A LATE FORMATIVE PERIOD OCCUPATION IN EL ORO, ECUADOR: A CASE FOR ECOLOGICAL CATASTROPHE?

Elizabeth J Currie (University of York)

In the early 1970s shrimp farmers began an intensive and ecologically controversial exploitation of the coast of El Oro (figure 1), constructing extensive and intricate systems of banks, dykes and lagoons (*camaroneras*) within which to rear large tropical prawns for the international export market.

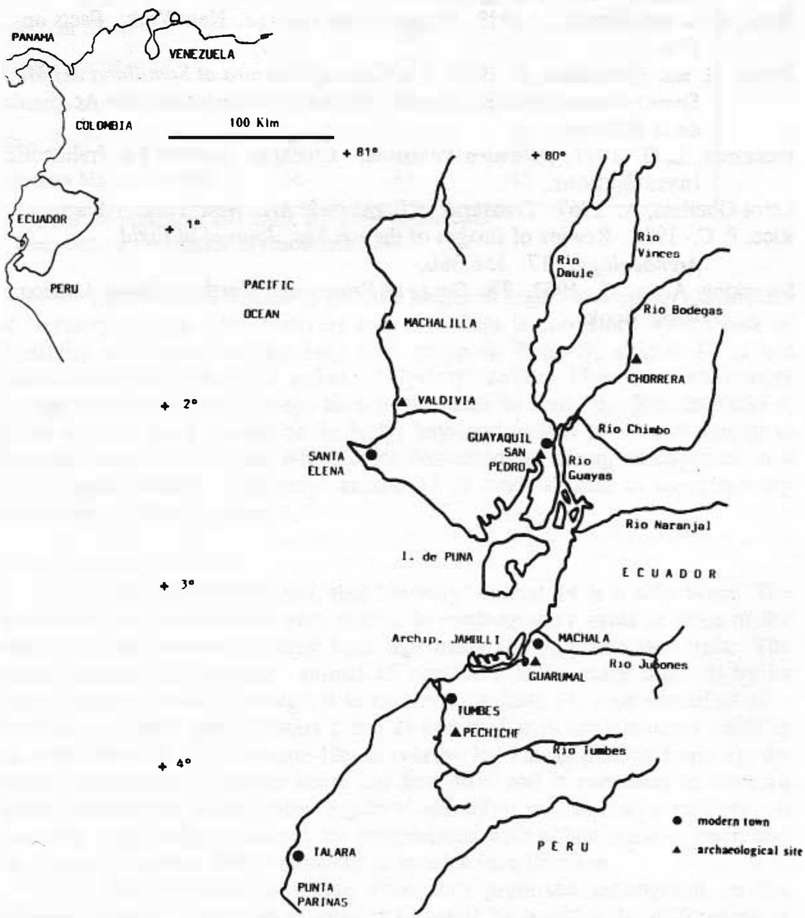
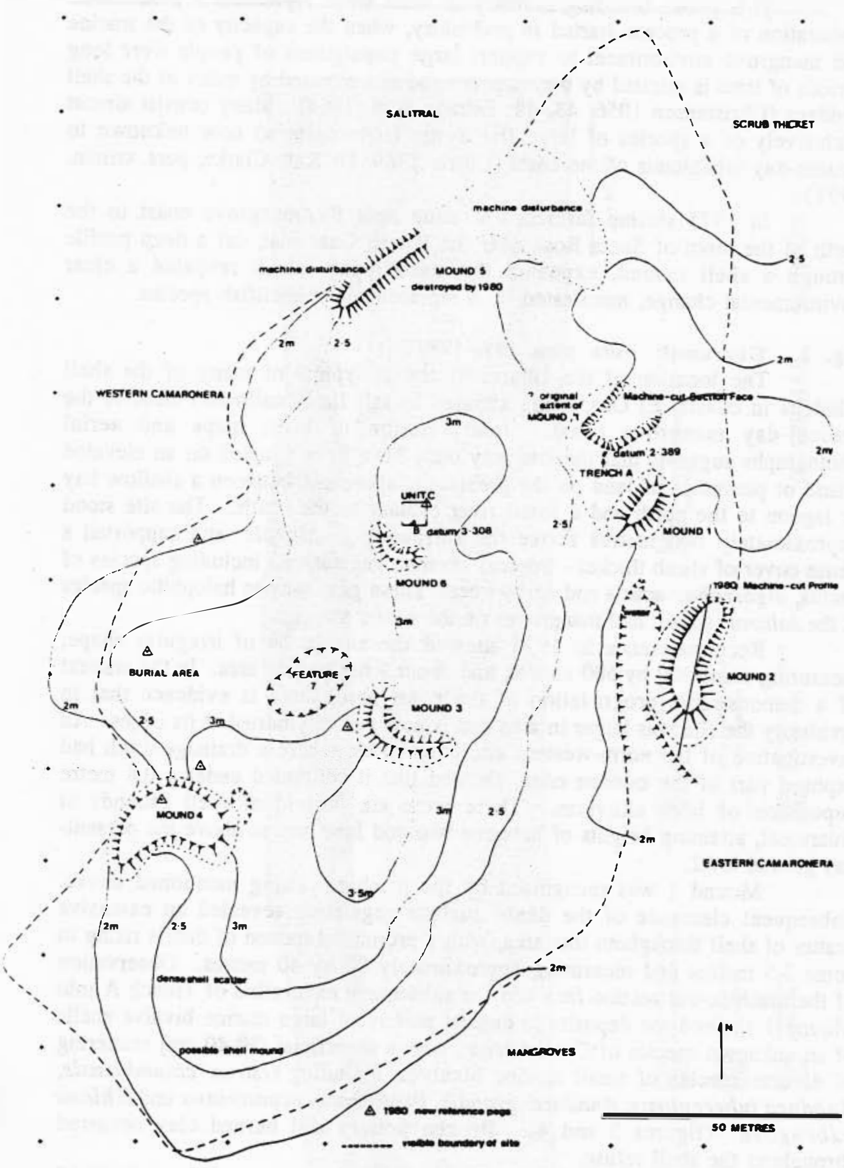


