An Amazing Great Leap: The Neolithic Transition in Puerto Rico

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RESUMEN

Hace dos mil años, navegantes con base en el ápice del delta del Río Orinoco establecieron asentamientos portuarios en las costas semiáridas de Puerto Rico y la vecina isla de Vieques. Su llegada marcó el inicio de la transición neolítica de una economía de subsistencia basada en pesca, recolección y huertos caseros a una que figuraba la plantación comunal extensiva. El sistema agrosocial emergente se extendería eventualmente a todo el archipiélago antillano. La naturaleza del proceso es quizás la cuestión más acaloradamente debatida de la prehistoria Caribeña, sobre la cual hay poca concordancia entre especialistas con diversas perspectivas disciplinarias. Se propone aquí una interpretación antropogeográfica que integra datos disponibles de arqueología, etnohistoria y geografía. El modelo emergente de un sistema de comercio especializado en que figura el intercambio de *excedentes* de niños y mujeres jóvenes de la cuenca del Orinoco resultó en crecimiento poblacional exponencial, que condujo al colapso de la capacidad de carga provocado por un desastre natural, documentado con una consecuente diáspora a las Antillas vecinas.

Palabras clave: paleodemografía caribeña, prehistoria puertorriqueña, Neoarcaico antillano

ABSTRACT

Two thousand years ago, voyagers based at the apex of the Orinoco delta established gateway settlements on the semi-arid south coasts of Puerto Rico and neighboring Vieques Island. Their arrival signaled initiation of the Neolithic transition from a subsistence economy of fishing, gathering, and gardening to one featuring extensive communal field cropping that would eventually extend throughout the Antillean archipelago. The nature of the process is perhaps the most hotly debated issue of Caribbean prehistory, over which there has been little agreement among specialists with diverse disciplinary perspectives. An anthropogeographic interpretation is here proposed that integrates available data from archaeology, ethnohistory, and geography. The emergent model is one of a specialized trade system featuring the exchange of 'surplus' children and young women from Orinoco basin villages for salt and other island products. The inception of extensive agriculture coupled with the reproductive subsidy of imported young people resulted in exponential population growth, leading to a collapse of carrying capacity brought on by a recorded natural disaster, with a consequent diaspora to neighboring islands.

Keywords: Caribbean paleodemography, Puerto Rican prehistory, Antillean Neo-Archaic

We know little of our past, and the sciences that study it often provide separate (and non-communicating) fragments of knowledge, it is important for them to learn how to help each other.
L. L. Cavalli-Sforza & F. Cavalli-Sforza, 1995

Introduction

Surely the most perplexing question of Puerto Rican prehistory is: What impelled the Neolithic transition with its spectacular increase in population (Curet, 2005) at the beginning of the second millennium BP? Most archaeologists now accept that two disparate expeditionary groups from Venezuela convened here to initiate the process, which begs the question: Why did they come? A conclusive explanation has not been forthcoming from the archaeological community, but has been proposed by this sympathetic geographer (Watlington, 2003).

Caribbeanist archaeologists rarely venture beyond the specialist confines of their discipline to consider alternative scientific perspectives; moreover, their narrow purview has been compounded by the enduring paradigmatic sway of an arcane ceramicist tradition long decried by Puerto Rican archaeologists, as enforced through virtual control of academic and professional English language peer-reviewed journals, by a clique of quasi-religious followers (Oliver, 2009); however, recent treatises by restive natives have challenged the canonical "Standard Culture History" of Irving Rouse (1913-2006), long-lived doyen of Caribbean archaeology (Curet, 2005; Pagán Jiménez & Rodríguez Ramos, 2008; Rodríguez Ramos, Torres, & Oliver, 2008; cf. Fitzpatrick, 2004).

Archaeologist L.A. Curet has taken the bull by the horns, disputing the received interpretation of the fabled Hacienda Grande site, near the mouth of the Loíza River basin in northeast Puerto Rico (Curet, 2005). Hacienda Grande was discovered by Ricardo Alegría, influential protégé and resident associate of Irving Rouse (Rouse & Alegría, 1990). Rouse's Yale lab established the site's ambiguous chronology using early (1960s) radiocarbon methodology. Curet's analysis definitively lays to rest Rouse's widely accepted assertion that Hacienda Grande is the premier "type site" of the Saladoid "invasion" of the Island and locus of introduction of the Neolithic transition to labor intensive field agriculture, featuring yuca or manioc (*Manihot esculenta*) production and processing into *casabe* hardtack bread.

A quarter of a century has elapsed since University of Puerto Rico archaeologist Luis Chanlatte Baik (1981) dared to contradict the Rouseian model, which postulated the Saladoid ceramic style as diagnostic of an "invasive culture" that "repeopled" the Island supplanting its previous residents (Rouse, 1992). Chanlatte's digs in the keystone south coast sites of Tecla (south-west in Guayanilla

Bay) and Sorcé—La Hueca (south-east on Vieques Island's south coast) determined that the newcomers came peaceably and settled in a few well-defined and distanced villages, shared in Vieques by two different ethnic groups (Huecoids and Saladoids) each in its own barrio (Chanlatte Baik & Narganes Storde, 1980; 1983);[1] moreover, their tightly knit communities coexisted for centuries with the old-time Archaic inhabitants, retaining their basic identity while modifying the livelihood and demographics of their neighbors through interactive "acculturation".

