Archaeology of Formative Ecuador

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Appendix A

Formative Period Chronology for the Coast and Western Lowlands of Ecuador

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INTRODUCTION

Appendix A summarizes the Formative period chronology for both the coast and interior western lowlands of Ecuador and encompasses the following six modern provinces from south to north: El Oro, Guayas, Los Ríos, Manabí, western Pichincha, and Esmeraldas. The chronological information amassed from this extensive area is more voluminous than for the highlands or the Oriente for a number of reasons. First, the land area encompassed by the coast and interior lowlands is larger. Secondly, the coastal lowlands have received a disproportionate amount of archaeological attention over the last century. Finally, it is believed there was a much higher density of Formative period populations inhabiting the coastal lowlands throughout the entire period, and especially in the Early Formative period. In chronological order, the three Formative period cultural complexes found in the coastal lowlands are the well-known Valdivia, Machalilla, and Chorrera complexes. Each of these is treated separately below.

The Formative period chronology of this extensive area is based on five dating methods. Absolute dating is based on *radiocarbon assays*, *thermoluminescence (TL)* assays, and to a lesser extent, *obsidian hydration*. Relative dating is based on *tephrostratigraphy* and *ceramic cross-dating*. Radiocarbon dating is by far the most important of these methods for our understanding of Formative chronology in the coastal lowlands, and primarily emphasis is given here to this method. This review is not intended as an exhaustive discussion of Formative period prehistory in the western Ecuadorian lowlands. It is focused on absolute chronology; therefore, specific archaeological contexts and ceramic complexes are discussed only insofar as they shed light on our understanding of absolute chronology. For supplementary information on the archaeological data discussed herein, see Marcos (1998).

Table A1 contains a compilation of 161 Formative period radiocarbon assays and their calibrated calendrical ranges in years B.C. They are arranged by province, beginning with Guayas province, and the assays are listed in descending chronological order within each province. Each listing includes the site name, cultural and phase affiliation, laboratory name and number, the uncalibrated age in radiocarbon years before present (RCYBP) along with the standard error, the calibrated calendrical age range (in years B.C.) at a 68.2% probability, the calibrated calendrical age range (in years B.C.) at a 95.4% probability, and bibliographic references for the published assays (or information on their archaeological context). Calibration of all radiocarbon determinations was carried out with the OxCal program, version 3.4 (see Bronk Ramsey 1994, 1995) on the basis of Stuiver and Reimer (1986) and extensions in Stuiver, Long, and Kra (1993). For additional information on some of the radiocarbon determinations in Table A1, see Ziólkowski et al. (n.d.: 95–195). For a comparison of the ^{14}C and TL chronology for Formative Ecuador, see Marcos and Obelic (1998).

VALDIVIA CHRONOLOGY

By far the best known and most investigated of the three Formative period cultures from the coastal lowlands of Ecuador is Valdivia, named after a fishing village on the north coast of Guayas province. It was initially defined by Ecuadorian archaeologist Emilio Estrada (1956, 1958) and subsequently studied in greater detail by Meggers, Evans, and Estrada (1965; Evans and Meggers 1957). Much has been written and debated about Valdivia chronology because of its status as one of the earliest pottery-producing cultures in the New World exhibiting a sedentary settlement pattern and a broad subsistence base dependent on marine resources and horticultural production. The Valdivia relative chronology is based on ceramic seriations developed by Meggers et al. (1965) derived from their pioneering excavations at the type-site (G-31) and elsewhere along the Guayas coast, and by Hill (1972–74) from ceramic material collected by Lanning (n.d.) on the Santa Elena peninsula. The former subdivides the Valdivia sequence into four broad phases (A, B, C, and D), while that of Hill provides a more refined breakdown of the Valdivia ceramic sequence into eight phases of varying duration (1–8). Subsequent research at large Valdivia village sites such as Real Alto and Loma Alta has confirmed the validity of the Hill sequence, as well as its greater utility for chronological analysis.

As Table A1 shows, some 95 radiocarbon determinations now exist for Valdivia: in Guayas, El Oro, and Manabí provinces. Terminal Valdivia (Phase 8) pottery has also been found in Los Ríos province, but no radiocarbon determinations are as yet available. Of these four provinces, only Guayas province exhibits the entire 3,000-year sequence, whereas Manabí contains all but the earliest phase, and the other two provinces contain only its terminal phases.

The most recent evaluation of the Valdivia chronology is that of Marcos and Michczynski (1996), who combined radiocarbon determinations with recent thermoluminescence assays of Valdivia pottery to form a revised absolute chronology for the eight phases of the Valdivia sequence. Three of these ceramic phases (1, 2, and 8) are divided into two subphases (a and b) yielding a sequence of 11 temporal periods. Phases 1, 2, 3, and 8 are dated with radiocarbon determinations, whereas Phases 4, 5, 6, and 7 are dated with TL assays. In some cases, both methods are employed. Table A2 reproduces their absolute chronology, which spans from 4400 to 1450 B.C.