Fig. 1. Map of S. Ecuador and N. Peru



GUARUMAL SITE PLAN - 1976 & 1980

The Guarumal site (figure 2)

This prawn-breeding industry in some ways represents a commercial elaboration of a process started in prehistory, when the capacity of the marine and mangrove environment to support large populations of people over long periods of time is attested by the numbers and size attained by many of the shell middens (Christensen 1956: 43, 48; Estrada et al. 1964). Many consist almost exclusively of a species of large flat oyster (*Crassostera*) now unknown to present-day inhabitants of the coast (Currie 1989; Dr Kate Clarke, pers. comm. 1991).

In 1975 shrimp farmers operating near the mangrove coast to the north of the town of Santa Rosa near the Estero Guaramal, cut a deep profile through a shell mound, exposing the stratigraphy which revealed a clear environmental change, manifested by a replacement of shellfish species.

Fig. 2. Guarumal: site plan 1976-1980

The location of the Guarumal site is typical of many of the shell middens in coastal El Oro, being situated in salt flats (*salitrals*) close to the present-day mangrove coast. Interpretation of local maps and aerial photographs suggests that the site may once have been situated on an elevated island or peninsula of land on the prehistoric shoreline, between a shallow bay or lagoon to the north and a fossil river estuary to the south.. The site stood approximately two metres above the surrounding *salitrals* and supported a dense cover of shrub thicket - tropical savanna vegetation - including species of cactus, *algarrobo*, acacia and *ceibo* trees. These gave way to halophitic species at the *salitral* edges, and mangroves on the wetter margins.

Reconnaissance in 1976 showed the site to be of irregular shape, measuring some 300 by 500 metres, and about 9 hectares in area. In the context of a demonstrable progradation of the coast here, there is evidence that in prehistory the site was larger in area and is now partially buried at its edges. An investigation of the north-western site boundaries, where a drainage ditch had exposed part of the midden edge, showed that it continued under a 0.8 metre deposition of later alluvium. There were six individual shell mounds at Guarumal, attaining heights of between two and four metres above the present-day ground level.

Mound 1 was recognised by the machine-cutting mentioned above. Subsequent clearance of the dense surface vegetation revealed an extensive scatter of shell throughout this area, with a prominant mound of debris rising to some 2.5 metres and measuring approximately 80 by 40 metres. Observation of the machine-cut section face and the subsequent excavation of Trench A into Mound 1 showed the deposits to consist mainly of large marine bivalve shells of an unknown species of *Crassostrea* , with a superficial (30-40 cm) scattering of diverse species of small marine bivalves, including *Ostrea columbiensis*, *Anadara tuberculosis*, *Anadara grandis*, *Protothaca ecuatoriana* and *Chione subrugosa* (figures 3 and 4). Broken pottery and burned clay occurred throughout the shell refuse.

