of the sites themselves) would have existed in the later period just before the arrival of the Europeans. What we know of the ages of several sites on San Salvador for which dates are available is that many of these sites have radiocarbon dates or other datable objects mostly covering the period ca. A.D. 850-1500, suggesting generally lengthy, and late, occupations of the larger and/or better studied and dated sites: Three Dog (A.D. 600-1160/Spanish contact); North Storr's Lake (A.D. 855-1552); Pigeon Creek (A.D. 895-1170 and A.D 1435-1480); Minnis-Ward (A.D. 950-1450); Palmetto Grove (A.D. 1280-1483); Major's Cave (A.D. 1260-1390); Barker's Point Shell Midden (A.D. 1397-1493); and the likely Columbus landing site at Long Bay (A.D. 1492/Spanish contact).

COMPARISON OF PREVIOUS AND CURRENT PRE-COLUMBIAN POPULATION ESTIMATES FOR SAN SALVADOR

Craton and Saunders (1992) population estimate for San Salvador is based on the erroneous assumption that the Pigeon Creek site, although certainly one of the largest, if not the largest site on the island at ca. 8-10 ha in size, was occupied by some 500-1000 people (or half of the island's population). Area estimates for the Pigeon Creek site are ca. 8.4 ha (Rose 1987) to perhaps 9.79 ha (calculated by Blick from aerial photographs). Even at the higher pre-Columbian population density of 10 persons per ha used for Mesoamerica, this would suggest a maximum population for Pigeon Creek in the 84-98 people range. If the Pigeon Creek site was occupied by some 25-30 households at 5-6 persons per house, this would yield ca. 125-150 or 150-180 persons, respectively, in the village – numbers that are much more realistic when compared to ethnographically known villages of the tropical rainforest which generally reach a critical threshold of about 150-200 people before village fissioning occurs (Chagnon 1975, Freedman 1984). Population numbers in the low hundreds, versus the 500-1000 suggested by Craton and Saunders (1992), seem much more plausible for the Pigeon Creek site.

Following the lead of Craton and Saunders (1992), and perpetuating their error, Keith Pickering's (1997) population estimate for San Salvador is based purely on a Pacific island model of population density. The Pacific island model used by Pickering is not applicable to the Bahamas for at least two reasons: 1) Pacific islands are known to have had very high population densities with cultures developed along the more complex end of the socio-political spectrum (e.g., Hawaii, Tahiti, Tonga); and 2) Pacific islands are more likely to have been "high islands" of volcanic origin with very rich soils and higher rainfall amounts capable of supporting much larger populations than "low islands" such as the limestone based, sandy, coral atolls, which are much more like the islands of the Bahamian Archipelago. The Pacific islands, in fact, would be more akin to the Greater Antillean islands of the Caribbean (e.g., Cuba, Hispaniola, Puerto Rico), which were indeed known for their larger populations and higher population densities (Curet 2005, Denevan 1992). Furthermore, it is clear from Pickering's (1997) article that his scholarly aim is to cast doubt on San Salvador as the island of the Columbus landfall and to refocus research on the Plana Cays, his preferred landfall site (Pickering 1994). Pickering's (1997) article leads us down the primrose path by using a second-hand overestimate of the population of the

Pigeon Creek site (Craton and Saunders 1992) upon which to base San Salvador's average population size, which he calculates as 2250-2700 (with maximums ranging upward to 4400-5700). Based on Pickering's use of the Pacific island model, and the inaccurate population estimate for Pigeon Creek he begins with, Pickering concludes that San Salvador could not have been Guanahaní because it was physically too large in size and too large in population, to have been the landfall island (note: the Plana Cays are ca. 15.5 sq km in land area compared to San Salvador's ca. 94 sq km, which Pickering considers too large).

The prehistoric population estimates presented in this paper are much more consistent with the "low estimate" school composed of previous scholars including Hoffman (1967), Kelley (1992), Perez (1995), and modern census data for San Salvador provided by the Bahamas Government (2005). Most of the population estimates have a central tendency around a figure of ca. 1000 people in pre-Columbian times for the island, suggesting there may be some carrying capacity limit of the island, perhaps based on fresh water availability (Blick 2007, Davis 2008) or the availability of other resources. A table of prehistoric population estimates for San Salvador, along with a brief description of the methods used to obtain the estimates, is presented in Table 1.

