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MORBIDITY AND MORTALITY IN ANCIENT ECUADOR: EVIDENCE FROM THE COASTAL SITE OF SALANGO

MORBILIDAD Y MORTALIDAD EN EL ECUADOR ANTIGUO: EVIDENCIAS DEL SITIO COSTERO SALANGO

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Archaeological excavations at Salango, on the central coast of Ecuador, have produced human skeletal material dating from ca. 1500 BC to AD 1531. The time range represented by the remains offers an extraordinary opportunity to examine temporal change in ancient coastal Ecuadorian patterns of morbidity and mortality. Statistics resulting from study of the skeletal material are shaped by sampling, site function, and other factors, but generally reveal increasing morbidity and mortality. Such increase was likely related to sedentism as well as to population size and density.

Key words: Ecuador, Salango, human skeletal remains.

Excavaciones arqueológicas en Salango, en la costa central de Ecuador, han producido restos óseos humanos que datan de alrededor de 1500 AC a 1531 DC. El rango de tiempo representado por estos restos ofrece una oportunidad extraordinaria para examinar cambios temporales en los patrones de morbilidad y mortalidad de la antigua costa ecuatoriana. Las estadísticas resultantes del estudio del material esquelético están determinadas por muestreo, función del sitio, y otros factores, pero generalmente revelan morbilidad y mortalidad crecientes. Tal aumento es probable que estuviera relacionado con el sedentarismo, así como con el tamaño y la densidad de la población.

***Palabras claves**: Ecuador, Salango, restos óseos humanos.*

Evidence for morbidity and mortality represents a prominent, if not dominant, feature of bioarchaeological analysis. Information on disease and health in ancient times forms the bedrock of the field of paleopathology and facilitates understanding of key anthropological issues relating to subsistence, adaptation, population growth and the quality of life in ancient times (Larsen 1999). Bioarchaeological analysis of human skeletal remains recovered from carefully excavated archaeological contexts reveals important elements of the life histories represented. Coupled with archaeological interpretations, skeletal data provide unique sources of information regarding health conditions and the factors that affected them (Milner and Larsen 2023). In comparative contexts, such studies offer an opportunity to evaluate the quality of life through time and space and understand the complex influences of geography, diet, population size and density and related cultural issues (Steckel and Rose 2002).

In Ecuador, numerous studies of human remains from archaeological contexts have provided a wealth of comparative data from a variety of time periods and geographical areas within the country. Published skeletal analyses are available from highland (Ubelaker 1980a, 1990) and coastal (Ubelaker 1980b, 1981, 1983, 1988a, 1988b, 1997) sites representing most major precontact time periods. Reports also are available on analyses of highland samples from various time periods within the historic period (Ubelaker 1994, Ubelaker and Ripley 1999; Ubelaker and Rousseau 1993). In general, these studies have documented a temporal increase in morbidity and mortality but with significant geographical variations.

This report adds to that growing literature by presenting new data from Salango, a key site located

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at the center of the Ecuadorian coast (Figure 1). Lying opposite Salango Island at the sheltered south end of a sandy bay, the Salango site, now largely covered by a fishmeal factory, has been occupied nearly continuously since about 4000 BC. Sea fishing, shellfish collection, residence, ritual performance, and sacred architecture have all contributed to the creation of an extraordinarily varied, complex, and richly detailed archaeological register of multiple, successive, and occasionally contemporaneous ancient cultural traditions.