Beyond disestablishing Rouse, Curet's discourse on Puerto Rican paleodemography adds little to Chanlatte's foresight that is not theoretical; indeed, he strikes at a virtual *piñata* of relevant possibilities. For example: "Long distance migrations are . . . more common among societies that depended on a narrow range of highly productive but relatively inelastic and localized resources (i.e. groups with more specialized subsistence strategies)" (Curet, 2005: 49). Curet's rumination provides a glimpse of the scenario conceived and elaborated by myself over a good many years of research into the demographics of ancient Puerto Rico (Watlington, 1974; 1997; 2000; 2003). What follows is a restatement of my proposed interpretation of the Neolithic transition in Puerto Rico, updated in consideration of accrued information and the recent spate of contributions by other workers.

The "Wave of Advance" Model

Archaeologists have long associated the early presence of pottery in Prehistoric middens with the inception of field crop agriculture. The connection is especially convincing when, as is the case in Puerto Rico, the potsherds include pieces of baked clay griddles known as *burén* that are still widely used to toast expressed yuca pulp into casabe biscuit-bread and and *farinha* meal. If the ceramic ware is notably sophisticated in technique and design, again the case in Puerto Rico, collateral inferences of cultural preeminence *vis-à-vis* so called "preceramic" societies seem justified.

"If we knew only pottery", affirms Irving Rouse in his 1992 compendium *The Tainos,* "we could not be sure whether the Saladoid peoples actually entered the West Indies or merely passed their ceramics on to its Archaic age inhabitants (34)." He then goes on to assert that these "ancestors" of the Greater Antillean "Taino" originated on the Orinoco River "broke through its delta to the Guiana and eastern Venezuela coasts", and subsequently "invaded the West Indies and conquered its Archaic-age inhabitants as far north as Puerto Rico" (ibid: 37).

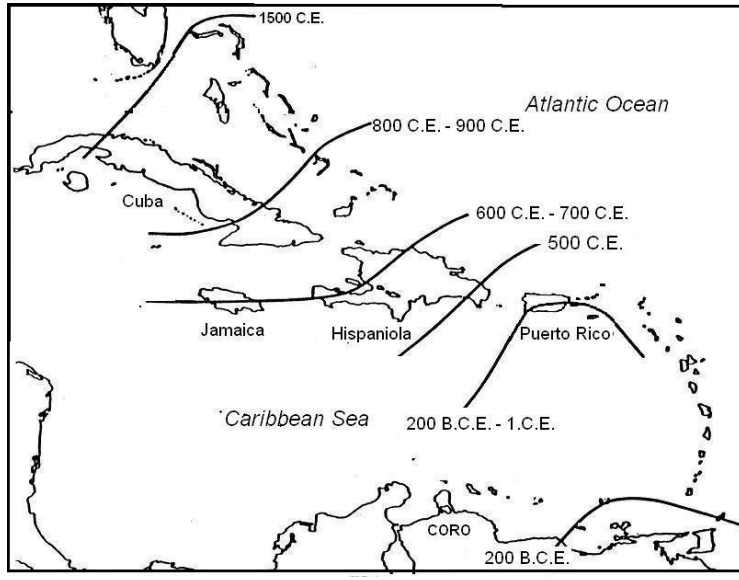
Rouse's ambivalence can be attributed, in part, to the widely held premise that, to quote Robin Dennell, "was based on the supposition that early Neolithic farmers possessed an overwhelming demographic and economic superiority over local Mesolithic [i.e. Archaic] hunter-foragers and thus could appropriate their lands and dispossess them" (1992: 90). Dennell was referring to the Neolithic transition in Europe, computer mapped on the basis of radiocarbon dates associated with earliest presence of pottery (Ammerman & Cavalli-Sforza [hereafter A&CS], 1984; Cavalli-Sforza & Cavalli-Sforza, 1995; Watlington, 2003).

There is a striking similarity between the European "wave of advance" and Rouse's map of the "Advance of the ceramic/Archaic-age frontier through the Caribbean" (Rouse, 1992: 36). Both maps feature $_{14}C$ dated concentric isochrons that suggest the source of departure of the "wave", and the geographic pattern of its spread. There are other interesting similarities as well as differences in the nature and rate of advance of the respective ceramic frontiers; nonetheless, the Neolithic transition in Europe provides a useful heuristic analogy for the agroceramic transition in Puerto Rico and beyond.

The European "wave of advance" proceeded from the Middle East through Anatolia (Turkey) to the western and northern confines of Europe three to four thousand years later. A&CS plotted the advance with isochrons at 500 year intervals and estimated an average rate of spread of one kilometer per year or 625 k² per generation of 25 years. An agroceramic "wave of advance" within Puerto Rico that fits neatly the European template followed a 'great leap' (Allaire, 2003: 201) from Venezuela that largely bypassed the Lesser Antillean island chain.

In Puerto Rico the transition was foreshadowed by an uncertain period of contact, implying Saladoid and Huecoid familiarity with the Island, its people, and resources, as the prospective destination for a venue of trade and ceremonial exchange, which culminated in the establishment of "gateway" communities (Hirth, 1978) at the beginning of the Common Era.[2] After a "long pause" (Keegan, 2006: 3) of around 500 years, glossed over in Rouse's map (Rouse, 1992, Fig. 10: 36), the agroceramic expansion spilled over onto Hispaniola, sweeping that island and neighboring Jamaica in less than two centuries, and entering Cuba and the Bahamas a century later, all much faster than would be expected from simple extrapolation. Clearly, there is a fundamental difference between the nature of the agroceramic transition on Puerto Rico (cf. my map, Fig. 1) and in the other Greater Antilles.

Figure 1. Wave of advance of the Neolithic transition in the Greater Antilles. Reinterpretation of Rouse, 1992.



The crux of the matter is in the population dynamics at each stage of the expansion, conflated by its interpretation as a uniform migratory process. Once again Curet offers a clue, embedded in his meandering consideration of migration.