Population Estimate	Method of Calculation Applied to San Salvador
310	Minimum estimated population density of the Bahamian Archipelago
582	Maximum estimated population density of the Bahamian Archipelago
799.84	0.50% per annum population growth rate
945	30 habitation sites x 6.3 houses per site w/ 5 people per house
700.57	Average population estimate based on 29 ethnographic samples, 6 outliers excluded
1134	30 habitation sites x 6.3 houses per site w/ 6 people per house
1139.81	Average population estimate based on 29 ethnographic samples, 3 outliers excluded
1215.87	0.55% per annum population growth rate
1530	Population doubling every 100 years
1005.89	**AVERAGE**

Table 1. Prehistoric population estimates for San Salvador and methods of calculation (see discussion).

WHAT HAPPENED TO THE LUCAYAN POPULATION OF SAN SALVADOR?

Circa 40,000+ Lucayans were taken away by the Spanish as slaves to work plantations in the Greater Antilles during the peak slave raiding period in the Bahamas, ca. 1509-1512/1513 (Sauer 1966, citing Peter Martyr's seventh *Decade*, 1912, 1989; see also Romero 2003, Romero, Chilbert and Eisenhart 1999). If the population of the Lucayans in the Bahamas was toward the smaller end of the range, this could account for the enslavement of some 85% of the population; if the population was larger, then perhaps some 28% of the population was enslaved. An unknown number of Lucayans, famous for their swimming and diving skills, was taken by the Spanish to dive for pearls off the north coast of Venezuela at Cubagua and Margarita (Romero 2003, Romero, Chilbert and Eisenhart 1999). There, they were essentially worked to death, forced to dive from dawn to dusk. Contemporary records describe the Lucayan pearl divers as salt-encrusted, red-haired (from sun bleaching), and more like sea wolves than men (Las Casas in Craton and Saunders 1992, Romero, Chilbert and Eisenhart 1999). Sauer (1966:160) asserts that even the "'discovery' of Florida by Juan Ponce de León in 1513 was, in fact, an extension of slave hunting beyond the empty islands." This interpretation is well documented by Scisco (1913), Kelley (1991), and Fuson (2000).

It is apparent from Ponce de León's log (Kelley 1991, Scisco 1913) that, in de León's 1513 voyage to Florida, he spent some 9-12 days on San Salvador likely in search of Indians to enslave, but Ponce de León reported the islands to be uninhabited (Fuson 2000, Kelley 1991, Sauer 1966, Scisco 1913 and Map, Route of Ponce de León). Parts of the Bahamas seem still to have been occupied in 1513 because it is reported that de León "left the chiefs and Indians of the said island of Bimini [Andros?] peaceful; and he assured them ... they would not be removed from there ... like the Lucayans, since it is what they most fear" (Scisco 1913:734). One old woman was encountered by Ponce de León's expedition living on an island that was dubbed "La Vieja"

("the old woman"), probably one of the Bimini islands. Many other documents and maps, such as Bellin's (1754) *Carte du Golphe du Mexique et des Isles de L'Amerique*, clearly show the "Route de Ponce de Leon ... pour la Découverte de la Floride" and equate the island of Guanahaní as synonymous with San San Salvador ("I. Guanahani ou San Salvador"). De León's log, and maps such as this, would seem to argue on behalf of the fact that the fabled island of Guanahaní is indeed Columbus's San Salvador (see also Shaklee, this volume). Of the fate of the Lucayan Isles, Sauer (1966:160) wrote: "The Lucayas Islands were the first part of the New World to become wholly depopulated, for which the date of 1513 seems acceptable." Figure 2 models the growth of the indigenous Lucayan population of Guanahaní (San Salvador) with the subsequent population decline brought about by the advent of Spanish slave raiding and the influx of European diseases. Interestingly, San Salvador and Easter Island have similar population growth and decline trajectories (compare Figure 2, below, to Stevenson 1986:77, Fig. 8.3).