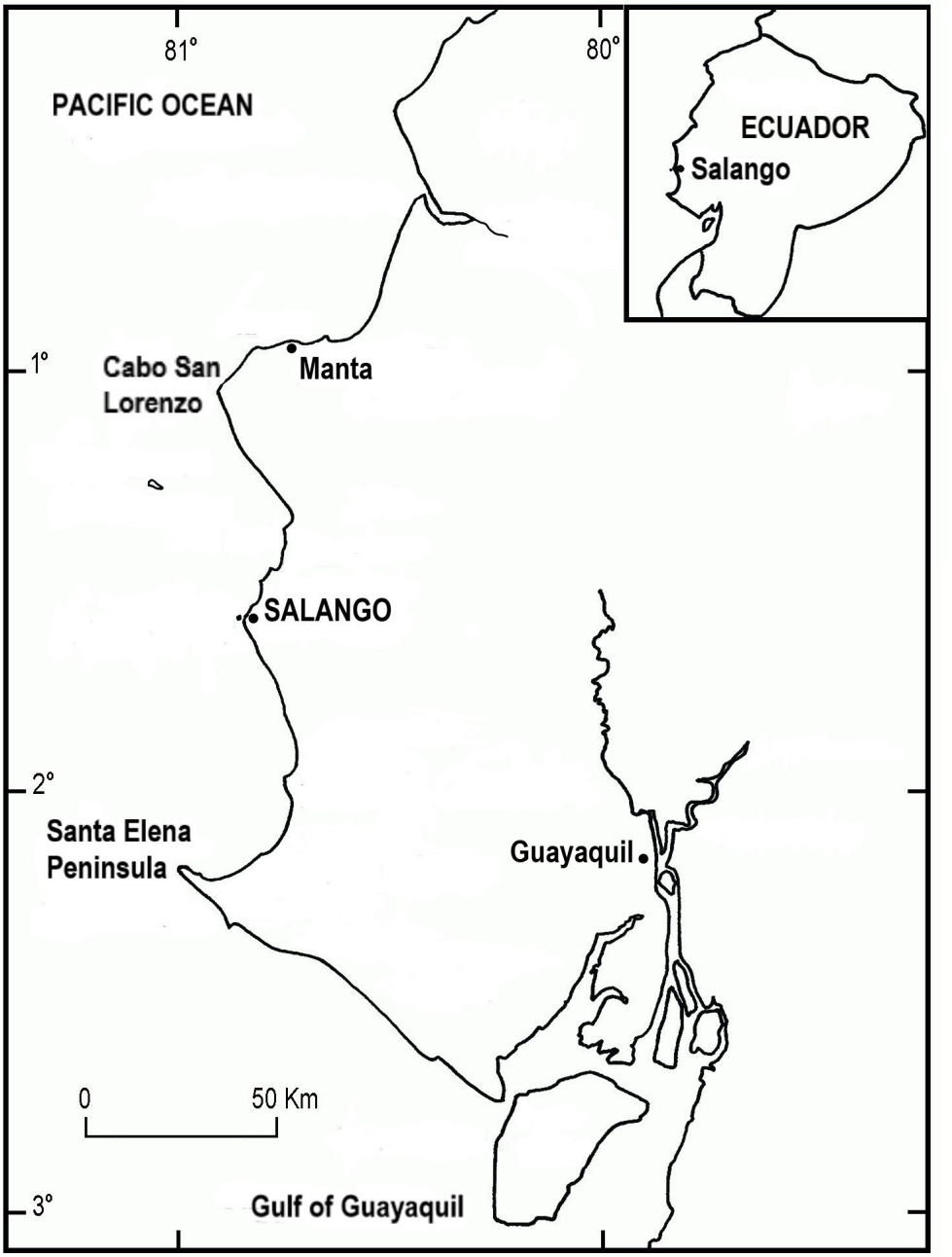

Figure 1. Location of the Salango site on the coast of Ecuador.

Ubicación del sitio Salango en la costa ecuatoriana.

The Programa de Antropología para el Ecuador (PAE), under the direction of Presley Norton, initiated in 1979 a program of field work at Salango that was to continue until 1989. Human burials associated with different occupations spanning the period ca. 1500 BC – AD 1531 were excavated and documented at Sectors 140, 141A, 141B and 141C (Figure 2). At the invitation of Presley Norton and his team, the first author analyzed the remains of over 240 of the individuals recovered, and it is these remains that are the subject of this study. Most of this material was studied at a facility organized by the first author outside of Quito, although some was examined on site and another small portion was studied at the laboratory of Karen Stothert at Cautivo, La Libertad. Data were collected in 1982, 1984, 1986 and 2003.