> The fact that the early Saladoid-La Hueca groups settled in areas with relatively higher density of Archaic sites such as Puerto Rico and the Virgin Islands seems to indicate that some serious and perhaps strong relationship was present between the Archaics and the Saladoid people prior to and after the movement of the latter (2005: 67).

The possibility of a substantial Archaic population is of course unacceptable to Rouseians fixated on a migratory imperative for Lebensraum; nonetheless, it somehow escapes Curet in his dismissive critique of the "wave of advance" model that A&CS advised:

> We also need to consider the interactions that can occur between a population of farmers expanding into a new area and the population of hunters and gatherers already living in the area. Such interactions might take any one of many different forms, ranging from mutualism through acculturation of the local Mesolithic [i.e. Archaic] population (62).

What sort of "mutualism" led simultaneously to the "acculturation" and "rapid" population increase of the Archaic inhabitants of Puerto Rico, as Chanlatte has long contended (Chanlatte Baik & Narganes Storde, 1986; Chanlatte Baik, 2000; 2003a)?[3] Precursory to answering the question, it is convenient to interpose an estimation of the increase in population of ancient Puerto Rico during its agroceramic transition, for which A&CS provide applicable guidelines. Apparently, the Archaic population went on fishing, hunting, gathering, and gardening while becoming increasingly reliant on yuca based field agriculture and associated food processing.[4] The husbandry of previously underutilized land gradually enhanced the Island's carrying capacity in terms of available alimentary biomass (cf. Watlington, 2009).

According to A&CS, the agrodemographics of the Neolithic transition impel a typical population increase of one hundred times the Mesolithic density. They noted that an exponential rate of increase of 1% per year would achieve the expected densification with a doubling time of 69 years (A&CS: 71); therefore, with reference to the A&CS model and pertinent geographical data, it is possible to approximate the time span of the Neolithic transition in Puerto Rico. The Archaic population of Puerto Rico at the dawn of the agroceramic transition can be calculated at roughly 4,000 adult inhabitants.[5]

Following A&CS, the "wave of advance" would have radiated from the ports of entry (i.e. "gateways") at the concentric rate of one kilometer per year or 625 km² per generation. At that rate, by about CE 400 (1600 BP) all of Puerto Rico would have completed the transition and its adult population increased to around 250,000 (Table 1). My estimation is in agreement with Cavalli-Sforzas' (1995) prediction and the emergence of Rouse's Cuevas horizon, the earliest island-wide endemic agroceramic culture of ancient Puerto Rico.

Table 1. Puerto Rico: Hypothetical Neo-Archaic Population Growth (Annual Rate: 1%)

Years CE [A.D.]	Adults	Ceramics and Events
1	4,000	Saladoids arrive and
69	8,000	interface with Archaics.
138	16,000	Gradual diffusion of yuca complex
207	32,000	including ceramics
276	64,000	Neo-Archaic adaptation
345	128,000	of Saladoid ceramics
414	256,000	Cuevas horizon ceramics
483	512,000	Neo-Archaics expand inland.
552	1,024,000	Mass diaspora event

As the Island's Neo-Archaic population grew, hamlets sprouted throughout the inland piedmont, interior valleys, and highlands. The

new farmers continued to fish, hunt, and gather while practicing slash and burn agriculture, with increasing environmental impact. By the mid 6th century CE (ca. 1450 BP) ancient Puerto Rico's population may have surpassed the million mark, straining the Island's carrying capacity, when a predicated natural disaster, possibly a mega-El Niño event or La Niña super hurricane, caused unprecedented devastation. Evidence of a torrential rainfall scenario was early noted by Chanlatte (1981, quoted in Watlington, 1997), and can be proximately dated to the mega-El Niño event reported from northern South America and Peruvian archaeological sites (Meggers, 1994; 1995; Fagan, 1999; Caviedes, 2001), which devastated Moche civilization, and by super hurricane marked lake sediment cores from the north-central Gulf of Mexico coast (Liu & Fearn, 2000).[6] Within a century a mass exodus from Puerto Rico had settled the major valleys of Hispaniola and by 700 CE (1300 BP) entered Jamaica (Rouse, 1992). By 800 CE (1200 BP) the Neo-Archaic wave was advancing through eastern Cuba and the Bahamas.

The agroceramic wave of advance through the western Greater Antilles covered much more territory in considerably less time than the transition in Puerto Rico. Implied is a population growth rate of 3% to 4% per year, which stretches the limit for reproductive potential in humans (A&CS: 71). Whereas the original process within Puerto Rico appears to have featured cultural diffusion, the much more rapid demographic expansion to the west was clearly what A&CS call "demic diffusion" combining migratory colonization by a Neolithic people and enhanced reproductive population growth (A&CS: 134).

Saladero: Portal of The Orinoco Basin

Back to the crucial question: Why did the Saladeños come to Puerto Rico in the first place? Rouse was hoisted on his own petard mind-set that saw the amazing great leap from the coast of eastern Venezuela to the Island as an invasive: "population movement and colonization [wherefore] . . . the invading people's societies take over an entire area, replacing the societies of the previous inhabitants" (Rouse, 1992: 73-74). Confronted by the impressive wholesale stock of bijouterie unearthed at the Vieques bazaar by Chanlatte & Narganes (1980; 1983), he reluctantly conceded: "The Sorcé site may well have been a port of trade" (op. cit.: 87).