First, they examined 80 radiocarbon determinations spanning the entire Valdivia sequence and provided calibrated calendrical age ranges at 95% probability for each (Marcos and Michczynski 1996: table 1). Noting that many of these determinations were derived from excavations that employed arbitrary levels and were thus dating "periods" rather than "events," they selected suites of 33 reliable radiocarbon determinations derived from controlled stratigraphic excavations pertaining to phases 1a,b, 2a,b, 3, and 8 at the sites of Ayalán, Colimes (Perinao site), Loma Alta, San Isidro, Real Alto, and Valdivia excavations by Bischof and Viteri Gamboa (1972; Marcos and Michczynski 1996: table 2). Even in these cases some feature contexts associated with building activity, such as wall trenches, were eliminated from consideration because of the higher likelihood of mixing. Examples include radiocarbon assays from Real Alto wall trench features dating to phases 4, 5, and 6. Likewise, charcoal samples derived from long-lived species of wood used for wall posts or roof timbers were avoided where possible, as radiocarbon analysis would result in "cutting" dates that may be a century or more older than the actual burning event (see Schiffer 1986). The 33 selected radiocarbon determinations were then used to calculate a composite probability distribution of calibrated radiocarbon dates for the six phases and sub-phases. The 68% confidence interval (CI) was then selected to represent the calibrated calendrical age ranges for each of the phases and subphases (see Table A2).

Next, the TL chronology was developed with assays from the sites of Real Alto, Punta La Tintina, Loma de Los Villones, and San Lorenzo del Mate. Selected pottery samples were stylistically affiliated with Valdivia Phases 1b, 2b, 3, 4, 5, 6, 7, and 8 (Alvarez, Marcos, and Spinolo 1995; Marcos and Michczynski 1996: app. 2; Martini et al. n.d) and served to augment the radiocarbon analysis by filling in gaps where reliable radiocarbon determinations were not available. The resulting TL chronology for these phases and subphases is provided in Table A2. By combining these two independent dating methods, Marcos and Michczynski (1996) then derived the new absolute chronology for Valdivia provided in the rightmost column of Table A2. Note that Table A2 contains a reference to Phase 8b for which no radiocarbon determinations nor TL assays are given. Jorge Marcos (personal communication; Marcos and Michczynski 1996) proposes this as a provisional subphase dating from 1600 to 1450 B.C. because of a distinct post-Phase 8 ceramic assemblage from the site of San Lorenzo del Mate. He argues that it may eventually warrant designation as Valdivia Phase 9 and should include a similar ceramic assemblage from the Emerenciana site in El Oro (Staller 1994). One caveat regarding this new chronology is that Marcos and Michczynski (1996) contains typographical errors in the transcription of several radiocarbon determinations and standard errors. For the most part, these are minor and even if inadvertently used to calculate the composite probability distributions, their effect would be minimal. One exception, however, is their use of one of the earliest determinations from Real Alto: ISGS-448, 5620 ± 250 (Liu, Riley, and Coleman 1986: 106), pertaining to Valdivia Phase 1a. It is listed incorrectly in two different tables as 5260 ± 256 (Marcos and Michczynski 1996: tables 1, 2), creating an error of 360 radiocarbon years. Calculating the composite probability distribution for Phase 1a with their figure, then their suggested beginning date of 4400 B.C. for Phase 1a would actually be earlier.

A second caveat concerns the use of TL assays as sole determinants of the age ranges of Phases 4 through 7. Since the samples used are not as geographically diverse as the radiocarbon determinations employed in the analysis, they may be biasing the results toward TL dates that apply to only restricted area(s) (i.e., the Chanduy valley and San Lorenzo del Mate in Guayas province). As a result, I argue that they may be systematically placing the age ranges of phases 5, 6, and 7 (as well as Phase 8) slightly later in time (i.e., younger) than may be warranted (see Table A2). This has important implications for the absolute dating of Phase 8. When radiocarbon determinations are utilized for deriving the Phase 8 B.C. chronology, all three of the CIs used (50%, 68.2%, and 95.4%) show that Phase 8 began *at least* by 2000 B.C. (Marcos and Michczynski 1996: table 3). This earlier start date also agrees perfectly with the results of a Bayesian statistical analysis conducted on radiocarbon determinations from the San Isidro site in the Jama River valley of northern Manabí (Zeidler, Buck, and Litton

1998: table 4). Yet when combining the radiocarbon results with the TL results, Marcos and Michczynski (1996) arrived at a questionable age range of 1800 to 1600 B.C. for Valdivia Phase 8. In the Jama valley case, the modal values of the 95% HPD (highest posterior density) regions for the start and end of Phase 8 in northern Manabí ranged from 2030 to 1880 B.C.. These figures correspond very closely to the 50% confidence interval provided by Marcos and Michczynski (1996: table 3) for Phase 8: 2030–1830 B.C., from the five San Isidro determinations and two determinations from the Ayalán site in Guayas province. They also agree well with the radiocarbon data from other Phase 8 sites such as La Emerenciana in El Oro province (Staller 1994) and the Anllula shell mound in Guayas province. Thus, several geographically dispersed radiocarbon determinations from El Oro, Guayas, and Manabí provinces are all in agreement that 2000 to 1800 B.C. is a highly likely age range for Valdivia Phase 8 throughout coastal Ecuador. The subsequent phase of the Valdivia sequence, termed Phase 8b or possibly Valdivia Phase 9, discussed by Marcos and Michczynski (1996), has been tentatively identified at San Lorenzo del Mate in Guayas province and by Staller (1994) at La Emerenciana in El Oro province. It represents a transitional phase between Terminal Valdivia and Early Machalilla ceramics and is suggested here to date between 1800 and possibly 1500 B.C. If Valdivia Phase 8 proper dates from 2000 to 1800 B.C., then the rather late age ranges suggested by Marcos and Michczynski (1996) for Phases 6 and 7 should be adjusted accordingly. In spite of these caveats, the Marcos and Michczynski absolute chronology represents a significant advance in Valdivia archaeology that will be of great heuristic utility for years to come.