Mound 2 was kidney-shaped, and measured approximately 60 by 35 metres, rising to a height of 2.14 metres above the present-day ground level. Superficial reconnaissance revealed a high percentage of the cupped mangrove oyster, *O. columbiensis*, together with small quantities of very eroded oxidised red pottery in the most superficial layers. The area of ground between the

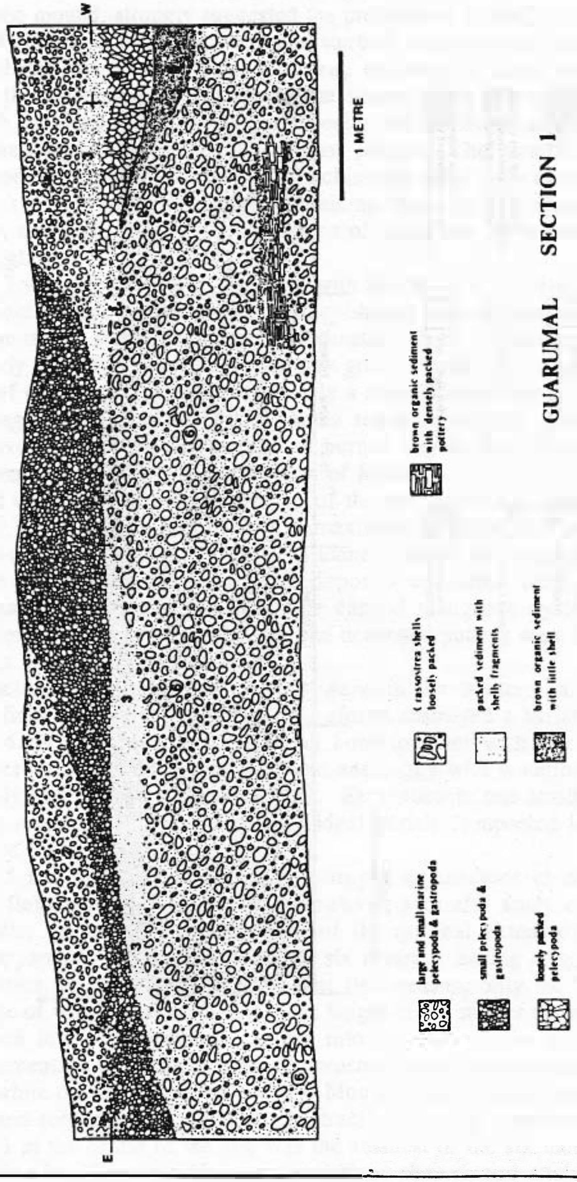


Fig. 3. The machine cut section face Mound 1

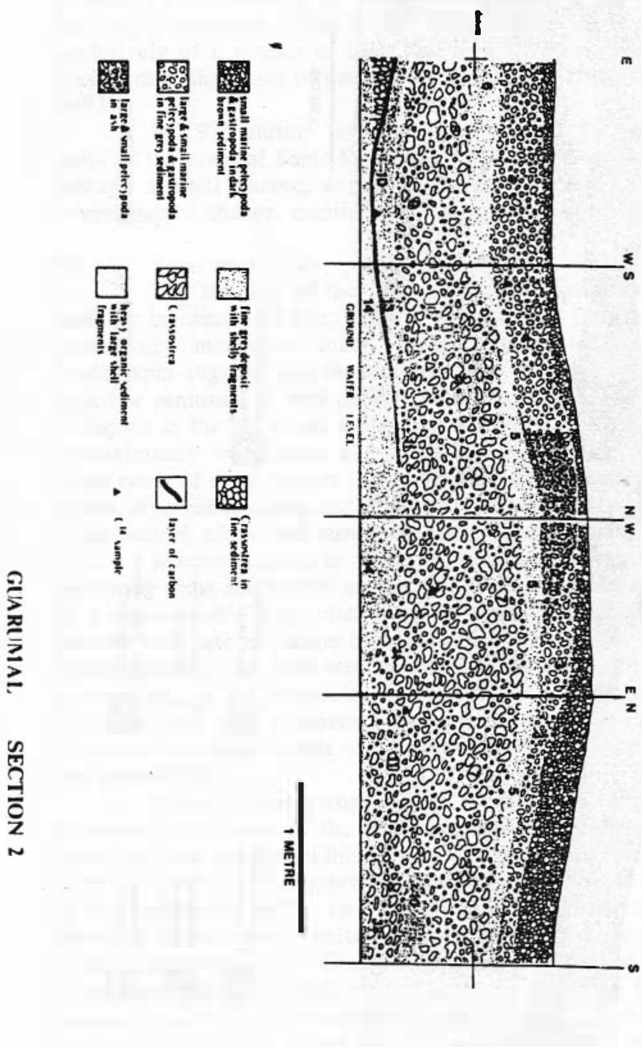


Fig. 4. Composite of profiles Trench A and Mound 1

eastern hollow of the mound and the western edge of the flanking *camaronera* was profusely scattered with large pieces of burned clay, many of which still retained the impression of cane wattling. This, together with the characteristic kidney shape of the mound, strongly suggested the presence of a structure here.

In 1976 Mound 2 was intact and undisturbed, but was later partially bulldozed to enlarge the eastern *camaronera*, exposing a deep profile. Examination of this machine-cut section in the second field season (1980) confirmed a high incidence of *Crassotrea* species and a virtual absence of pottery, other than fragments in the uppermost layers. The stratification revealed in Mound 2 resembled that of the machine-cut section-face and the Trench A profiles of Mound 1, although containing more grey sedimentary layers and lenses, and a slightly higher proportion of small mangrove-dwelling pelecypods throughout.

Mound 3 was one of the two mounds (with Mound 4) to survive intact into the second field season. It was another kidney-shaped mound, located towards the centre of the site, measuring approximately 45 by 15 metres wide and rising to nearly 4 metres over the present-day ground level. It contained a high percentage of *Crassostrea* species, with only a superficial scatter of small mangrove-dwelling shellfish, together with some red-ware pottery. Surface reconnaissance revealed substantial quantities of burned clay in the central area of the site, apparently associated with the hollow of Mound 3.

Located upon the south-western edge of the site, Mound 4 measured approximately 60 by 30 metres and attained a maximum height of 2.7 metres above the present-day ground level. It, too, was kidney shaped, but had a flatter profile than the other mounds. superficial deposits consisted of a high proportion of small *pelecypoda*, including the cupped mangrove oyster *O. columbiensis*. Sherds of fine red and white-on-red decorated pottery were found in surface contexts around this mound.