Stalwarts and post-Rouseians alike have been blindsided by a lingering tenet that views the Saladeño outreach in terms of migratory rather than commercial interaction (Siegel 1991; Boomert, 2000; Curet, 2005); moreover, while the Huecoid lapidarists are easily recognizable as members of an artisanal guild—a "co-op of the condor"—the exchange focus of the Saladeños is less obvious. The

showy Saladoid trademark ceramics, recovered mostly from their own village in Vieques, may have been the formal tableware displayed at the ceremonial reception of visiting clients; however, as will be seen, the Saladoids were actually the pivotal movers at the Vieques fair, and the Huecoids seemingly their boutique purveyors of bodily adornments. Similarly restricted to the Huecoid quarter, greenstone and bluestone pendants in the shape of a condor carrying either a human head or a bird in its clutches may have been personal passports, and together with their lapidarian craft suggests an eventual Andean provenance of the guild.

Present-day Saladero is a sleepy little riverside village on the outskirts of the keystone port and portage town of Barrancas at the apex of the Orinoco delta, terminus of the overland road from the Gulf of Cariaco and eastern Venezuelan coast. Salt-cured fish are a well-documented staple of prehistoric subsistence in the region (Kirchhoff, 1963; Wassén, 1955; Boomert, 2000). Has any Saladoid archaeologist bothered to ask how Saladero got its name? Early colonial chronicles identify the locale as congruent with the aboriginal conurbation of Arowacai, described by Oviedo in the 1530s and by Walter Ralegh who was there in 1596. According to Ralegh: "The seate of this towne . . . was very pleasant, standing on a little hill, in an excellent prospect, with goodly gardens a mile compasse round about it, and two very faire and large ponds of excellent fish adjoining" (Ralegh, 1997: 168). Ralegh noted that he was invited to Arowacai by the "Lord" of the place at whose "owne port" he anchored, and from there was "carried some mile and a halfe" to the main town (167).

Boomert (2000: 444) offers a succinct summary of the available documentation of the site: "Aruacay has been classified as a 'gateway community', through which coastal and insular products such as *salt*, pearls and conchs were exchanged for hinterland articles and, perhaps *slaves*" [emphasis added]. Elsewhere Boomert (op. cit.: 247), citing Kirchoff (1963) and other sources, mentions salt from Araya, the major salina at the western end of the two-pronged Araya-Paria peninsula, being traded in brick form to the interior. Boomert construed Ralegh's fish ponds as "seasonal lagoons" (ibid: 290; cf. Fernández de Oviedo, 1959 [1535]: 398), whereas in context the reference could just as well imply holding ponds for river fish awaiting salt curing. Both interpretations are plausible. The extensive shallow lagoons or *esteros* left by seasonal inundation of the llanos become crowded with fish as they dry out, facilitating their capture (Novoa, 1982; Machado-Allison, 1994; Granado & Taphorn, 2000).

Entranced by the elegant beauty of a visiting cacique's wife, Ralegh was remiss in describing the local economy. His rapt description of the lady in question suggests a possibly mestizo beauty of queenly mien; however, on resumption of his fact-finding mission, he sailed upstream

to the river Cari, the ensuing tributary on the northern bank of the Orinoco, site of the "chiefe towne", Acamacari, of a "Canibal" nation where he found: "A continuall markette of women for 3 or 4 hatchets a peece, they are bought by the Arwacas and by them solde into the West Indies" (Ralegh, 1997: 179). Ralegh, thus, establishes Arowacai as an entrepôt of the contraband Indian slave trade, between Spanish traffickers with outlets in the Greater Antilles and their designated Carib enemies. Boomert (2000: 427) adds the Spanish adoption of the term *guatiao* as meaning bonafide (trusted) "middleman".

Further on Ralegh adds details implying that freewheeling Spanish interlopers were by-passing Arowacai to buy directly from Carib suppliers on the south bank of the Orinoco:

> And there buie women and children from the Canibals, which are of that barbarous nature, as they will for 3 or 4 hatchets sell the sonnes and daughters of their owne brethren and sisters, and for somewhat more even their owne daughters: hererof the Spaniards make great profit, for buying a maid of 12 or 13 yeeres . . . they sell them againe at Marguerita [an entrepôt] . . . for 50 and 100 pesoes (Ralegh: 153).

Encroachment by colonial slave traders on native trade networks is likely at the root of the unrelenting Carib opposition to Spanish interference (Biord Castillo, 1985; Whitehead, 1988); likewise, the enduring alliance between Spanish and Arwakas on one hand and Caribs and Dutch on the other may have derived from pre-contact turf wars between the rival ethnic kinship *confederations*.[7] Most remarkable of Ralegh's observations are his specifications for the human *merchandise* being exchanged. In stark contrast to the African slave trade which focused on manpower, the Orinoco trade had a clearly domestic focus, having evolved to bolster tribal households in subsistence based social economies subject to endemic environmental constraints.

Oviedo's 1535 account of Diego de Ordaz' brutal entrada two thirds of a century before Ralegh attests that the Arwaka-Spanish connection was established early on (Fernández de Oviedo, 1959 [1535]: 393). Arowacai served as the friendly base from which Ordaz launched the gratuitous massacre and plunder of an upstream community that refused the requisition of provisions for his expedition. Only the women were spared to be shared as slaves with the Arwakas, who Oviedo wryly noted already had a surfeit of women at their disposal. He also remarked that dried fish and shrimp were dietary staples in Arowacai (ibid: 396). Not long after Ralegh's sojourn, Arowacai entered decline as Spanish inroads and abuses undermined their association with the Arwakas, who apparently removed to a more secure location (Vázquez de Espinosa, 1942 [ca. 1620]).