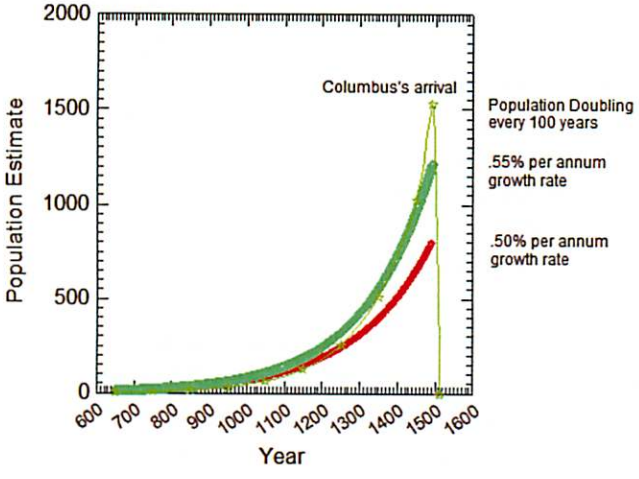

Figure 2. Graph of general prehistoric population trend on San Salvador based on colonization by 12 individuals in A.D. 650, with low growth rates of 0.50%-0.55% per annum and population doubling every 100 years, followed by major population decline in the wake of the Spanish arrival.

THE LEGACY OF THE LOST LUCAYANS

Is 1513 the "acceptable" date for the cultural extinction of the Lucayan people as Sauer (1966) asserts? A suite of five recent radiometric (AMS) dates on carbonized wood and sea turtle bone from the North Storr's Lake site (SS-4) indicates that Lucayan presence on San Salvador may have persisted for several decades after the Spanish slave raiders had virtually depopulated the Bahamas. These dates range from cal A.D. 1408-1572 with three of the dates having midpoints between 1530-1534. The dates (corrected, calibrated, 1σ) are as follows: 1013±25 B.P. (A.D. 1408-1523) (UGA-4341a); 977±26 B.P. (A.D. 1428-1552) (UGA-4340); 929±24 B.P. (A.D. 1465-1594); 418±40 B.P. (A.D. 1492-1572) (UGAMS-17154); and 416±37 B.P. (UGAMS-17153) (A.D. 1497-1571) (Blick and Murphy 2005, Blick, Creighton and Murphy 2006, Blick, Zardus and Dvoracek, this volume). Although these radiometric dates are not without question in regard to their interpretation, they raise the interesting possibility that some Lucayans on San Salvador may have survived the devastating slave raids of the Spanish and persisted a few more decades into the early sixteenth century as the Taíno seem to have done on Hispaniola (Deagan and Cruxent 2002, S. Wilson 1990).

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REFERENCES

Albury, P. 1975. *The Story of the Bahamas.* MacMillan, New York.

AP (Associated Press). 1984. Population growth of islands outpaces the national rate. New York Times. December 16, 1984.

Bahamas Government. 2005. Population in islands, census years 1970-2000. Available: http://www.bahamas.gov.bs/bahamasweb2/home.nsf/vContentW/9C7DE759B4AEFBEA06256ED10071AF8C

Bead Study Trust. 1990. A possible link with Christopher Columbus. Bead Study Trust 15 (April):1-2.

Bellin, N. 1754. *Carte du Golphe du Mexique et des Isles de L'Amerique.* Map in possession of the author.

Berman, M.J., and P. Gnivecki. 1995. The colonization of the Bahama archipelago: A reappraisal. World Archaeology 26(3): 421–441.

Berman, M.J., and D.M. Pearsall. 2008. At the crossroads: Starch grain and phytolith analyses in Lucayan prehistory. Latin American Antiquity 19:181-203.

Blick, J.P. 2009. San Salvador site list. Database in possession of the author.

Blick, J.P. 2007. Pre-Columbian impact on terrestrial, intertidal, and marine resources, San Salvador, Bahamas (A.D. 950-1500). Journal for Nature Conservation 15(3): 174-183.

Blick, J.P. 2004. *Report on the 2004 Archaeological Investigations at Barker's Point (SS-15, SS-37) and Minnis-Ward (SS-3), San Salvador, Bahamas, With Commentary on the Nature of Fire-Cracked Rock.* Research report presented to the Gerace Research Center, San Salvador, Bahamas.

Blick, J.P. 2004-2008. Pre-Columbian population of the Bahamas and San Salvador. Unpublished manuscript in possession of the author.

Blick, J.P., and S.K. Blick. 2009. *Relocation of the Prehistoric Palmetto Grove Site (SS-2) and the Rediscovery of the Historic Dido Arnott (d. 1889) Cemetery Near Quarters Settlement, San Salvador, Bahamas (December 2008).* Research Report Presented to the Gerace Research Center, San Salvador, Bahamas, August 2009.