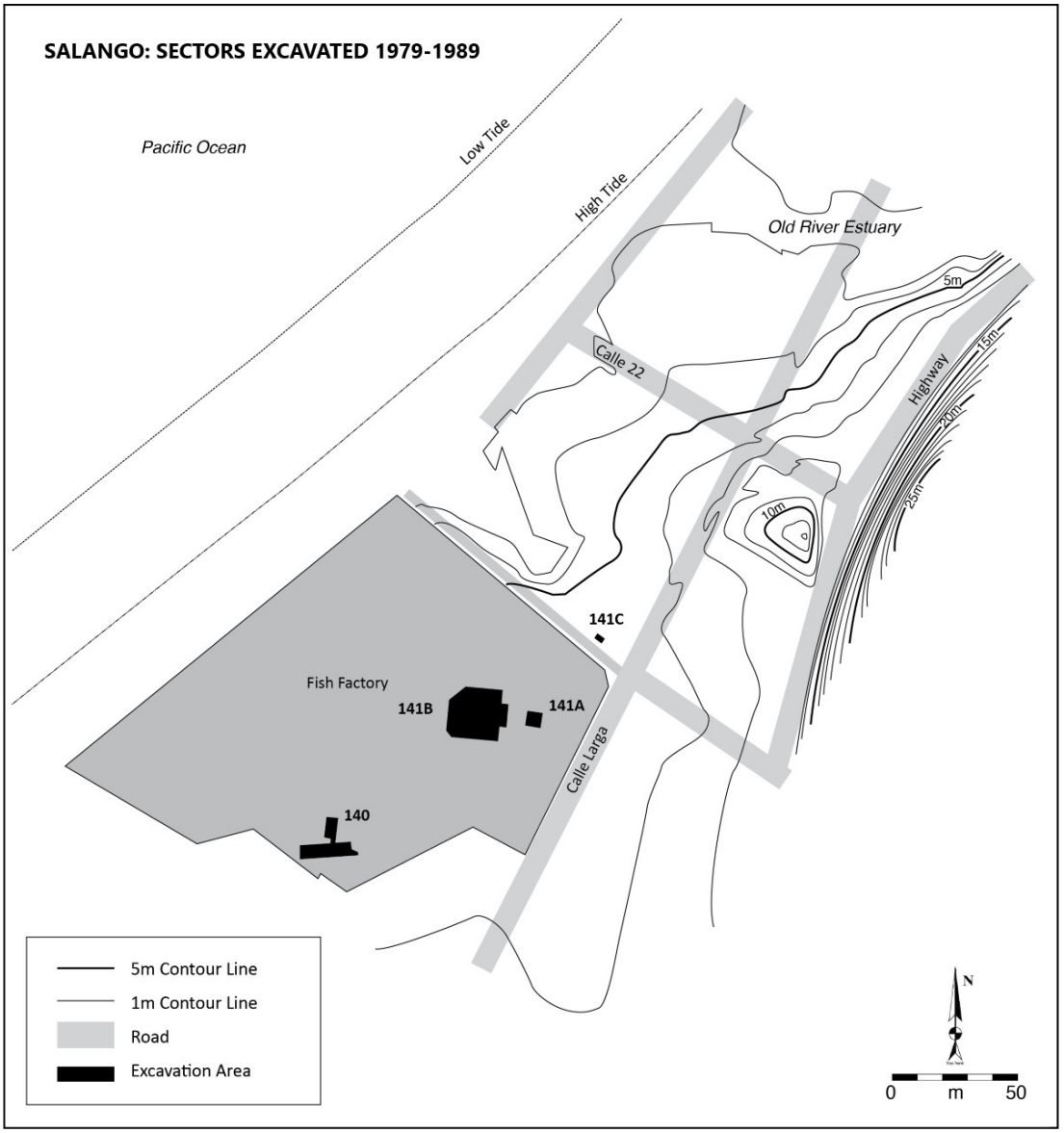

Figure 2. Map of Salango, showing Sectors 140, 141A, 141B and 141C.

Mapa de Salango, indicando los Sectores 140, 141A, 141B y 141C.

Salango Through Time

Information regarding the dating of the grouped samples, as well as information on diet, settlement pattern, and other cultural features has been gleaned from sustained archeological research over many years. This research reveals the following general characteristics of the groups represented.

The earliest documented occupation of Salango can be traced to 4000 BC, when a Late Archaic and then Valdivia fishing settlement or camp was established at the foot of the headland at the south end of the bay (Lunniss et al. 2021). There was subsequent occupation of the site, largely continuous but for a long period ceremonial rather than residential in character, up to the Spanish conquest and beyond (Norton et al. 1983; Benzoni 2000 [1572]:123). The human burials at Salango belong to four main stages of this post-Valdivia occupation.

Machalilla phase Salango (1500–900 BC) witnessed a prosperous fishing village rise over the site of the preceding Late Archaic and Valdivia settlements (Béarez et al. 2012; Norton et al. 1983). While sea fish, and especially tuna species, were the main source of protein, maize was consumed in the form of chicha and perhaps also tortillas (Béarez et al. 2012; Van der Merwe et al. 1993). The greatest density of remains spread over an area of 1 ha, though discontinuous and lighter quantities of material extend a further 2 ha around that. No house structures have been firmly identified, and the total number of houses and likely resident population is hard to determine but, using Clark et al.'s (2010) estimates for the comparably sized Valdivia Phase 1 and 2 settlements at Real Alto, Machalilla phase Salango may have been home to around 100 people. The Machalilla burials at Salango, found at Sectors 141A, 141B and 141C, were sited at or close to the center of the settlement and are all likely to have been of persons who lived in the village.