How, then, did Arowacai become Saladero-Barrancas? The site's strategic location would have assured continuity of key economic activities besides the slave-mart during the protracted colonial transition period.[8] On a hunch, in 1995 while attending the 3rd Latin American Ecology Congress in Mérida, on the Andes at the other extreme of Venezuela, I visited the local public market and went directly to a stall offering sheaves of salt-dried fish. A signboard listed various species of large freshwater fishes featuring Pimelodid catfishes (*bagres*) and Characids such as *cachama* (Colossoma) and *morocotó* (Piaractus). I was told the entire stock had come from Barrancas, the premier fishing and fishery processing center on the lower Orinoco. Subsequent research substantiated that the deltaic apex area supplies over half of the total riverine catch or some 4,000 tons per year, which is transported by overland trucking throughout the country (Novoa, 1982; 1990).

Where does Barrancas obtain the salt for curing its catch? The massive discharge of the Orinoco, plus additional outflow from a series of capacious Guyanese rivers precludes saltworks by diluting seawater in the littoral zone from as far away as the mouths of the Amazon in the east to the Gulf of Paria and Trinidad just above the great delta, and west on the north shore of the Paria peninsula for about 135 km to the town of Carúpano (van Andel, 1967). On the arid seacoast west of the town there are several natural salt pans culminating in the famed salina at the headland of the Araya peninsula, entryway to the Gulf of Cariaco (Vargas Arenas, 1983; Sanoja, 1989).

Araya has been the most important salina of Venezuela since earliest colonial times, as chronicled by Spanish authorities who fortified the site (in 1622) to stave off Dutch interlopers (Sluiter, 1948; Varela Marcos, 1980; Humboldt, 1995 [1799]). It is described as a shallow lagoon a league and a half (8 km) in circumference, and extremely productive, yet subject to brief dilutions in salinity due to unusual hurricanes, and prolonged catastrophic fluctuations in sealevel caused both by eustatic and tectonic forces. The neighboring Gulf of Cariaco is actually a restless geological graben (roughly 50 km long by 10 km in width) nestled between transverse faults that separate the Caribbean and South American tectonic plates (Iturralde-Vinent & Macphee, 1999, Fig. 17: 9).

The Araya salina is auspiciously located about 20 km from Cumaná, founded in 1520, the first Spanish beachhead on the South American continent (Vázquez de Espinosa, 1948 [1629]), at the southern tip of the entryway to the Cariaco embayment. The salina is a convenient 30 km commute to Margarita Island, the earliest Spanish gateway to the continent. Cumaná is connected to Barrancas by a roughly 500 km beeline road over largely evenly graded terrain and by the possibly less exacting roundabout intracoastal waterway via

the canal-like Guarapiché River and Caño Manamo. By contrast, the nearest comparable salina west of Araya is in Coro about 800 km away following a steep, rugged coastline. On the other hand, Vieques, Puerto Rico, lays 7º of latitude almost due north from Margarita, at about the same distance over water as Coro.

There are early colonial records of salt-burdened native canoes from Coro supplying the Andean piedmont through Lake Maracaibo, from whence salt-cured lake fish were traded inland in exchange for textiles, maize, and probably gemstones and gold from the highlands (Wassen 1955; Strauss 1992). Apparently this trade was controlled by ethnic Caribs. At any rate, the diagnostic ceramics of Saladero-Barrancas have not been found beyond the islands on the western periphery of Araya (Antczak & Antczak, 1993). It is also recorded that at the *raudales* (rapids) of Atures in the middle reaches of the Orinoco large migratory *bagres* sustained a productive Carib fishery that smoked its catch, presumably because sea salt was not readily available (Biord-Castillo, Amodio, & Morales-Méndez, 1989). Coincidentally, Atures appears to have marked the limit of upriver Saladoid presence (Boomert, 2003).

When did the Saladeños begin to use salt to preserve fish? The Saladoid pottery sherd trail suggests that within two centuries before their 'leap' to Puerto Rico their forebearers emerged from the lower Orinoco to establish a string of outposts along the arid north shore of the Araya peninsula from Carúpano west to the vicinity of the namesake cape and its great salina (Sanoja & Vargas, 1983; Vargas Arenas, 1983). Located in a zone inhospitable to agriculture, most if not all the Saladoid sites are in proximity of local natural salt pans, and Archaic fishing villages.[9] Sanoja describes one of the larger sites:

> During the dry season, the lagoons and marshes around Playa Grande turn into salt flats, which have been exploited until very recently. The prehistoric population may also have collected salt, both for local consumption and for trade over a wide region (1989: 454).

The ancient Saladeños must have learned salt curing techniques from their Archaic neighbors, who would have exchanged their salt and other coastal products for goods from the Orinoco Basin and far-off Andean highlands.

Wayside Waifs to Saltworthy Wives and Wards

The ancient Saladeños arrival on Araya heralded a burgeoning trade in salt-dried river fish between portal Saladero and the seasonally inundated Orinoco hinterlands when the communities marooned on

island-like levees or barrancas could neither fish nor hunt, and had to subsist on stockpiled foodstuffs featuring storable maize and yuca derived casabe (Denevan, 1996). Before the last millennium BCE, the staple of year around subsistence in the Orinoco basin was yuca: "As a special purpose crop for the production of trail bread and meal especially suited to the needs of frequent travelers: traders, fishers, hunters and raiders" (Watlington, 2003: 81). Requiring a long growing period (at least nine months in Puerto Rico), it must be planted above the high-water level of seasonal flooding; thus, population was limited to the carrying capacity of the scarce islands of high ground; however, during the last thousand years BCE Orinoco peoples turned increasingly to maize for sustenance (Roosevelt, 1980; van der Merwe, Roosevelt, & Vogel, 1981). Because maize can be harvested four months after planting, it is an ideal field crop for the vast, fertile alluvial flood plains that are available for cultivation only when exposed during the low-water dry season (Weibezahn, Álvarez, & Lewis, 1990). As more and more flood-prone land was planted to maize and other short season crops such as peanuts and sweet potatoes, the carrying capacity of the Orinoco Basin increased exponentially, leading to a fifteen-fold increase in population between 800 BCE and 400 CE, according to Roosevelt and her associates. As noted by Fernández de Oviedo in Arowacai:

> When the river rises the fields on both sides are flooded very close to the town, and when the river ebbs they follow it planting to its course; and as the river swells they eat their way from farthest off to what is nearest the houses (396).