Construction of a large new *camaronera* in the western salt flat between the two field seasons had disturbed and almost destroyed a burial area north of Mound 4. Large quantities of human bone together with fine red-painted pottery were scattered in the area, broken and soggy with waterlogging from the artificially high ground water table here. Excavation in one small area here revealed the remains of up to seven individual burials compacted into a deposit of less than 50cm in depth (Currie 1989).

Mound 5 had already been largely destroyed by machine clearance prior to the first field season at Guarumal. However, a careful study of the surface shell scatter allowed a reconstruction of the original extent of this mound. It was apparently the largest of all the six mounds, having originally measured 115 metres by 65 metres. By the first field season, only the "tail" remained, the ridge of which attained a maximum height of 3.4 metres above the present-day ground level. A machine cutting into the side of the tail had revealed a high percentage of shells of large *Crassostrea* species, together with red-painted and white-on-red decorated pottery. Mound 5 was totally levelled between the first and second field seasons, to construct a large new *camaronera*.

Mound 6 in the centre of the site was the smallest of the six mounds, measuring 25 metres by 10 metres. It, too, was kidney shaped, and attained a maximum height of 1.5 metres above the present-day ground level. The surface shell scatter associated with this mound appeared to indicate that it consisted of a high proportion of diverse species of small mangrove shellfish, including the cupped mangrove oyster *O. columbiensis*. Subsequent excavations in this area, however, indicated the presence of deep accumulations of the large *Crassostrea* species in the lower strata. Dense surface scatter of burned clay in the vicinity of the hollow of Mound 6 guided the location of Trench B to test for structural evidence for human occupation. During the second field season it was decided to open a ten metre square area, Trench C, close to the indentation of the mound in order to recover more information on the occupation, together with a plan of any structures that had existed there.

Mound stratigraphy

The stratigraphy of the machine-cut section and Trench A of Mound 1 showed three broad groups of layers, an upper, middle and lower. These were characterised by a high percentage of small marine bivalves and univalves in the upper layers, lying unconformably over layers containing a high proportion of the large flat *Crassostrea* species. This break was associated with fine grey silty sediments, possibly indicative of a phase of disuse or even general site abandonment.