Blick, J.P., and B. Murphy 2005. *Report on the 2005 Archaeological Investigations at the North Storr's Lake Site (SS-4), San Salvador, Bahamas.* Research Report Presented to the Gerace Research Center, San Salvador, Bahamas.

Blick, J.P., A. Creighton and B. Murphy. 2006. *Report on the 2006 Archaeological Investigations at the North Storr's Lake Site (SS-4), San Salvador, Bahamas: Stratigraphic Excavations and the Role of the*

Sea Turtle in Lucayan Subsistence. Research Report Presented to the Gerace Research Center, San Salvador, Bahamas.

Blick, J.P., C.C. Jackson, F.O. Thacker, and J.M. Pittman. 2009. *Archaeological Excavations at the Minnis-Ward Site (SS-3), and the Discovery of the Mary Ann Blick Site (SS-41), May-June 2009*. Research Report Presented to the Gerace Research Center, `San Salvador, Bahamas. December 2009.

Bologna, M. and Flores, J. C. 2008. A simple mathematical model of society collapse applied to Easter Island. Europhysics Letters 81 (4): 48006.p.1-48006.p.2.

Brill, R.H. 1988. Glass finds on Bahamian island open up new world of thought about site of Columbus's landfall. The Corning Museum of Glass Newsletter. Autumn 1988. pp. 1-2.

Brill, R.H. 2005. Some small glass beads from San Salvador Island. Glass Science in Art and Conservation. Marinha Grande, Portugal, September 21-22, 2005, pp 135-135.

Brill, R.H. and C.A. Hoffman. 1987. Some glass beads excavated on San Salvador Island in the Bahamas. *Annales du 10e Congrès de l'Association Internationale pour l'Histoire du Verre*. Madrid-Segovie, 23-28 septembre 1985. pp. 373-398. Amsterdam, Association Internationale pour l'Histoire du Verre.

Brill, R., I.L. Barnes, S.S.C. Tong, E.C. Joel, and M.J. Murtaugh. 1987. Laboratory studies of some European artifacts excavated on San Salvador Island. Pp. 247-292 in Gerace, D.T., ed., *Columbus and His World: Proceedings of the First San Salvador Conference*. San Salvador, Bahamian Field Station.

Chagnon, N. A. 1975. Genealogy, solidarity and relatedness: Limits to local group size and patterns of fissioning in an expanding population. Yearbook of Physical Anthropology 19: 95-110.

Craton, M. and G. Saunders. 1992. *Islanders in the Stream: A History of the Bahamian People, Volume I: From Aboriginal Times to the End of Slavery*. University of Georgia Press, Athens.

Curet, L.A. 2005. *Caribbean Paleodemography: Population, Culture History, and Sociopolitical Processes in Ancient Puerto Rico*. University of Alabama Press, Tuscaloosa.

Davis, R. Laurence. 2008. Water on Columbus' isle: 22 years of "going with the flow" at the Gerace Research Centre. Paper Presented at the Joint Meeting of The Geological Society of America, Soil Science Society of America, American Society of Agronomy, Crop Science Society of America, Gulf Coast Association of Geological Societies. Seattle, October 7, 2008. Geological Society of America Abstracts with Programs, Vol. 40, No. 6, p. 417.

Deagan, K. and J.M. Cruxent. 2002. *Columbus's Outpost Among the Taínos: Spain and America at La Isabela, 1493-1498*. Yale University Press, New Haven.

Denevan, W.M. 1992 *The Native Population of the Americas in 1492*. University of Wisconsin Press, Madison.

Drennan, R.D., ed. 2006. *Prehispanic Chiefdoms in the Valle de la Plata, Volume 5: Regional Settlement Patterns*. University of Pittsburgh Memoirs in Latin American Archaeology No. 16.

Dunn, O. 1985. Columbus's first landing place: The evidence of the journal. Pp. 35-50 in DeVorsey, L. and Parker, J., eds., *In the Wake of Columbus: Islands and Controversy*. Wayne State University Press, Detroit.

Dunn, O. and J.E. Kelley. 1989. *The Diario of Christopher Columbus's First Voyage to America, 1492-1493*. University of Oklahoma Press, Norman.

Freedman, D.G. 1984. Village fissioning, human diversity, and ethnocentrism. Political Psychology 5(4):629-634.

Fuson, R. 2000. *Juan Ponce De León and the Spanish Discovery of Puerto Rico and Florida*. McDonald & Woodward, Blacksburg, Virginia.