MACHALILLA CHRONOLOGY

Neither the Machalilla nor the Chorrera cultural sequence has received the same amount of statistical scrutiny as Valdivia, nor are their internal phase designations as widely agreed upon as those of the Valdivia sequence Hill (1972–74) developed. The Machalilla complex, named after a coastal fishing village in southern Manabí province, was initially defined by Estrada (1958). Evans and Meggers (1961; Meggers and Evans 1962) and Meggers et al. (1965) made the earliest attempts to place Machalilla culture in a chronological context. They consistently regarded it as largely coeval with the final half of Valdivia Phase C and all of Phase D (roughly corresponding to Phases 4–8 in the Hill sequence), but their absolute chronology for Machalilla has varied over the years. As recently as 1977, however, they dated it from 2300 to 1500 B.C. because of their belief that Machalilla "trade sherds" and "deformed skulls" occurred in their excavations of certain Late Valdivia sites (Meggers and Evans 1977).

Most archaeologists working on the coast of Ecuador after the mid-1960s, however, have followed Estrada's (1958: 55) initial supposition that Machalilla culture succeeded Valdivia. Indeed, as mentioned above, clear evidence for a transitional ceramic phase linking Valdivia Phase 8 with Early Machalilla has been found at two sites (San Lorenzo del Mate and La Emerenciana) far removed geographically from the southern coast of Manabí province where Machalilla culture was initially defined. Interestingly, Machalilla does *not* follow Terminal Valdivia in at least one area of the coast: northern Manabi province (Zeidler et al. 1998). Here the Valdivia Phase 8 occupation ended at about 1880 B.C. due to ashfall from a major volcanic eruption (Tephra I) emanating from highland Ecuador (see Zeidler and Isaacson this volume). A 500-year hiatus followed, and the Jama valley was abandoned until the onset of the Late Formative Chorrera culture (Tabuchila variant) at 1300 B.C. in calibrated calendrical years (Zeidler et al. 1998).

With respect to relative dating, the internal delineation of ceramic phases within Machalilla culture has not met with the same amount of scholarly agreement as the Valdivia sequence. The earliest attempt at defining an internal ceramic sequence for Machalilla was that of Meggers et al. (1965), who proposed a sequence of three phases (A, B, and C) from Fordian seriation of excavated ceramic materials derived from arbitrary, horizontal, 20-cm levels. The shortcomings of their analytical method have been thoroughly reviewed by Lippi (1983: 226–230), and their three-phase sequence has not received widespread usage. Subsequent attempts at a seriation for Machalilla ceramics were those of Bischof (1975b) and Paulsen and McDougle (n.d.a; see also Paulsen and McDougle n.d.b), both of which proposed five-phase sequences that were based on limited ceramic data. Bischof's (1975b) scheme, from research in the vicinity of Valdivia, is convincing only for his Machalilla phases 2 and 5. The sequence proposed by Paulsen and McDougle (n.d.a), which was based on the La Libertad site on the Santa Elena peninsula, relies on a few ceramic attributes and is therefore of limited utility for comparisons outside the Santa Elena peninsula.

The most current and comprehensive Machalilla ceramic seriation is the seven-phase sequence Lippi (1983) proposed from his excavations at the La Ponga site. Here a broad range of Machalilla ceramic attributes associated with bowl forms were analyzed, forming a logical progression from Late Valdivia attributes to early Chorrera attributes. Unfortunately, none of these internal phase designations has been dated either through radiocarbon methods or through TL analysis. Consequently, they cannot be placed with certainty on an absolute time scale. Two of the radiocarbon determinations from Lippi's work at La Ponga (WIS 1140 and WIS 1141) are attributed to his Machalilla Phases 1 through 5 (Lippi 1983: 348), whereas three determinations from Paulsen and McDougle's (n.d.a) work at on the Santa Elena peninsula (I 7006, I 7008, and I 7013) are attributed to Machalilla phases 3 through 7 (Lippi 1983: 348; see Table A1). It is clear that a considerable amount of new field research will have to be conducted on the Machalilla occupation of coastal Ecuador before significant advancement can be made toward establishing an absolute chronology for these ceramic phases.

Absolute dating of Machalilla has thus been limited to a general bracketing of the entire cultural complex, and estimates have varied over the years as more radiocarbon determinations have been made available. Initial estimates by Lanning (n.d.), Lathrap, Collier, and Chandra (1975), and Lathrap, Marcos, and Zeidler (1977) placed the beginning date at 1500 B.C. and an end date at approximately 1000 B.C. In a subsequent estimate based on excavations in coastal Guayas province, Bischof (1975b) argued for a beginning date between 1750 and 1550 B.C. and an end date of 950 B.C. The earlier start date proposed by Bischof was based on his belief that his five-phase ceramic sequence (beginning with Machalilla 2 or Early Machalilla) required sufficient time depth to have developed out of Terminal Valdivia. Machalilla 1 was proposed as an undefined hypothetical phase. From their research at La Libertad on the Santa Elena peninsula, also in coastal Guayas province, Paulsen and McDougle (n.d.b) estimated a time span of 1300 to 900 B.C. This is slightly earlier that the estimate of 1200 to 800 B.C. suggested by Lippi based on his excavations at the La Ponga site in the Valdivia valley (Lippi 1983: 35).