The rise of ancient Saladero and its long distance trade connections with Araya-Paria and eventually Puerto Rico coincides with the period of exploding population in the Orinoco Basin. Boomert asserts that: "By the first centuries of our era the Barrancoid centre on the Lower Orinoco had developed into a densely populated settlement which stretched along the river for several kilometers" (2003: 160).

As modeled by Denevan (1996: 668), both maize and manioc derived casabe hardtack could be stored along with smoked fish: "to feed people during the high-water and flood periods." He cautioned that: "The capacity for food storage . . . may not have been sufficient to counter high floods of long duration," and at length concludes that other "non-flood plain (terra firme) sources of food would have been essential for the support of large numbers of people over the long run." Although Denevan favored resource complementarity between llanos and peripheral bluff uplands, he also recognized an alternative possibility. "We do not know", he admits, to what degree prehistoric riverine peoples might have "relied upon specialization and exchange" (op. cit.: 674).

In normal times old Saladero would have supplied salt-dried fish, providing a necessary protein complement to the starchy mainstay diet of seasonally stranded villages. In trade the latter would proffer local resource commodities and proprietary artisanal specialties (Wassén, 1955; Morey & Morey, 1975); however, anomalous years of unusually early or persistent inundation, or longer episodic droughts (Meggers, 1994; 1995), might result in cropping shortfalls and ensuing threat of famine. Assuming the ancient Saladeños continued to purvey salt-cured fish to despairing villagers when provisions were running low and starvation loomed, what could they offer in exchange for food of high intrinsic value but that had become a liability and was therefore expendable?

A diminished carrying capacity would have created a population 'surplus' of young people that the Saladero trading network could relocate far from the stricken region to unaffected coastal areas, where Archaic fisherfolk were perennially hard-pressed to maintain generational renewal. Confronting demographic attrition by occupational hazards, high infant mortality, and an all too short adult life expectancy, they would have eagerly adopted tractable preadolescent and teen-age waifs as apprentice wives and wards. The youngsters would, of course, have been exchanged for salt and other coastal products.

If waifs for salt was the gist of their trading enterprise, why did Saladeño merchants embark on an offshore venture to faraway Puerto Rico? They obviously possessed the navigational skills and seaworthy barks for expeditious round trips to Puerto Rico.[10] It is known that construction of seafaring canoes was an Orinoco Delta specialty. Large dugouts were fitted with raised plank gunnels and prows caulked with Trinidad tar so that they could capably ply ocean swells; moreover, upriver passage against the flood level flow was assisted by the easterly trade winds with the aid of sails assembled from cotton textile *mantas* or plaited palm fiber mats as *esteras* (Fernández de Oviedo, 1959 [1535]; Humboldt and Bonpland, 1814, vol. 4: 465). Rigging was braided chiquichiqui palm fiber cordage, so serviceable it was widely traded well into the late colonial period (Briceño de Bermúdez, 1993).

The Saladeño's great leap to Puerto Rico at the dawn of the Common Era coincided, as Sanoja (1989) has noted, with a critical sea level fluctuation on the Araya-Paria two-pronged peninsula. About a half century BCE sea level briefly dropped to one meter below the current mark during the so-called "Paria emergence", which ended roughly a century later with a transgression that inundated the coastline to one meter above the present level.[11] The upshot left the great salina at Araya high and dry for several generations and subsequently drowned for as long as a millennium.

Similar catastrophic changes in sea level at Araya have been documented for the early historical period, and attributed mainly to

tectonic upheaval. At the end of the 18th century Humboldt surveyed the region and concluded:

> On the Cumaná coast and on Margarita Island most share the opinion that the Gulf of Cariaco was formed as a consequence of the fracturing of the territory and a flooding from the sea. The memory of this powerful cataclysm had been preserved by the Indians up to the 15th century, and it is said that by Christopher Columbus's third voyage the Indians still talked about it as recent (1995 [1799-1804]: 57).

Humboldt goes on to mention the successive earthquakes that devastated Cumaná from 1530 through 1767, and the unusual hurricane that disrupted the production of salt indefinitely (op. cit.: 69): "In 1726 a violent hurricane destroyed the Araya salt works . . . the high waves penetrated far inland and transformed the salty lake into a gulf several miles long." Surprisingly, Sanoja (1989: 454) did not correlate his proposed Paria emergence with the interruption of salt production at Araya, by implication the crisis that actuated the Saladeño outreach to Puerto Rico; nonetheless, he cogently recognized that the "amalgamation of gatherers [Archaics] and agriculturalists [Saladeños]" on Paria-Araya resulted in cultural sharing and integration, "which culminated in the establishment of large communities identified with the Coastal Saladoid Tradition." It was from this structurally complex market centered society that issued the establishment of the Saladeño outposts in southwestern Puerto Rico and Vieques Island unearthed by archeologists Chanlatte and Narganes, which as Sanoja noted coincided with the emergence at Paria.