Middle Engoroy and then Late Engoroy (600–300 BC and 300–100 BC) saw a dramatic change in the function and appearance of the site. In place of the fishing village that continued from Machalilla times into Early Engoroy, an increasingly complex, extensive and important ritual sanctuary was established there. To date there is no evidence of residence adjacent to the sanctuary, which by the end of Late Engoroy covered 3 ha. But pottery vessels and sherds as well as fish remains, fishhooks, and net weights all point to a diet that, as before, was based on sea fish and maize products (Béarez 1996; Lunniss 2001).

The Middle Engoroy burials were incorporated in a ritual house at 141B (Lunniss 2001, 2021). Subsequently, the Late Engoroy burials, also at 141B, were all set within or just to the rear of an elaborate platform associated with dozens of stone ancestor figurines emerging from a surrounding ceremonial floor (Lunniss 2001, 2011, 2021). Most of the individuals buried in this highly ritualized setting were adults, and most were accompanied by one or more grave goods. While it seems likely that they were generally representatives of a local population, grave goods and other associated artifacts suggest that some at least were associated with more distant communities as well.

The end of the Late Formative occupation at Salango, currently estimated around 100 BC, was marked by a fall of volcanic ash, preserved as a 1–2 cm thick layer over the final Late Engoroy ceremonial platform at 141B, with a range of serious social and other impacts (Juengst et al. 2019; Lunniss 2023). Early Regional Development recovery during a subsequent Very Early Guangala phase is estimated to have taken around a century, and the next set of burials discussed in this study belong to the following centuries of the Early Regional Development (ca. AD 1–300). During this stage, the sanctuary was further formalized and became the focus of competing interests from the two neighboring culture groups, Early Guangala and Bahía II, whose areas of influence, to south and north respectively, converged at Salango (Lunniss 2019). Again, no residential area adjacent to the sanctuary has yet been identified. At the center of the site at Sector 141B lay an elaborate funerary enclosure that accommodated the burials of Bahía II-associated aristocrats, identifiable as such not only for the highly decorated ceremonial serving vessels that accompanied them, but also their elaborate personal ornaments and coca paraphernalia (Lunniss 2017, 2022). Outside the enclosure, but still within the sanctuary, most of the burials seem more likely to have been of Early Guangala-associated individu als, several of them also with elaborate grave offerings (Bythell 2019; Lunniss 2019), and some of these from 141C are included in the sample. It is likely that many burials were of individuals who had lived at places of the central coast distant from Salango, though some of the Early Guangala individuals will probably have resided more locally. At this stage, the joint value

of the sea and land for subsistence and identity is underscored by the inclusion of large stone anchors and maize grinding stones in the buried architecture of the enclosure (Lunniss 2022a).

Late Manteño Salango was a settlement and port linked to coastal Spondylus trade and large balsa raft navigation (Lunniss 2022a; Sámanos 1842 [1527–1528]; Szászdi 1978). All the Manteño burials, deriving from Sectors 140 and 141B, likely belong to this late stage, which is more widely datable to AD 1000–1531 (Stothert et al. 2020), though radiocarbon dates from Salango itself are limited to the centuries from AD 1300 onwards (Carter 2008:87).

Archaeological data (Norton et al. 1983) and ethnohistoric accounts (Sámanos 1842 [1527–1528]) suggest that ritual focus had by now shifted to a sanctuary on Salango Island. On the mainland, there was considerable expansion of the settlement and population. Two earth terraces, excavated at Sector 140, were constructed along approximately 400 m of the lower slope of the headland, southwest of the main area of the settlement and facing across the strait to the island sanctuary. Other than shell-bead manufacture (Carter 2008) and the reduction of *Spondylus limbatus* to lime, human interment, in both primary and secondary burials, figure among the many activities carried out there (Boyer 2019; Henderson 2022; Moore 2021). A small number of Manteño burials of different types were found immediately below the north-east end of the terraces in Sector 141B. Settlement expansion also saw colonization behind the beach to the northeast, and up the river valley and on the hill tops to the east, such that the mainland area involved, though discontinuous, likely extended over more than 40 ha. Population increase is further suggested by the widespread presence of mostly secondary urn burials (Graber and Jastremski 2009; Jastremski 2006; Norton et al. 1983: 68, Photos 38, 39). Overall population size may have been 500–1000. The burials discussed here were all from the headland terraces or the lower ground adjacent to the north-east end of the terraces.