Although several Machalilla radiocarbon determinations predating Lippi's 1200 B.C. start date exist for coastal Guayas province, Lippi (1983) has rejected these as unreliable. First, the early determination obtained by Meggers at al. (1965) from the Buena Vista site (SI 69, 3450 ± 50 RCYBP) is based on a shell sample from *mixed* Valdivia and Machalilla deposits (Lippi 1983: 351). Likewise, SI 107 (3320 ± 170 RCYBP) from the La Cabuya site was a *split sample* from a single charcoal specimen that provided the determination for SI 108 (2980 ± 160 RCYBP) and cannot be reliably used alone. Finally, the two radiocarbon determinations obtained by Norton at the Buena Vista site (SI 1050, 3250 ± 90 RCYBP; SI 1051, 2945 ± 115 RCYBP) are ambiguous because it is unclear, according to Lippi (1983: 351), whether they pertain to the Late Valdivia or the Machalilla components of the site. Thus, Lippi's (1983) estimated Machalilla time range of 1200 to 800 B.C. is based on a total of seven radiocarbon determinations: three from La Ponga (WIS 1125, 1140, and 1141), three from La Libertad (I 7006, I 7008, and I 7013), and one combined determination from the Buena Vista site (SI 107/108) in which the two assays are averaged.

A more recent estimate from current calibrated radiocarbon data places Machalilla culture from 1300 to 800 B.C. (Lippi 1996: 61). However, if we use the radiocarbon determinations from La Ponga and La Libertad as a guide, the calibrated 68.2% age ranges given in Table A1 span from about 1430 to 830 B.C. This start date coincides well with Marcos and Michczynski's (1996) absolute chronology for Valdivia, in which their provisional Valdivia Phase 8b ends at 1450 B.C. This date might serve as a better starting point for Machalilla culture at inland localities in Guayas and El Oro provinces and may actually mark the beginning of Early Machalilla occupations on the northern Guayas and southern Manabí coast for which reliable radiocarbon determinations have not yet been obtained.

Curiously, the end date of ca. 800 B.C. extends Machalilla culture well into Late Formative times because of absolute dating of Chorrera manifestations elsewhere in the coastal lowlands. Thus the end of a given cultural manifestation in one region may overlap considerably with the early florescence of a different but related manifestation in another region, until the former becomes totally eclipsed by the latter. Such may be the case with the Machalilla/Chorrera "transition" in certain parts of the coastal lowlands.

CHORRERA CHRONOLOGY

As for Valdivia Phase 8 and Machalilla culture, it is important to clarify the geographical limits of the radiocarbon determinations and TL assays used to make broad time range estimates for specific cultural occupations. We should not assume that a single time range applies equally to all areas of the coastal strip and western lowlands because of the well-known lag time or Doppler effect (Deetz and Dethlefsen 1965) in ceramic decorative traits when traced over large geographical areas (see also Zeidler et al. 1998). As David Braun (1985: 137) observes

> Different parts of . . . (a) region (may) in fact differ in the relative frequencies, and even in the presence vs. absence, of different decorative techniques among contemporaneous sites . . . As a result, we can never assume that a decorative technique or type will convey the same chronological information regardless of location, even controlling for so-called Doppler effects. (Deetz and Dethfelsen 1965)

Beginning and ending dates for a single cultural manifestation or ceramic phase may vary considerably from locality to locality, and this appears to be the case with Chorrera culture.

Chorrera culture was first defined somewhat independently in the Guayas basin at the type-site of La Chorrera on the Babahoyo River (Evans and Meggers 1954) and on the Guayas coast at the site of La Carolina (OGSE 46D or Engoroy cemetery) on the Santa Elena peninsula (Bushnell 1951). Some debate still exists over the extent to which Chorrera represents a true "cultural horizon" characterized by stylistic unity in ceramic manufacture (albeit encompassing some regional variation), or whether the numerous Late Formative regional variants such as Engoroy and Tabuchila, are better understood as *independent* regional archaeological cultures. Recent summaries of Chorrera archaeology can be found in Beckwith (n.d.) and Engwall (n.d.), and Cummins (1992; this volume) and Scott (1998) provide overviews of Chorrera ceramic art. Here a certain degree of stylistic unity in ceramic manufacture is acknowledged as a generalized Chorrera cultural manifestation extending from the Guayas basin and Guayas coast northward to include Manabí, Los Ríos, western Pichincha, and Esmeraldas provinces. Yet both the nature of this stylistic unity and the regional variation apparent in other ceramic traits are in need of further explanation. Correct chronological placement of these regional variants may help shed light on this issue.