Why Puerto Rico? The short answer is that the smallest of the Greater Antilles is also the first really large island to be encountered along the Antillean chain from Venezuela. Located in the midst of the Caribbean hurricane belt, the Islanders were even more hard-pressed than their continental counterparts to sustain generational recruitment. It was the nearest destination where a substantial supply of salt might be had from reliable salinas long exploited by resident Archaic fisher folk. As on Araya-Paria, the Saladeño settlements were sited within convenient walking distance from major salinas both on the big island and Vieques. Sued Badillo (1985) reports that at the outset of Spanish colonization in the early 16th century, the salina nearest the Saladoid site of Tecla (at Guánica) belonged to Agueybaná, the paramount chief over much of Puerto Rico.[12]

A cursory examination of the Vieques coastline shows a number of sites, which may well have been prehistoric salinas. A no-man's-land until late in the colonial period, there are salinas toponyms on the arid east end of the Island that evince the existence of documented

19th century saltworks. Curet's (2005) geographical distribution of known Saladoid sites shows they are evenly spaced along the protected leeward (south) coast in the proximity of potential Salinas; moreover, late Saladoid sites are more numerous in the vicinity of the confirmed east end salt ponds, currently pitted with naval bombardment craters and off-limits to archaeologists pending removal of unexploded ordnance.

In conclusion, Curet deserves credit for positing the theoretical questions that broached the present analysis; his following comments are especially pertinent:

> Young people that are in or about to enter their biologically reproductive and economically productive years can produce a positive impact similar to increased fertility in the receiving population, eventually leading to higher population growth rates. The addition of more women in their reproductive years than men can produce eventually an increase in growth rate, regardless of the total size of the migrant population (2005: 44).

Curet also cites the osteological age-at-death tabulations and graphs of Crespo Torres (2000) for Punta Candelero, a main-island site due west from Vieques, and comparable data from Paso del Indio, a far-removed inland site on the central north coast. The first sample is from a late "Saladoid" context (Cuevas, CE 400-600) while the second is considered a much later "Ostionoid" (CE 900-1200). Regardless of critical differences in chronological and locational context, both samples suggest similar demographic constraints, which I interpret as follows. A high rate of infant mortality is evident, resulting in a dearth of native-born adolescents that would have been mitigated by importing youngsters from Venezuela to subsidize the adult population.

The long voyage from the Orinoco Basin might have included a sojourn on Vieques where the young wards would be prep-schooled in appropriate skills and attitudes. Preadolescent girls would learn pottery making, cooking, gardening, manioc husbandry and processing, and the techniques to spin cotton and weave it into the colorful naguas petticoats they would wear as teenage brides.

Boys would be trained in various fishing techniques and associated gear-making crafts such as fishing arrows and harpoons, cordage, nets, basket traps, and weirs from diverse fibers. They would be taught the rudiments of carving dugout canoes with stone and conch adzes and chisels, and become apprentice house builders, learning to thatch roofs and weave multipurpose split palm frond matting. They would assist in clearing land by controlled burning and turn the soil with the *coa* stick-plow to plant field crops.

Boys and girls in their early teens would have completed their education on Vieques while awaiting adoption, betrothal, or indenture as a *maco* (Arwaka) or *poito* (Carib), the ambivalent Orinoco terms that can mean "son-in-law", "serf", or "slave" (Acosta Saignes, 1961; Whitehead, 1988; cf. Chanlatte Baik, 2003b). Over time the young immigrants would transform their Archaic foster home, by subsidizing its reproductive age population and augmenting the carrying capacity of the land, through gradual infusion of a socially and economically sophisticated crop technology complex based on the production of manioc bread and associated paraphernalia.

As noted by Curet (2005: 29), Vieques was an epicenter for the population growth that attended the Neolithic transition in Puerto Rico. The earliest increase occurred there in the Saladoid period during which the number of settlement sites quadrupled. A soil survey of Vieques attests that on the more cultivable western half of the island (about 1,250 mm rainfall per year, versus 500 mm for the eastern half) the prevalent soil type is 'Vieques loam' (Lugo-López, Bonnet, & García, 1953), a dark, friable and organically rich anthrosol (Smith, 1980) produced by centuries of intensive subsistence agriculture and dense human settlement; furthermore, yields of yuca, maize, and even cotton were greatly augmented by the northward saltation of 10º of latitude (lat. 8ºN to lat. 18ºN) that critically enhanced photoperiod-driven crop phenology (Watlington, 2003; 2009).

The Saladeño trade in youngsters would have declined as Puerto Rico became self-sufficient in population. The exchange might have ended with the catastrophic collapse of carrying capacity at the end of the Cuevas period. Concurrently, Saladeños on Martinique relocated from the humid northeast to the arid southwest and began to produce salt (Allaire, 1990). On the Orinoco the child trade survived into the late colonial period as part of the pervasive slaving culture that grew increasingly malignant under European patronage. The seamless continuity of aboriginal slaving from prehistory through the colonial period is recognized in the oft quoted summary by Gumilla:

> The main motive and cause of the mutual wars of these gentiles [i.e. natives] is an interest in the capture of women and children, and almost no concern for plunder and booty. The ancient purpose was to have captives [women] under their authority for [obtaining] offspring, and as workers in their fields, the children as *criados* (wards) in their service (1993 [1741]): 324).

Moreover, on the initiative of Spanish colonists in the early 16th century, depopulation of Puerto Rico was averted by a virtual revival of the Saladeño supply line from the Orinoco Basin. Research in progress

indicates that the terms of demand and supply of the contraband Amerindian slave trade that persisted in Puerto Rico until the end of the 18th century was essentially the same as those that are discernable for Saladoid prehistory.[13]

NOTAS

1. Although La Hueca can be plausibly derived from *huaca*, an Amerindian term widely adopted in Latin America for ancient aboriginal burial caches holding treasure-troves of ornate pottery, jewelry, and other valuables, Chanlatte (pers. comm.) asserts its meaning (literally, the hollow) refers to a deep ravine that transects the site, and is a reliable source of potable water.