Gerace, Donald T., ed. 1987. *Columbus and His World: Proceedings of the First San Salvador Conference*. San Salvador, Bahamian Field Station.

Harner, M.J. 1973. *The Jívaro: People of the Sacred Waterfalls*. University of California Press, Berkeley.

Henige, D. 1991. *In Search of Columbus: The Sources for the First Voyage*. University of Arizona Press, Tucson.

Hoffman, C.A. 1987a. Archaeological investigations at the Long Bay site, San Salvador, Bahamas. Pp. 237-245 in Gerace, D.T.,ed., *Columbus and his World: Proceedings of the First San Salvador Conference*. San Salvador, Bahamian Field Station.

Hoffman, C.A. 1987b. The Long Bay site, San Salvador. American Archaeology 6(2):96-101.

Hoffman, Charles A. 1970. The Palmetto Grove site on San Salvador, Bahamas. Contributions of the Florida State Museum, Social Sciences, Number 16. University of Florida, Gainesville.

Hoffman, C.A. 1967. *Bahama Prehistory: Cultural Adaptation to an Island Environment*. Doctoral dissertation. University of Arizona, Tucson.

Hopkins, J.H. 2007. Pre-Columbian archaeological sites on San Salvador Island, Bahamas (A GIS analysis). Unpublished research project in possession of the author.

Hopkins, J.H. and P. Wyatt. 2008. Using advanced modeling in ARCGIS 9.2 to perform resource proximity analysis for prehistoric settlements on San Salvador Island, Bahamas. Unpublished research papaper in possession of the author.

Hopkins, Jacqueline Hope, Oetter, Doug, and Blick, Jeffrey P. 2009. Geographic information system analysis of archaeological sites and prehistoric settlement patterns on San Salvador, Bahamas using the San Salvador GIS database. This Volume, xx-xx.

IRD (Institut de Recherche pour le Developpement). 2008. Population growth in Reunion: A strong point for the island's economic expansion? Actualité Scientifique, Sheet No. 294. Available: http://www.ird.fr/us/actualites/fiches/2008/fas294.pdf

ISTAC (Instituto Canario de Estadística). 2006. Canary Islands population prowth in 250 years. Available: http://www.secret-tenerrife.com/2006/11/canary-islands-population-growth-in.shtml

Jijón y Caamaño, J. 1938. *Sebastián de Benalcázar*, Volumes I-II. Editorial Ecuatoriana, Quito.

Johnson, A. and T. Earle. 1987. *The Evolution of Human Societies: From Foraging Group*

to Agrarian State. Stanford University Press, Palo Alto.

Judge, J. 1986. Columbus's first landfall in the New World. National Geographic 170 (November):589-590.

Keegan, W.F. 1997. *Bahamian Archaeology: Life in the Bahamas and Turks and Caicos Before Columbus*. Media Publishing, Nassau.

Keegan, W.F. 1992. *The People who Discovered Columbus: The Prehistory of the Bahamas*. University Press of Florida, Gainesville.

Keegan, W.F. 1985. *Dynamic Horticulturalists: Population Expansion in the Prehistoric Bahamas*. Doctoral dissertation, University Microfilms, Ann Arbor.

Kelley, J.E. 1992. Epistemology 101 for first landfall students: An appreciation of an important new book. Terrae Incognitae 24:101-110.

Kelley, J.E. 1991. Juan Ponce de León's discovery of Florida: Herrera's narrative revisited. Revista de Historia de América III:31-65.

Kowalewski, S.A., G.M. Feinman, L. Finsten, R.E. Blanton, and L.M. Nicholas. 1989. *Monte Alban's Hinterland, Part II: Prehispanic Settlement Patterns in Tlacolula, Etla, and Ocotlan, the Valley of Oaxaca, Mexico*. Museum of Anthropology, University of Michigan, Ann Arbor.

Martyr d'Anghera, P. 1912 [1530]. *De Orbe Novo* (Vols. I and II), translated from the Latin with notes and introduction by F.A. MacNutt. Putnam, New York.

Martyr, D'Anghiera, P. 1989 [1530]. *Decadas del Nuevo Mundo (Crónicas y Memorias)*. Ediciones Polifemo, Spain.

McElroy, J.W. 1941. The ocean navigation of Columbus on his first voyage. The American Neptune 1:209-240.