Initial attempts at placing Chorrera in an absolute chronological context were made by Evans and Meggers (1960; 1961; Meggers 1966: fig. 4) in collaboration with Emilio Estrada (1962: cuadros 3, 4, and 5). These efforts included the use of a few radiocarbon determinations together with experimental results from the newly developing field of obsidian hydration dating (Evans and Meggers 1960; Friedman and Smith 1960). The radiocarbon evidence included a single Chorrera radiocarbon determination (HO 1307, 2800 ± 115 RCYBP) from the Véliz site (M 42) in northern Manabí province, and two determinations dating an apparent Chorrera/Bahía transition at the La Sequita site (M 55) in central Manabí (SI 43, 2540 ± 125 RCYBP; SI 35: 2525 ± 105 RCYBP) (see Meggers 1966: fig. 4). The obsidian hydration evidence, on the other hand, was more voluminous, although somewhat less reliable. Of the 122 thin sections from Ecuador measured for hydration layer thickness, 31 obsidian samples from four different archaeological sites were assigned a Chorrera affiliation (Evans and Meggers 1960: fig. 19; Friedman and Smith 1960: table 1). The four sites are the Chorrera type-site (R-B-1/Cut 1) on the Babahoyo River (9), the Naupe site (G-D-8/Cuts 3 and 4) on the Daule River (16), the Libertad site (G-76/Cut A) on the Santa Elena peninsula (5), and the Machalilla site (M-28) on the southern Manabí coast (1). Although Meggers and Evans considered the specimen from the Machalilla site to be of Chorrera age (Friedman and Smith 1960: table 1), Estrada (1962: cuadro 4) apparently disagreed, dating it prior to the Chorrera time range (pre-1500 B.C.); as a result, Evans and Meggers (1960: fig. 19) do not include it in their final evaluation of the obsidian hydration analysis. The other three sites yielded the following time ranges for the Late Formative Chorrera culture: the Chorrera type-site, 1840–540 B.C.; the Naupe site (Cut 3), 1640 to ca. 500 B.C.; the Naupe site (Cut 4), 1640 to ca. 500 B.C.; and the Libertad site, 1740 to 1240 B.C. (Evans and Meggers 1960: fig. 19). Subsequently, Estrada (1962: cuadro 4) reproduced these results and added an additional obsidian hydration date of 750 B.C. for the Véliz site in northern Manabí, although no provenance or specimen quantities were indicated.

At both the Chorrera type-site and the two cuts from the Naupe site, Chorrera ceramic traits appear to be replaced by Regional Developmental ceramic traits in the 550 to 500 B.C. time range, as estimated by hydration analysis. The somewhat early start date for Chorrera in the 1840 to 1640 B.C. time range appears to be consistent across the three sites. These results led Meggers (1966: fig. 4) to conclude that Chorrera culture dated from 1840 to 540 B.C.; yet, elsewhere in this influential volume the time range is rounded upward, extending from 1500 to 500 B.C. (Meggers 1966: 55, 66). Although the latter figures came to be widely accepted in both the academic and popular archaeological literature as a pan-Chorrera time range, it is now clear that the *actual* beginning and ending dates of Chorrera may vary from region to region. The 1500 to 500 B.C. time range derived from obsidian hydration analysis, even if considered reliable, may only apply to the Babahoyo and the lower Daule river areas where the Chorrera type site and the Naupe site are found. But even there, it must be considered a provisional dating because there is no correlative evidence from radiocarbon dating.

Subsequent investigators who believed, contrary to Meggers that the Machalilla culture succeeded Valdivia, have argued that Meggers's (1966) start date of 1500 B.C. for Chorrera was far too early and that her proposed end date of 500 B.C. may be too early as well. By the mid-1970s, for example, Lathrap proposed a 1000 to 300 B.C. time range for Chorrera (Lathrap et al. 1975) because of new data from the Engoroy variant in the greater Santa Elena peninsula and northern Guayas coast areas (Bischof 1975a; Paulsen and McDougle n.d.b).

With respect to relative chronology, the internal delineation of ceramic phases for Chorrera/Engoroy culture has been based largely on the Santa Elena peninsula and northern Guayas coast. Simmons (1970) proposed the first ceramic sequence for Engoroy materials recovered in archaeological excavations by Ferdon (1941a,b) at the La Carolina (OGSE-46D) site in the 1940s. Using a type-variety approach to ceramic analysis, Simmons subdivided Engoroy into a series of three phases: Early, Middle, and Late Engoroy. He also argued for clear transitions from Machalilla into Early Engoroy and from Late Engoroy into Guangala. From comparisons with Estrada's Bahía I material from the central Manabí coast (Estrada 1957, 1962; see also Meggers 1966: fig. 4), Early Engoroy was tentatively placed at around 850 B.C., whereas Middle Engoroy was thought to date from 500 to 100 B.C.

Parallel efforts to refine the Engoroy ceramic sequence were subsequently carried out by Bischof (1975a, 1982) and Paulsen and McDougle (n.d.a,b), with the added benefit of radiocarbon determinations. Bischof conducted research at two sites near the modern town of Palmar in the Javita valley, north of the Santa Elena peninsula. On the basis of stratigraphic excavations and a type-variety analysis of ceramic materials, Bischof proposed a series of six ceramic phases for Engoroy (Engoroy 1–6), which he then collapsed into three larger groupings: Early Engoroy (Phases 1–3); Middle Engoroy (Phase 4); and Late Engoroy (Phase 6). Phase 5 is suggested as a hypothetical transitional phase that was not documented stratigraphically (Bischof 1982: 141). The three larger groupings are then placed in a chronological context on the basis of available radiocarbon determinations (Bischof 1982: 162–165). Early Engoroy has a start date of 900 B.C., because of slighter earlier radiocarbon determinations (SI 67, SI 107, and SI 108) for Late Machalilla (see Table A1) and an end date of 600 B.C. Middle Engoroy has a range of 600 to 300 B.C. because of two radiocarbon determinations from Bischof's Palmar excavations (Hv 1293, 2385 ± 80 RCYBP; Hv 2978, 2295 ± 75 RCYBP), both of which directly date his Engoroy Phase 4. As Table A1 demonstrates, the calibrated calendrical range for these two determinations at 68.2% probability is 760 to 380 B.C. and 410 to 200 B.C., respectively. Late Engoroy has a range of 300 to 100 B.C., which is largely based on bracketing by radiocarbon determinations for the succeeding Guangala Phase 1 (HV 1294 and HV 2976; not in Table A1).