The lower strata in Trench A just visible in the machine-cut section face of Mound 1 consisted of fewer *Crassostrea* in a dark, greyish-brown sediment, which also contained very weathered pottery sherds. The lower layers contained much organic matter, and possibly represented a humus-rich 'A' horizon of the fossil pre-midden land surface.

The occupation in Trench C by Mound 6 was represented by a sequence of well-constructed floors, post-holes and construction trenches. Although reconnaissance had indicated a high incidence of small mangrove-dwelling species of shellfish, such as *O. columbiensis* in Mound 6, the lower layers of the two excavated sub-units showed that a high proportion of the lowest layer again consisted of the large flat oyster *Crassostrea*.

Radiocarbon dates

Radiocarbon dates from charcoal from Trench A, mound 1 and Trench C, Mound 6, in conjunction with the stratigraphic evidence and the pottery typology have assisted in the formulation of a chronological framework for the site.

Beta 22914-6 on charcoal from a deep floor layer cut by Feature 8 in Trench B (a deep 'structural' phase post-hole) gave a date of 2250 ±95 BP.

Beta 22915-7 on charcoal from Feature 2 Trench C ('walltrench' possible wattle and daub building phase) gave a date of 1830 ±80 BP.

Of the four samples submitted to the British Museum Research Laboratory, two were affected by laboratory errors and only unrevised dates, 'too young' by up to 250 radiocarbon years are available (Bowman et al. 1990), while two were later remeasured and given revised dates. These are:

Layer 11, Trench A (*Crassostrea* strata), 2020 ±130 BP [BM 1684R].

Layer 13, Trench A (charcoal of a fossil pre-midden land surface), 2040 ±120 BP [BM 1684R].

[BM 1689] from layer 27 Trench B (upper floors),remains unrevised at 1960 ±40 BP and [BM 1688] from layer 4 of Trench A remains unrevised at 1475 ±35 BP.

Occupation phases

Stratigraphic excavation of two key areas at the Guarumal site showed two clear phases of site occupation based upon the exploitation of the large oyster, and between these, structural evidence was recovered in the form of living floors, deep post-hole and 'construction trench' structures (Currie 1989). Continuing exploitation of *Crassostrea* during this interval is probable.

The initial phases of refuse deposition for Mound 1 probably occurred around the final phases of floor construction in Trench C. They were, however, likely to be earlier than the structural phases of the Trench C occupation, dated to around 1830 ±80 BP (Beta 22915-7). This also tends to be confirmed by analysis of the pottery (Currie 1989). The large oyster continued to be exploited by those dwelling in the vicinity of Mound 1, until a sharp break in the deposition showed a break in occupation which was marked by the disappearance of *Crassostrea* as a resource.

The following phase represents a transition which is experienced in the archaeological record as an accumulation of fine grey sediments containing few shells or pot sherds. These sediments tend to suggest a phase of mound abandonment, which is further supported by the fossil land-snail record (Currie 1989). Following this hiatus, Mound 1 was apparently re-used and is marked by a high proportion of smaller mangrove-dwelling species of shellfish. The large *Crassostrea* had completely disappeared.

Summary of the occupation at Guarumal (Figure 5)

1) Earliest exploitation during preceramic times of unknown date is represented at Mound 2. *Crassostrea* was by then a major food source, supplemented by *O. columbiensis* and *A. tuberculosa*. The flat, uncupped morphology of this unknown species of *Crassostrea* infers open estuarine, or protected shoreline conditions, where oyster beds of this kind could accumulate in an environment which was not unduly silty. *O. columbiensis* and *A. tuberculosa* are both found in mangrove conditions, suggesting that the occupants of Guarumal were able to exploit both types of ecosystem from the site.

2) Periodic exploitation from preceramic to ceramic times are attested by individual mounds on the site as yet not studied in detail. Mounds 3 and 5 which both contain high percentages of the large *Crassostrea* well into their surface layers are possibly from this period.

3) The occupation at Mound 6 begins with the deposition of *Crassostrea* onto the natural thick grey clay, with the succeeding layer consisting of shells embedded in clay. There is no sign of a fossil pre-midden soil such as existed in the lower strata of Mound 1. It may be feasible to interpret the clay here as fossil shoreline or *estuary* bank.