2. The most extensive Saladoid chronology available for Puerto Rico (Narganes Storde, 1991) includes a single 5th century BCE date from Tecla and a single 160 BCE date from La Hueca, both of which I disregard as inconclusive, and incongruent with the chronology of events relevant to my hypothesis. The earliest cluster of dates from Vieques occurs around the beginning of the Common Era; however, itinerant Huecoid tradespeople who left earlier traces on other Antilles may have preceded the Saladoids (Watters, 1997).

3. Chanlatte designates post-transitional Hispaniolan Neo-Archaics as "Agro-III," or "Early Taino" (Chanlatte Baik, 2003a), corresponding to the Ostionoid ceramic series; however, he also recognizes that the actual transition process took place in Puerto Rico before the emergence of "Agro-III," a "Formative" stage during which diverse ethnic groups of Archaics were differentially acculturated by the agroceramic "Early Taino" (Chanlatte Baik, 2000).

4. A growing body of evidence attests that island Archaics lived in permanent settlements with gardens, orchards, and various domestic animals (Watlington, 2003; Rodríguez Ramos, 2005; Pagán Jiménez, Rodríguez López, Chanlatte Baik, & Narganes Storde, 2005); however, the main source of Archaic subsistence was fishing, which required that productive energy be devoted to making canoes and fishing gear, and going on fishing expeditions, which would have precluded extensive farming.

5. Although there is considerable variation in the density of extant and ancient pre-agricultural populations, shoreline, estuary, and riverine fisher-gatherers show the highest densities for restricted coastal habitats, for which A&CS propose a median density of one person per square kilometer. Assuming the pre-transition Archaics of Puerto Rico occupied mainly the 500 km coastal perimeter, bounding roughly half of the Island's 8,900 km² territory (rounded out, includes Vieques and Culebra islands; Cruz Báez & Boswell, 1997), its adult (i.e. reproductive) population can be heuristically

estimated at about 4,000. I exclude the non-reproductive children and assume an infant mortality rate of 50% (cf. Crespo Torres, 2000; 30%), which implies a ratio of 4 live births per woman of child bearing age to maintain a stable reproductive population, and 5 to 6 live births for a 25% non-compounded increment in one generation. Life expectancy for transitional women would have averaged 26 to 30 years, each of which would have had one child every 2 to 2.5 years from age 14 on. If children are counted, total population would have exceeded 12,000.

6. Meggers postulates extreme drought over the entire circum-Caribbean region, in contrast to torrential rains and flooding on the northern coast of Peru; however, relevant data from the stratigraphy of widely separate sites such as Paso del Indio and El Yunque (Clark 1992; 1993), suggests a scenario more akin to that of Peru. The *visit* of El Niño on the eve of Three Kings Day in 1992 is exemplary. Heavy advection crossed the isthmus of Panama bearing northeastward to collide with a southeast bound cold front along the Cordillera Central, causing catastrophic flooding and alluviation on the south coast piedmont.

7. Whitehead's exhaustive compendium of the historical Carib polity is flawed by omission of Biord Castillo's (1985) elegant summarization of the diachronic context of interethnic trade and political interaction, such that normally decentralized tribal units could on occasion coalesce into state-like confederations for a common purpose.

8. By the end of the 19th century San Rafael de Barrancas was well on its way to reclaiming prominence as trade portal of the Orinoco. A district of the province of Cumaná, Barrancas brokered the all-important distribution of salt and other coastal imports throughout the basin, until by government fiat the customs house was removed upstream to Angostura, modern Ciudad Bolivar (Briceño de Bermúdez, 1993).

9. If the sought-after commodity was salt, Boomert's (2003) proposition that the Saladeños settled Araya from Trinidad rather than directly from Saladero is questionable, as is the Rouseian presumption that Trinidad's Cedrosan is the precursor of Puerto Rican Saladoid. (see Allaire, 2003: 200); however, as he well notes, The Guarapiché 'River', an intercoastal waterway, allows safe passage from the Gulf of Cariaco to the Gulf of Paria opposite the pitch lake of Trinidad. Piché was the Arwaka cognate for the tar they obtained there for caulking large wicker baskets, for what purpose is not specified by Boomert (2000); however, Fernández de Oviedo (1959) observed that on Hispaniola especially water-proofed baskets were used to carry salt by columns of Indian bearers.

10. Callaghan's (2001) conservative assessment of Saladoid navigational capabilities does, albeit, highlight the geographical obstructions that attend the Lesser Antillean arc route and favor a beeline course.

11. Having collated archaeological and paleogeographical data, Sanoja (1989) *corrects* the eustatic Fairbridge Curve by transposing the chronology of the Paria and Florida emergences. Both Fairbridge (1976: 359) and more broadly Hallam (1992), have cautioned that reconstruction of continent-wide eustatic sealevel stands is complicated by "local neotectonic accelerations".

12. Documentary sources affirm there were several active salinas on the south coast of Puerto Rico, under control of local caciques, when the Spanish arrived in 1508 (Sued Badillo, 1985). Following the native uprising of 1510-1513, salt stocks were plundered (one raid yielded a reported 10 almudes of salt (A box-type volumetric measure, widely variable in weight depending on the nature of its contents, if salt, about 38 kg) and the salinas, all in rebel territory, abandoned and henceforth subject to guerrilla raids by the resistance until 1530 (Sued, pers. comm.). From 1514 on the colonists turned to Araya for provision of salt-cured mullet and salt, produced by native suppliers based on Cubagua Island (Otte, 1977).

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