Paulsen and McDougle (n.d.a,b) have presented successive refinements of their ceramic seriation efforts from materials excavated at La Carolina (OGSE-46D) by McDougle. Their analysis was based on a limited number of ceramic attributes found on open bowl forms (collar nicking, interior and exterior tiers, and notched fillets); consequently, doubt clouds its overall utility for comparative purposes (Lippi 1983). Like Bischof, they proposed a six-phase ceramic sequence (Engoroy 1–6), but added a seventh transitional phase between 3 and 4. Two larger temporal groupings are also proposed: Early Engoroy, encompassing Phases 1 through 3 and the transitional Phase 3/4; and Late Engoroy, encompassing Engoroy phases 4 through 6. Of the 11 available radiocarbon determinations derived from these excavations, only four—all from Cut AA—

are considered reliable and in correct stratigraphic position by the excavators (Paulsen and McDougle n.d.a: 20). The uncalibrated determinations in question were transformed by the excavators into calendar years B.C. by simply subtracting 1,950 years from the determinations (Paulsen and McDougle n.d.c: fig. 2). The four resulting dates are as follows, in descending order: 1110 B.C. (Level SS), 870 B.C. (Cut RR), 625 B.C. (Cut MM), and 425 B.C. (Cut JJ). A fifth determination, 750 B.C. (Cut KK), was slightly out of stratigraphic order. These and other radiocarbon determinations from Paulsen and McDougle's Engoroy seriation are not included in Table A1, as they have no associated information (i.e., laboratory number, age in radiocarbon years before present, standard error) and hence cannot be calibrated with current analytical methods.

Another important piece of the Late Formative dating puzzle in Guayas province comes from the lower Guayas basin site of San Pedro de Guayaquil on the outskirts of modern Guayaquil. In the late 1960s Resfa and Ibrahim Parducci (Parducci and Parducci 1970, 1975) encountered a ceramic assemblage considered transitional between the Late Formative and Regional Developmental periods designated the Fase Guayaquil. Both ceramic cross-dating and a series of three radiocarbon determinations (Table A1) suggested it was roughly contemporaneous with the later part of the Engoroy sequences proposed by Bischof (1975a, 1982) and Paulsen and McDougle (n.d.a,b); that is, Engoroy 6 to Guangala 1 (Parducci and Parducci 1975). The three determinations are in descending chronological order: UW-125, 2290 ± 100 RCYBP; UW-124, 2185 ± 80 RCYBP; and UW-123, 2175 ± 60 RCYBP. When calibrated at the 68.2% confidence level, the latter determination ranges in age from 360 to 120 B.C., clearly marking the terminal portion of the Late Formative in the lower Guayas basin and demonstrating the continuity of Chorreroid ceramic traits.

While little new research has been devoted to the internal sequencing of Chorrera ceramics since 1981 through 1982 when the Bischoff and Paulsen and McDougle seriations appeared, considerable headway has been made with respect to absolute chronology. As Table A1 demonstrates, some 46 radiocarbon determinations now exist for Chorrera representing five provinces. Much of this new information comes from Guayas province and southern and northern Manabí province, but Los Ríos, Esmeraldas, and western Pichincha provinces are now represented as well.

Beginning with the Guayas basin, dissertation research carried out in the 1980s by Aleto (1988) on Puná Island and by Stemper (1989, 1993) in the Daule River basin each yielded a new radiocarbon determination marking terminal Chorrera occupations in their respective areas. Aleto's Bella Vista occupation on Puná Island yielded a determination of 2460 ± 110 RCYBP (ISGS

1347), which he equates with the Fase Guayaquil (Aleto 1988; see also Beckwith n.d.). When calibrated at the 68.2% CI this yields a calendrical time range of 760–410 B.C. (see Table A1), which overlaps with the calibrated range of the earliest Fase Guayaquil determination (UW 125) at the 68.2% CI (see Table A1). Stemper's excavations at site PL 18 along the Daule River near the town of Yumes yielded a single radiocarbon determination corresponding to Late Formative times and marking the end of his Silencio Phase 1 (Stemper 1989, 1993). The determination (AA-1763) was 2280 ± 110 RCYBP, which after calibration yielded a calendrical time range of 520 to 160 B.C. at the 68.2% CI (see Table A1). Stemper (1989: 334) considers the associated context (Deposit 8) and ceramic materials to be derived "from an earlier Chorrera-like style," rather than a pure Chorrera component.

In southern Manabí province, archaeological excavations by Marcos and Norton (1981, 1984) at La Plata Island yielded a series of nine new radiocarbon determinations for Late Machalilla and Chorrera components (see Table A1). Unfortunately, the radiocarbon evidence was unavailable at that time, and neither Marcos nor Norton has since published these results nor discussed their implications for Chorrera archaeology. They do, however, appear in Lippi's (1983: table c) discussion of the La Ponga site but unfortunately lack information on provenance associations. Although included in a list of radiocarbon determinations under the caption Machalilla Radiocarbon Dates, Lippi (1983: 351, 352) is careful to note that collectively the nine dates "must be used only as a rough bracket for Late Machalilla" and one of the excavators, Norton, indicated that their affiliation is "Late Machalilla and/or early Chorreroid." Therefore, Lippi (1983: 351–355) does not incorporate them into his absolute dating of Machalilla culture. All but one of these nine dates are assigned a Chorrera cultural affiliation in Table A1, whereas the earliest (GX 7821, 3065 ± 135 RCYBP) is listed as Late Machalilla/Chorrera. The rationale for this Chorrera designation is based on (a) the presence of Chorrera culture at the Salango site in southern Manabí, directly southeast of La Plata Island, at about the same time (GX 13027 3045 ± 150 RCYBP) (Lunniss and Mudd n.d.); and (b) the simultaneous beginning of Chorrera culture in northern Manabí province, where it has been termed the Tabuchila variant after Estrada (1957, 1962; Engwall n.d.; Zeidler et al. 1998; see also Zeidler and Sutliff 1994). Bayesian statistical analysis of the Tabuchila radiocarbon determinations suggest a calibrated calendrical date of 1300 B.C. for the onset of Chorrera in northern Manabí (Zeidler et al. 1998: table 4). This accords well with the calibrated age range (at 68.2% probability) given in Table A1 for the earliest La Plata date (GX 7821): 1500–1120 B.C. The approximate midpoint of this range falls close to 1300 B.C. The eight subsequent determinations from La Plata would fall squarely within the Chorrera time period, assuming they are derived from valid uncontaminated charcoal samples in correct stratigraphic context.