4) The next phase of the occupation is marked by concretion of the deep *Crassostrea* strata with a hard concreted lime-based material, 20 centimetres thick. Up to eight successive floors can be demonstrated, although as yet it has not been possible to assign any particular form of structure to them. A date of 2250 ±95 BP (Beta 22914-6) on charcoal from another early floor context towards the base of a deep post hole close by, gives an idea of the age of this phase, although the earliest floors may well be older. Exploitation of the large oyster continues. Stylistic analysis of the pottery places these occupations within the Ecuadorian Late Formative period (ca. 300-100 BC, Currie 1989), with affinities to the Guayaquil phase, Chorrera and Engoroy cultures of the Guayas Basin (Aleto 1988; Parducci and Parducci 1975; Evans and Meggers 1957; Bischof 1975) and principally to the Pechiche culture of the far north coast of Peru (Izumi and Terada 1966).

5) In Mound 1, dark, brownish-grey sediments underlying the *Crassostrea* may represent a fossil humus-rich 'A' horizon of the original land surface, prior to the main phase of midden use here. Charcoal from one of the lowest layers (layer 13) produced the date of 2040 ±120 BP (BM 1682R). *Crassostrea* continue in large quantities in the 'middle' group of strata from Trench A and the machine-cut profile. Charcoal from this context (layer 11) produced a date of 2020 ±130 BP (BM 1684R). Deposits of the large flat oyster produced a date of 2020 ±130 BP (BM 1684R). Deposits of the large flat oyster continue for about a metre above this, and then cease abruptly.

6) Pottery evidence suggests that Mound 4 may provide the next phase in the sequence, although there are no corroborative stratigraphic evidence or radiocarbon dates for this (Currie 1989: 98).

7) Occupation in the vicinity of Mound 6 continued after the earliest 'floors' phase, with at least two different successive building periods characterised by the deep post-hole (possible pile-built) structures, followed by 'wall trench' (postulated wattle and daub) style dwellings. These succeeded the floor-building phase by an interval of time sufficient for a soil to have developed over the last floor, a fact supported by the later 1830 ±80 BP date obtained from a stake-hole of one of the 'construction trench' features.

8) Fine grey sediments which succeed in the next layers of the machine-cut profile and Trench A indicates a period of mound abandonment. The highly calcareous nature of the sediments on the mounds precluded a study of the pollen. However, high percentages of shade and litter-loving species of land molluscs in samples from these sediments supports this interpretation, indicating that during this phase of disuse, the mounds were colonised by vegetation (Allen in Currie 1989).

9) The final phase of site use is represented by the uppermost strata of small mangrove dwelling shellfish from Trench A and the machine-cut profile. Charcoal from a late layer (layer 4) in Trench A produced an unrevised date of 1475 ±35 BP (BM 1688), which may be earlier by some 250 radiocarbon years (see above). These upper layers represent the latest phase of site exploitation,

with the pottery now showing a stylistic relationship with the Ecuadorian Regional Development Period (*ca* 100-AD 500), represented by the Jambeli culture here (Estrada et al. 1964). Shortly after this, the site was apparently abandoned.

Discussion

It is probable that each mound at Guarumal developed around the presence of one or more dwellings from which the inhabitants discarded refuse over successive years, resulting in the characteristic kidney shape of the mound.

Although it is not possible to calculate the exact length of time of the different occupations, there is nevertheless an indication that these mounds developed over the space of a few hundred years. The depth, size and complexity of the 'floors' and 'structural' phases of occupation from the vicinity of Mound 6 support the view that the Guarumal occupations were unlikely to have been the transient or seasonal camps of a shifting populace occupying flimsy dwellings. The pottery typology also supports the long-term view, showing a gradual change from Late Formative period styles in the 'floors' and 'structural' phases to those more characteristic of the Regional Development period in the Late phase upper group of mound strata (Currie 1989: 278-9).

It is not clear how many settlements existed together at any one time, or if each of the mounds represented a discrete occupation. The evidence tends to support the view that the settlement moved around the site through time, for the occupations associated with Mounds 1 and 6 only partially overlap, a view supported both by the radiocarbon and ceramic data.

For much of the period of occupation, a species of *Crassostrea* was an important resource. The ready availability of such an excellent resource would explain the size, apparent permanency and duration of Guarumal's occupation. The diet is likely to have been supplemented by fish, crabs and smaller shellfish from the mangrove swamps, and by the hunting of small game such as water fowl, deer and peccary (Currie 1989). Maize agriculture is suggested by the Form 13 *comales*, and by the presence of *manos* and *metates* (from surface context), but this association is stronger with the later, post *Crassostrea* phase.