Diet continued to be based on a combination of sea fish and shellfish, along with maize used for making chicha and tortillas. Notably, secondary burials were often placed inside pottery urns identical or very similar to large pots, presumed to have been used for chicha production and storage, and could also be capped by large *comales* such as were used as griddles for the making of tortillas. This suggests a conscious identification of humans with cooked maize.

With such marked changes in site function through its history from Machalilla to Manteño times, there would have been significant variability in individual occupation, status, and likely also diet. Thus, the Machalilla burial population probably reflected the general non-hierarchical social structure of the fishing village, although one individual stands out for unique post-mortem treatment and burial configuration. Burial in the Middle Engoroy house and even more so in the Late Engoroy platform ritual platform suggests a selection process focusing on individuals deemed appropriate for such spiritually charged settings. With the Early Regional Development there was an even stricter selection process, especially for inclusion in the central funerary enclosure, where the Bahía II aristocrats were not only of higher rank than commoners but likely also distinguished by their work. With Late Manteño, on the other hand, both the secondary urn burials and the primary burials mostly lacked any indications of special status and as such would mostly appear to be those of a commoner class engaged in a wide range of economic activities.

Materials and Methods

All human remains were unpacked, separated from any soil matrix present, sifted through a 1 mm screen, washed using water and a fine brush and dried prior to analysis. As needed and possible, individual bones were reconstructed from fragments using an acetone soluble adhesive. A careful inventory was made of all bones and teeth present. Data were collected regarding sex, age at death, living stature, and evidence of disease and trauma. Many of the reconstructed crania and pathological conditions were photographed. Following analysis, all materials were placed in labeled plastic bags, packed in the original containers, and returned to the Norton team.

Data were collected following procedures and definitions previously employed in the analysis of samples from Ecuador. Measurements and observations supporting interpretations of sex, age at death and living stature followed procedures published in Ubelaker 1978 and in subsequent editions (1984, 1989, 1999). Methods utilized were limited to those available at the time of analysis. Note that in subsequent years, many other improved methods have become available.

Depending upon the year of data collection, age estimation of the immature utilized the dental chart originally published in Ubelaker 1978, dental maturation data published by Moorrees (1965;

Moorrees et al. 1963a, 1963b) and Nolla (1960), and long bone length data published by Fazekas and Kośa (1978), Merchant and Ubelaker (1977), and Scheuer et al. (1980), among others. Age estimates for the immature were based on dental formation when the appropriate teeth were present. In the absence of dental evidence, estimates relied upon long bone length and general bone size and development.

Estimation of age at death of adults relied extensively on methods published by Baccino and Zerilli (1997), Brooks and Suchey (1990), Galera et al. (1998), Gilbert and McKern (1973), Iscan and Loth (1986), Iscan et al. (1984, 1985, 1987), Lamendin et al. (1992), Lovejoy et al. (1985), McKern and Stewart (1957), Meindl and Lovejoy (1985), Phenice (1969), Stewart (1958), and Suchey et al. (1986), among others.

Estimation of sex was not attempted for the immature due to lack of accuracy of available methods for that age period. Estimation of sex for adults relied extensively on data provided by Falsetti (1995), Holman and Bennett (1991), Lazenby (1994), Ousley and Jantz (1996), Phenice (1969), Robling and Ubelaker (1997), Scheuer and Elkington (1993), Smith (1996), and Steele (1976), among others. Estimates of adult sex relied extensively on pelvic morphology when those bones were present; otherwise, general bone size and morphology were utilized.

Stature calculations utilized data published by Genovés (1967) for indigenes of Central Mexico. Stature estimates were based upon intact femora or fibulae when these bones were available. In their absence, calculations were based on measurements of intact bones from the upper limbs or estimates made from incomplete bones. Calculations were omitted from bones that were judged to be too incomplete to render accurate maximum length estimates.

Pathological conditions of fractures, periosteal lesions, and cranial porotic hyperostosis were recorded. Porotic hyperostosis was classified as being on the cranial vault or within the frontal orbits (cribra orbitalia). The location and severity of antemortem fractures and periosteal lesions were documented.

All teeth were inventoried with documentation of tooth type and deciduous/permanent status. Evidence of antemortem loss of teeth was recorded based on evidence of tooth absence and alveolar remodeling of the tooth socket. All teeth present were surveyed for the presence of carious lesions and/or hypoplasia. All associated alveolar bone was examined for the presence of dental-related abscess.

To achieve adequate sample sizes for analysis, data were grouped into the four cultural/temporal categories of Machalilla, Middle-Late Engoroy, Early Regional Development (ERD)/Early Guangala (EG), and Manteño (Table 1). Data were included only from individuals whose context indicated correspondence to one of these four groups. Data were excluded from individuals deriving from contexts that could not be firmly dated and from isolated bones and bone fragments lacking clear contextual information. For these reasons, the numbers reported here may differ slightly from those indicated in other Salango reports.