The radiocarbon determination mentioned above from the site of Salango (OMJPLP-141) has unfortunately never been published, but it represents one of three charcoal samples from a unique Chorrera ceremonial structure (Structure 1) carefully excavated by Lunnis and associates in Area 141-B of the site (Lunnis and Mudd n.d.; Norton et al. 1983). These excavations, initiated in 1982, were described in preliminary form in 1983 (Norton et al. 1983: 21–41). Excavations continued in succeeding years, yet by 1987 it was still only partially excavated (Lunniss and Mudd n.d.). Lunniss and Mudd (n.d.) have defined a four-phase multicomponent sequence of use, abandonment, and reconstruction of this ceremonial locality beginning in Chorrera times and extending through a Bahía 1/Engoroy occupation, a Bahía 2 occupation, and a Guangala occupation. Components included elite burials with grave goods as well as dedicatory ritual caches. Whereas the three latter phases involved the construction of a rectangular precinct measuring some 10 m × 10 m defined by thick adobe walls and posts, the initial Chorrera ceremonial center involved construction of a low mound or foundation layer with a clay cap (Context 7300) measuring 8.2 m × 4.2 m, supporting a simple wooden post structure (Lunniss and Mudd n.d.: Fig. 8).

The earliest radiocarbon determination (GX 13027, 3045 ± 150 RCYBP) apparently came from an ash layer (Context 6653-C) covering a portion of this occupation. The precise stratigraphic location of the second radiocarbon determination (GX 13028, 2540 + 85 RCYBP) is unclear but was extracted from posthole fill associated with the Chorrera foundation layer, thus *underlying* the previous determination. In spite of this, the authors assigned a greater contextual reliability to the earlier of the two determinations because the GX 13027 charcoal specimen was associated with in situ burning, while the other specimen was extracted from posthole fill that showed no evidence of *in situ* burning (Lunniss and Mudd n.d.). Finally, the third radiocarbon determination (GX 13026, 2340 ± 485 RCYBP) was extracted from an occupation layer found at the end of the four-phase multicomponent sequence and probably dates the final Guangala occupation of the ceremonial precinct. Its rather large standard error renders it useless for present purposes, however. What is most intriguing about the investigation of this ceremonial precinct is the clear stratigraphic separation between what the excavators identified as Chorrera proper in Construction Phase 1 and an overlying Engoroy/Bahía I occupation in Construction Phase 2 (Lunniss and Mudd n.d.).

Deep stratigraphic excavations in other areas of the Salango site (Area 141-C) have yielded additional radiocarbon determinations for the Chorrera component that accord well with the previous two determinations from Area 141-B and those from La Plata Island mentioned above. Although this radiocarbon information was never published (see Kurc n.d.), fortunately it recently appeared in Beckwith (n.d.: table 2.1), who researched the Chorrera ceramic material excavated from Levels 4, 5, and 6/7 in Area 141-C. These excavations yielded five new radiocarbon determinations, all of which fall in between the two determinations from Area 141-B (see Table A1). These five assays are in descending order of radiocarbon years before present: GX 9990, GX 9994, GX 9992, GX 9991, and GX 9995. The earliest of these (GX 9990, 2765 ± 175 RCYBP) yields a calibrated calendrical age range of 1260 to 780 B.C. (at 68.2% probability). The most recent one (GX 9995: 2590 ± 170 RCYBP) yields a calibrated calendrical age range of 900 to 410 B.C. (at 68.2% probability). Beckwith (n.d.: 234) has interpreted these ceramics as possibly representing two separate periods within the Late Formative. The early part, represented by Level 6/7, is equated with an early Chorrera phase derived in part from late Machalilla ceramic traits. Levels 4 and 5, on the other hand, are equated with Early Engoroy. The radiocarbon evidence seems to bear this out, as even the most recent date from Area 141-C (GX 9995) precedes Bischof's two determinations for his Engoroy Phase 4 (Hv 1293 and Hv 2978) by 200 to 300 radiocarbon years (see Table A1). This and the stratigraphic evidence of the Structure 1 ceremonial context discussed above suggest that for southern Manabí, Engoroy represents a later phase within the broader Late Formative cultural complex (see also Norton 1992: 28–32).