The stratigraphic evidence supports the view that the disappearance of the *Crassostrea* species was sudden, rather than a gradual reduction over a long period of time, through over-exploitation. Nor can a gradual environmental change be argued, from a primarily open estuarine habitat favouring the formation of deep oyster beds, into muddier, more enclosed mangrove conditions, where the cupped oyster *O. columbiensis* and such mud-dwellers as *A. tuberculosis*, thrived. Instead it is argued that natural events may have been responsible for wiping out the local oyster beds in one episode, bringing to an end the Late Formative period occupations here.

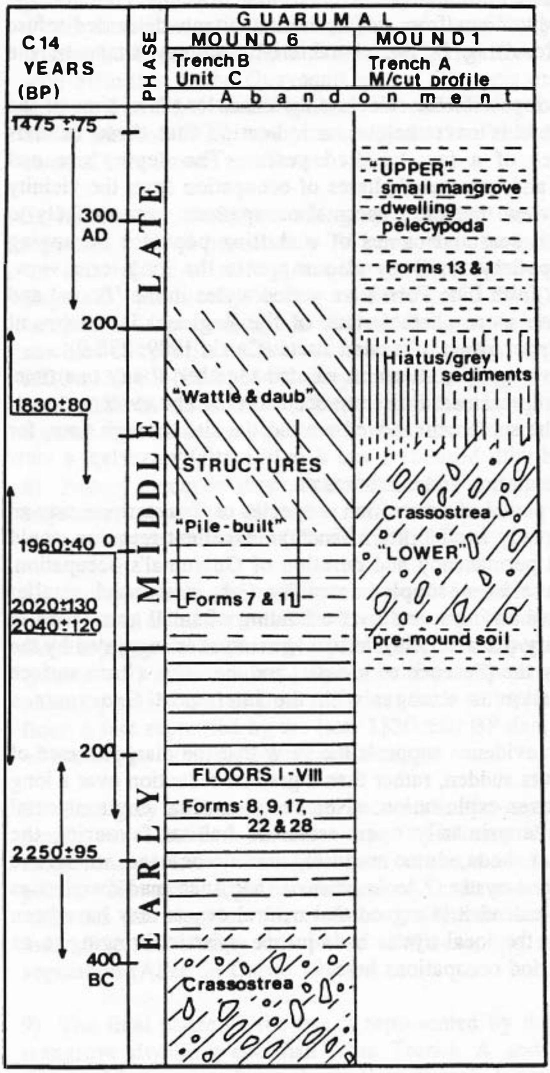


Fig. 5. Occupation phases at Guarumal

El Niño-Southern Oscillation (ENSO)

Such an event could well be represented by the periodic and cataclysmic El Niño-Southern Oscillation phenomenon which still affects the region today, and by causing torrential rain, flooding and mud-slides, is capable of wreaking ecological catastrophe.

ENSO events involve complex oceanic-atmospheric interactions which affect a large part of coastal South America, south from Ecuador. These should not be confused with 'El Niño', the less severe annual deflection of the equatorial counter-current south to between 2° and 4° south around Christmas time.

Many observers have recounted events of ENSO years in detail (e.g. Murphy 1926; Caviedas 1975), describing seasons of heavy rainfall and flooding, sometimes nearly as far south as Chile. The ENSO phenomenon has clearly been an important environmental influence during the last 5,000 years BP (Rollins et al. 1986). Archaeological research along coastal Peru has revealed evidence of prehistoric ENSOs which caused severe flooding at different periods in the history of the central Moche valley (Nials et al. 1979; Browman 1983; Moseley 1987). Flooding had been attested in the archaeological record here sometime before AD 700, and at around AD 1100 (ibid). Between AD 700 and AD 1000, an episode of substantial flooding attributable to an ENSO event has been identified at Batán Grande, northern Peru (Craig and Shimada 1986). Yet another fourteenth century AD event has been documented from two Chimu settlements in the Casma valley, Peru (Moore 1991).

The southern coastal regions of Ecuador are also affected by years of higher than average rainfall and ENSO events, which result in flood damage to arable land and human settlements, the most recent of which occured in 1982-3 (Philander 1983). ENSO events accelerate the gradual processes of coastline progradation here, causing massive alluvial discharge from major rivers, some of which may also burst their banks, cutting new channels elsewhere. It is therefore possible that a massive alluvial deposition occurred during one such prehistoric event, destroying the local silt-sensitive oyster beds and possibly leaving an ancient beachline stranded inshore. Such an event may be reflected in the hiatus observable in the archaeological record in the sections through Mound 1.