Results

Table 2 presents the age at death and sex information derived from the analysis of the four groups.

Both sexes and the full range of ages at death were represented in all four samples. Minimal differences in age at death between adult males and females were found in all samples. In calculating the age at death values, mean individual age estimate values were used.

Comparative demographic features of the four samples are presented in Table 3. The life expectancy values were enabled through life table construction, again following procedures outlined in Ubelaker (1978). While life table presentations in paleodemography should be interpreted with caution due to possible sampling issues, they offer a useful format for demographic comparisons. The demographic features of life expectancy at birth, age 5 and age 15, as well as the ratio of immature to adult and maximum longevity were chosen for their

Table 1. Salango Samples.
Muestras de Salango.

Sample	No. Individuals	Dates
Manteño	62	AD 750 -1531
Early Regional Development and Early Guangala	120	AD 1-300
Mid-Late Engoroy	36	600 BC - 100 BC
Machalilla	25	1500-900 BC

Table 2. Age and Sex Components.
Componentes por edad y sexo.

	Male Age			Female Age			Sex?			Immature	
	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean	No.	Mean
Manteño	9	26-58	45	21	28-53	42	2	17-43	30	30	1.7
ERD/EG	36	20-55	35	38	18-50	32	26	23-55	33	20	7.2
Mid-Late Engoroy	9	18-43	34	10	23-53	38	4	19-48	35	13	2.6
Machalilla	7	29-45	36	7	16-48	31	1	33	33	10	1.5

Table 3. Comparative Demographic Features.
Características demográficas comparativas.

	Life Expectancy at Birth	Life Expectancy at Age 5	Life Expectancy at Age 15	Ratio Immature to Adult	Maximum Longevity
Manteño	23.5	35.7	26.7	0.94	58
ERD/EG	29.8	27.1	18.1	0.20	50
Mid-Late Engoroy	24.2	27.6	19.7	0.57	53
Machalilla	20.9	28.2	18.2	0.67	48

utility in comparison with previously published data from other Ecuadorean samples.

The earliest, Machalilla, sample shows the lowest life expectancy at birth at 20.9 years. This value reflects a relatively high ratio of immature to adult (0.67) as well as a relatively low life expectancy at age 15 (18.2).

The most recent Manteño sample of also reveals a relatively low life expectancy at birth of 23.5 years. This value is shaped by a very high ratio of immature to adult individuals (0.94), although coupled with a high life expectancy at age 15 (26.7).

The ERD/EG sample reveals the highest life expectancy at birth (29.8), largely reflecting the very low ratio of immature to adult individuals (0.20).

Periosteal lesions and evidence of trauma (Table 4) present valuable evidence of morbidity. Periosteal lesions refer to abnormal deposits of periosteal bone indicating that infection, or in some cases minor trauma, stimulated the periosteum to begin producing new bone. In such cases, the lesions are easily observable as new bone deposited on the normal bone surface. Such cases may have been active at the time of death or well-remodeled indicating they were formed long before death. The values reported in Table 4 indicate the highest values in the most recent Manteño sample, followed by the early Machalilla sample. Following procedures employed in previous publications on Ecuadorean samples, the values are presented as ratios to total individ uals and to adults in the samples.

All the examples of periosteal lesions were well-remodeled, indicating they represent antemortem conditions. They were concentrated in the lower limbs. Bone distribution of the 27 examples is as follows: tibia 11, fibula 5, calcaneus 2, radius 2, humerus 2, unspecified long bone fragment 2, femur 1, rib 1, talus 1.

Evidence of trauma consists of bone injury and structural disruption gleaned from direct observation and/ or through analysis of radiographs. All cases of traumatic injury were antemortem, presenting evidence of significant remodeling. No examples of trauma were detected in the earliest Machalilla sample, but relatively high ratios occurred in the Manteño

Table 4. Bones with Periosteal Lesions and Evidence of Trauma.
Huesos con lesiones periosteales y evidencia de trauma.