Mongabay. 2006. Remote island provides clues on population growth, environmental degradation. Available: http://news.mongabay.com/2006/0825-rapa.html

Morison, S.E. 1942. *Admiral of the Ocean Sea: A Life of Christopher Columbus*. Little, Brown and Company, Boston.

Muilenburg, P. 2001. Fate and fortune on the Pearl Coast. Americas 43:32-39.

Murdock, J.B. 1884. The cruise of Columbus in the Bahamas, 1492. Proceedings of the United States Naval Institute 1:449-486.

Murphy, Y. and R.F. Murphy. 1985. *Women of the Forest*. Columbia University Press, New York.

O'Neil, D. 2006. Horticulture [population estimates of the Fringe Enga and Gururumba]. Behavioral Sciences Department, Palomar College, San Marcos, California. Available: http://anthro.palomar.edu/subsistence/sub_4.htm

Peck, D.T. 1996. Rethinking the Columbus landfall problem. Terrae Incognitae 28:12-35.

Peck, D.T. 1992. Reconstruction and analysis of the 1492 Columbus log from a sailor-navigator viewpoint. Encounter '92 (3-4):5-6.

Pérez, A.R. 1995. Communication to Columbus Landfall Round Robin. Manuscript in possession of Keith Pickering (cited in Pickering 1997).

Pickering, K. 1994. Columbus's Plana landfall: Evidence for the Plana Cays as Columbus's San Salvador. DIO 4(1):15-32.

Pickering, K. 1997. The population of Guanahaní. Available: http://www.columbusnavigation.com/lclog4.shtml

Ramcharan, S. 2004. *Caribbean Prehistoric Domestic Architecture: A study of Spatio-temporal Dynamics and Acculturation.* Unpublished Master's Thesis, Florida State University, Tallahassee.

Robinson, M. and R. L. Davis. 1999/2005. *San Salvador GIS database.* Available: http://www.newhaven.edu/sansalvador/gis/ordering.htm

Romero, A. 2003. Death and taxes: The case of the depletion of pearl oyster beds in sixteenth-century Venezuela. Conservation Biology 17(4):1013-1023.

Romero, A., S. Chilbert, and M.G. Eisenhart. 1999. Cubagua's pearl-oyster beds: The first depletion of a natural resource caused by Europeans in the American continent. Journal of Political Ecology 6:57-78.

Rose, R. 1987. Lucayan lifeways at the time of Columbus. Pp. 321-339 in Gerace, D.T., ed., *Columbus and his World.* Bahamian Field Station, San Salvador, Bahamas.

Roukema, E. 1959. Columbus landed on Watling's Island. The American Neptune 19:79-113.

Rouse, I. 1992. *The Taínos: Rise and Decline of the People who Greeted Columbus.* Yale University Press, New Haven.

Sanders, W.T., J.R. Parsons, and R.S. Santley. 1979. *The Basin of Mexico: Ecological Processes in the Evolution of a Civilization.* Academic Press, Orlando.

Sauer, C.O. 1966. *The Early Spanish Main.* Cambridge University Press, Cambridge.

Scisco, L.D. 1913. The track of Ponce de León in 1513. Bulletin of the American Geographical Society Vol. XLV, No. 10. 721-735.

Shaklee, R. 2009. The search for San Salvador, a cartographic odyssey. This Volume, xx-xx.

Stevenson, C.M. 1986. The socio-political structure of the southern coastal area of Easter Island: A.D. 1300-1864. Pp. 69-77 in Kirch, P.V., ed., *Island Societies: Archaeological Approaches to Evolution and Transformation.* Cambridge University Press, New York.

Than, K. 2006. View of Easter Island disaster all wrong, researchers say. Available: http://www.livescience.com/history/060309_easter_island. html

Walton, J., K. Bunch and J. Paulette. 2006. San Salvador: Geographic information system (GIS) analysis of anthropological and spatial patterns. Unpublished research project in possession of the author.

Wilson, D.J. 1999. *Indigenous South Americans of the Past and Present: An Ecological Perspective.* Westview Press, New York.

Wilson, S.M. 1990. *Hispaniola: Caribbean Chiefdoms in the Age of Columbus.* University of Alabama Press, Tuscaloosa.

Wilson, S.M. 1989. The prehistoric settlement pattern of Nevis, West Indies. Journal of Field Archaeology 16:427-450.

Zyga, L. 2008. Model of Easter Island collapse might reveal message for today. Available: http://www.physorg.com/news121959198.html