When re-occupation took place, it seems to have been of a more limited nature, and possibly seasonal. Small, mangrove-dwelling molluscs now dominate the food refuse strata, perhaps suggesting that the environment of the locality had shifted towards a dominance of mangrove over open estuarine, or simply that the *Crassostrea* species having disappeared, the occupants of the site were now dependent upon the smaller shellfish. Pottery mortars (*comales*) are found in far higher proportions in the Late phase layers of Trench A, Mound 1, possibly implying that maize consumption had become more important among the people now occupying the site. These late phase occupations were, however, of short duration, and the final abandonment of Guarumal occured sometime around AD 475.

Acknowledgements

I should like to take this opportunity to thank Olaf Holm, Director of the Museo Antropológico del Banco Central del Ecuador for his past and continued support and encouragement in my work. I also owe thanks to Dr. Kate Clarke, currently working with the Programa de Antropología para el Ecuador in El Oro, Ecuador, for information shared with me, which I am able to report in this article.

Samples of the species of large flat oyster were taken to the British Museum of Natural History for identification, by Solene Morris, together with examples of all the other shell species found at Guarumal. An accurate identification could not be made of this type, given the ease with which members of the oyster family speciate. A fuller discussion of this question is contained in Appendix 1, Currie, 1989: 291.

References

Aleto, T. F. 1988. The Guayaquil Phase Ceramic Complex: the Late Formative Period in the Gulf of Guayaquil, Ecuador. Unpublished Phd thesis, University of Illinois, Urbana-Champaign.

Bischof, H. 1975. La Fase Engoroy - periódos, cronología y relaciones. In *Estudios sobre la Arqueología del Ecuador* (ed V. Oberem). BAS 3, pp. 15-42.

Bowman, S.G.E., Ambers, J.C. & Leese, M.N. 1990. Reevalutation of the British Museum Radiocarbon Dates issued between 1980 and 1984. *Radiocarbon* 32: 59-79.

Browman, D.L. 1983. Tectonic movement and agrarian collapse in prehispanic Peru. *Nature* 302: 568-569.

Caviedas, C. 1975. El Niño 1972: its climatic, ecological, human and economic implications. *Geographical Review* 65 (4): 493-499.

Christensen, R.T. 1956. *An archaeological study of the Illescas-Jubones coast of northern Peru and southern Ecuador.* PhD thesis, Department of Anthropology, University of Arizona. University Microfilms International, Ann Arbor.

Craig, A.K. & Shimada, I. 1986. El Niño flood deposits at Batán Grande, northern Peru. *Geoarchaeology: An International Journal* 1 (1): 29-38.

Currie, E.J. 1989. Cultural relationships in southern Ecuador 300 BC - AD 300: excavations at the Guarumal and Punta Brava sites. Unpublished PhD thesis, Institute of Archaeology, University College London.

Estrada, E., Meggers, B.J. & Evans, C. 1984. The Jambelí culture of south coastal Ecuador. *Proceedings of the United States National Museum, Smithsonian Institutions, Washington, D.C.*, 115 No. 3492: 483-558.

Evans, C. & Meggers, B.J. . 1957. Formative period cultures in the Guayas Basin, coastal Ecuador. *American Antiquity* 22: 235-246.

Moore, J.D. 1991. Cultural responses to environmental catastrophes: post-El Niño subsistence on the prehistoric north coast of Peru. *Latin American Antiquity* 2(1): 27-47.

Moseley, M.E. 1987. Punctuated equilibrium - searching the ancient record for El Niño. *The Quarterly Review of Archaeology* 8 (3): 7-10.

Murphy, R.C. 1926. Oceanic and climatic phenomena along the west coast of South America during 1925. *Geographical Review* 16: 26-54.

Nials, F.E., Deeds, E.E., Moseley, S.G., Pozorski, T.G. & Feldman, R. 1979. El Niño: the catastrophic flooding of coastal Peru. *Field Museum of Natural History Bulletin* 50 (7): 4-14; (8): 4-10.

Parducci, Z.R. and Parducci, Z.I. 1975. Vasijas y elementos diagnósticas: Fase Guayaquil. *Cuadernos de Histroia y Arquelogía* 42: 57-113.

Philander, S.G.H. 1983. El Niño Southern Oscillation Phenomena. *Nature* 302: 295-301.

Rollins, H.B., J.B. Richardson, J.B. & Sandweiss, D.H. 1986. The birth of El Niño: geoarchaeological evidence and implications. *Geoarchaeology: An International Journal* 1 (1): 3-15.