	Periosteal Lesions			Trauma		
	No.	Ratio No. to Total Individuals	Ratio No. to Adults	No.	Ratio No. to Total Individuals	Ratio No. to Adults
Manteño	18	0.29	0.56	9	0.15	0.28
ERD/EG	5	0.04	0.05	4	0.03	0.04
Mid-Late Engoroy	1	0.03	0.04	1	0.03	0.04
Machalilla	3	0.12	0.20	0	0	0

remains. Again, following previously established protocols, ratios were expressed in regard to the total individuals in the samples as well as the number of adults. All examples of trauma in the ERD/EG and Manteño samples were located on the postcranial skeleton, likely representing accidental injury. The specific bones involved included three ribs, two radii, two femora, and one of the following bones: proximal hand phalanx, thoracic vertebra, humerus, fibula and ulna. One frontal from the Mid-Late Engoroy sample displayed trauma, likely reflecting interpersonal violence. All the fractures represent blunt force; no sharp force trauma was observed.

Porotic hyperostosis represents a condition of the cranium displaying abnormal porosity and bone formation (Stuart-Macadam 1985). With long-term survival and remodeling following the initial expression, crania can display abnormal thickening. Many scholars (Stuart-Macadam 1987) have suggested that anemia represents the primary causal condition, produced by hereditary factors, dietary conditions, or parasitism. Previous studies of Ecuadorean samples have suggested that hookworm in coastal, sedentary populations is the likely culprit (Ubelaker 1992a). Other possible causes include infection and scurvy (Brickley 2018).

Evidence of porotic hyperostosis on the cranial vault was detected in all the Salango samples save those of Mid-Late Engoroy (Table 5). Porotic hyperostosis of the superior orbit area of the frontal (also referred to in the literature as cribra orbitalia) was confined to the Manteño sample. The data presented compares the number of bones with evidence of porotic hyperostosis to the number of individuals for which observations of porotic hyperostosis were possible.

Estimated living stature ranged from 143 cm to 165 cm in the Salango samples (Table 6). Due to extensive long bone fragmentation, samples sizes are relatively small and indicate minimal variation within the samples. In the three samples for which estimates were available, female values were consistently lower than those of males. For males, the tallest statures were recorded for the ERD/EG sample.

Table 7 presents results of dental analysis for the four samples. Antemortem tooth loss was greatest (27% of observations) in the Manteño sample, followed closely (24%) by the temporally preceding ERD/EG remains. Antemortem tooth loss in the earlier samples was considerably lower (only 2%) in the Mid-Late Engoroy group.

The greatest value for teeth with carious lesions was found in the Mid-Late Engoroy sample (9.3%) followed closely by the most recent Manteño teeth (8%). The earliest Machalilla sample presented a relatively high prevalence of about 7%.

Alveolar bone abscesses were most commonly detected in the Manteño sample (4%), followed closely in the Machalilla remains (3%). Abscesses were relatively uncommon in the Mid-Late Engoroy sample (0.9%).

Prevalence of dental hypoplasia displayed a temporal increase. No examples were found in the Machalilla sample. Percentages then increased to 1% in Mid-Late Engoroy, 2% in ERD/EG and then 3% in Manteño. Although all the values are minimal, dental hypoplasia displays the clearest temporal trend of all the dental attributes examined. Dental hypoplasia generally represents evidence of physiological stress during the period of formation of the particular tooth crown affected (Ubelaker 1992b).

Discussion

Interpretation of the demographic results at Salango incorporates archaeological information on settlement pattern and cultural issues. Archaeological

Table 5. Bones with Porotic Hyperostosis.
Huesos con hiperostosis porótica.

	Orbits (No./ No. Individuals)	Ratio	Vault (No./ No. Individuals)	Ratio
Manteño	3/62	0.05	2/62	0.03
ERD/EG	0	0	2/34	0.06
Mid-Late Engoroy	0	0	0	0
Machalillia	0		2/25	0.08

Table 6. Estimated Living Stature.
Estatura viva estimada.

	Male			Female		
	No.	Range	Mean	No.	Range	Mean
Manteño	3	155-160	157	7	143-159	149
ERD/EG	3	163-165	164	9	143-160	151
Mid-Late Engoroy	0	0	0	0	0	0
Machalilla	5	155-162	160	7	146-154	151

Table 7. Permanent Teeth.
Dientes permanentes.

	No. Present	Antemortem Absence (No. Absent/No Observations)	Carious Lesions (No. Teeth Carious/ No Observations)	Alveolar Abscess (No./ No. Observations)	Hypoplasia (No. / No. Observations)
Manteño	300	150/548 (0.274)	23/289 (0.080)	11/276 (0.040)	8/298 (0.027)
ERD/EG	1185	30/1272 (0.024)	29/1143 (0.025)	11/456 (0.024)	19/1182 (0.016)
Mid-Late Engoroy	292	6/310 (0.019)	27/290 (0.093)	1/113 (0.009)	3/292 (0.010)
Machalilla	293	33/37 (0.098)	20/292 (0.068)	9/270 (0.033)	0/293 (0)

evidence suggests that the Machalilla and Manteño samples represent deaths of the corresponding local settlement populations. In contrast, those of Mid-Late Engoroy and ERD/EG relate to development of the site as a ceremonial center with a focus on the burial of selected and mainly adult individuals. Accordingly, life expectancy at birth values of Machalilla and Manteño are substantially lower than the others, reflecting greater numbers of the very young. This difference is also clearly marked in the ratio of immature to adult individuals, with Machalilla and Manteño displaying higher values. Manteño presented the highest value for life expectancy at age 15, indicating that survivors of the high mortality early in life lived longer than those represented in the earlier samples. Maximum longevity was also greatest in the Manteño sample, although age at death of the elderly is difficult to estimate accurately.

Data on periosteal lesions and evidence of trauma suggest a clear temporal trend of increasing morbidity at Salango. These pathological conditions reflect extensive infection and severe trauma likely associated with temporal increases in population size and density. The observed lesions all displayed remodeling, suggesting that the individuals survived the infection/trauma events. Pressures of increased population size and density likely resulted in higher risk of infection and broken bones. Bone fractures likely represented falls or other accidental injury, except for the single fractured frontal from Mid-Late Engoroy that may represent interpersonal violence.

Although sample sizes are small, data on porotic hyperostosis also suggest increased morbidity in the Manteño population, particularly with the expression of the condition in the frontal orbit area. Cranial vault expressions show greater temporal variation with the highest value expressed in the Machalilla sample. Although the causal factors of this condition are not clear, parasitism can be suggested, and hookworm is the likely agent. The life cycle of the hookworm favors expression in a sedentary coastal human population (Ubelaker 1992a). Dietary anemia represents an alternative explanation but is unlikely in the Salango samples due to their iron-rich seafood diet.

The Salango dental data offer corroborative evidence of temporal increase in morbidity in populations represented by the four samples. The categories of antemortem absence, carious lesions and alveolar abscess are closely linked. Untreated carious lesions can expose the root canal to mouth bacteria. These bacteria can colonize in the bone at the base of the tooth root creating alveolar abscesses. Alveolar abscess leads to bone loss. Bone loss contributes to loss of the tooth during the life of the individual (antemortem absence). Although many factors can contribute to the development of dental caries, diet represents a likely culprit (Larsen et al. 1991), and scholars have suggested that maize consumption is cariogenic due to its high starch content (Turner 1978). Archeological evidence suggests that maize consumption in the form of chicha and tortillas occurred throughout the Salango sequence. The caries data reported here suggest that maize consumption likely was less during the high-status ERD/EG component of the site.

The results presented above offer an opportunity for comparison with those published for other ancient Ecuadorean samples. In particular, Ubelaker (1995) presented summary statistics for 20 samples representing 1474 individuals published at that time. Values were grouped into early precontact, intermediate precontact, late precontact, early historic and late historic categories from both coastal and highland samples. Temporal trends of increasing morbidity and mortality were documented with some variation.

Comparison of the Salango data with the Ubelaker (1995) information reveals the following noteworthy excessive values for the former. Machalilla, Mid-Late Engoroy and ERD/EG present the lowest life expectancy at age 15 values. Machalilla also shows the lowest hypoplasia and trauma prevalence. Mid-Late Engoroy remains presented record low values for the periosteal lesion/adults, antemortem dental loss, and alveolar abscesses but the highest value among prehistoric samples for dental caries. The ERD/EG sample presents record low values for periosteal lesions/individuals, adult longevity, and teeth with carious lesions but the greatest stature values. The most recent Manteño sample revealed record high values for life expectancy at age 5, periosteal lesions/adults, and record high levels of alveolar abscess and trauma among prehistoric samples.

Conclusions

The human remains from Salango presented in this study represent a time range of approximately 3,000 years and thus offer valuable perspective on temporal change in patterns of morbidity and mortality in coastal Ecuador. Analysis of the remains also reveals complexity shaped by factors related to sampling, site function, and individual occupation and social status. Salango populations enjoyed a healthy, iron-rich seafood diet supplemented with maize, although a high caries prevalence occurred in the Mid-Late Engoroy sample, perhaps indicating heightened reliance on maize among those represented. The earliest (Machalilla) and latest (Manteño) components each represent deaths among the contemporary local settlement population and reveal long term patterns of increasing morbidity and mortality, largely related to population density and sedentism. Values for the Mid-Late Engoroy and ERD/EG samples also reflect that pattern but are influenced by differences in the respective burial assemblages associated with site use as a ceremonial center.

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