An early start date for the Chorrera ceramic complex is also found in the Jama valley of northern Manabí province, where it is apparently not preceded by the Machalilla culture (Zeidler and Sutliff 1994). Rather, it begins abruptly ca. 1300 B.C. following a lengthy occupational hiatus caused by a volcanic ashfall (Tephra 1) that fell during the Valdivia 8 period (Zeidler et al. 1998; Zeidler and Isaacson this volume). The northern Manabí variant of Chorrera was termed *Tabuchila* by Estrada (1957) based on his surface collections and purchases of Chorrera pottery from the Hacienda *Tabuchilla* (note different spelling) in the Río Muchacho drainage south of Jama and north of Canoa. Its chronological placement in the Late Formative period was later confirmed with what would become the first radiocarbon determination for Chorrera culture at the Véliz site (M-42) located just west of Bahía de Caráquez on the left bank of the Río Chone (Estrada 1962). Excavations in Cut B, in clear stratigraphic association with Chorrera ceramics, yielded a charcoal specimen (HO 1307) with an age of 2800 ± 115 RCYBP and a calibrated calendrical age range of 1130 to 820 B.C. at the 68.2% probability (see Table A1). Estrada also notes (1962: 24; cuadro 4) that obsidian hydration analysis on material from this same cut yielded an age estimate of 750 B.C.

In subsequent archaeological investigations in the Jama River valley, Zeidler and associates adopted Estrada's term *Tabuchila* to designate the extensive Chorrera occupation of the valley (Engwall n.d.; Zeidler et al. 1998; Zeidler and Sutliff 1994). A total of five radiocarbon determinations from the Jama valley absolute chronology pertain to the Tabuchila complex and are derived from four different archaeological sites (see Table A1). Four of the five determinations (from sites at La Mina, Dos Caminos, and San Isidro) fall toward the early part of the Chorrera time period; the fifth was derived from a charcoal specimen extracted from a tephra layer (Tephra 2) immediately overlying terminal Chorrera deposits at the Mocoral site (Engwall n.d.; see Zeidler and Isaacson this volume). Bayesian calibration of these determinations for purposes of phasing the Chorrera occupation of the Jama valley suggested a beginning date of 1300 B.C. and an end date of 750 B.C. (Zeidler et al. 1998). Since four of the five determination fell at the early end of this sequence, the proposed start date is probably more secure than the end date of 750 B.C. The latter should probably be considered provisional, pending the availability of new radiocarbon determinations for late Chorrera contexts. Even the Mocorral determination itself (ISGS 2377), with a calibrated age range of 800 to 410 B.C. (68.2% CI) seems a bit early when compared with the dating of the Pululahua eruption. Pyroclastic deposits close to the Pululahua source eruption yielded a radiocarbon determination of 2305 ± 65 RCYBP (SI 2128) (Hall 1977). Although not in Table A1, this determination yields a calibrated age range of 404 to 207 B.C. at the 68.2% CI. The approximate midpoint, 300 B.C., might serve as a reasonable estimate for the Pululahua eruption that blanketed much of the western Ecuadorian lowlands and caused a major perturbation in Chorrera culture wherever it fell. Samples of these dated tephras have been chemically correlated (Zeidler and Isaacson this volume); therefore, the discrepancy in the two radiocarbon age estimates are due to the vagaries of the dating method itself rather than a misidentification of eruptive events. This discrepancy could possibly be due to the "old wood problem" (Schiffer 1986) with the El Mocorral sample actually dating wood that was significantly older than the stratigraphic (depositional) context from which it was extracted.

Moving inland from the Manabí coast to Los Ríos province, three radiocarbon determinations are now available for the Late Formative period. The recent excavations by Reindel and Guillaume-Gentil at the La Cadena locality near Quevedo provide the earliest determination (Guillaume-Gentil 1996, 1998; Reindel 1995). Deep stratigraphic excavations in the base of Tola 5 at that site yielded a determination of 2430 ± 80 RCYBP (B 5560) and was associated with ceramic materials of clear Chorrera affiliation. When calibrated at the 68.2% CI, this assay yields a calendrical time range of 760 to 400 B.C. (see Table A1), which places it in the late portion of the Late Formative, more or less contemporaneous with the calibrated time range for the Mocorral assay from the Jama valley (800–410 B.C.). Two thermoluminescence dates were also obtained for Chorrera ceramic materials from these contexts as well as Chorrera contexts in Tola 1 (Guillaume-Gentil 1998; Wagner 1995). Two TL age estimates were 2789 ± 290 BP and 2611 ± 430 BP, and although they have rather large error terms, they both fall squarely within the known time range of classic Chorrera culture at the Salango site and La Plata Island in neighboring Manabí province (cf. Table A1).

The other two Late Formative radiocarbon determinations from Los Ríos province were both provided by Porras and derive from his excavations at the Palenque site between the modern towns of Quevedo and Santo Domingo de Los Colorados (Porras 1983). Both determinations occur rather late within the Late Formative period and the associated ceramic assemblage is interpreted by Porras (1983) as relating to the Fase Guayaquil material from the lower Guayas basin. The two determinations are 2220 ± 75 RCYBP (RK 4206) and 2170 ± 65 RCYBP (RK 2207). When calibrated at the 68.2% CI, they yield overlapping calendrical time ranges of 380 to 200 B.C. and 360 to 110 B.C., respectively (see Table A1).

Moving northward to western Pichincha province, Chorrera-related materials have been found at three sites: Nambillo in the Mindo valley (Lippi 1998); Nueva Era in the Tulipe valley (Isaacson 1987); and Santa Marta in the Toachi valley west of Santo Domingo de Los Colorados (Lubensky n.d.a,b). At Nambillo, Lippi (1998) has reported a series of five radiocarbon determinations, the two earliest of which (GX 12471 and GX 12470) apparently predate human occupation at the site (see Table A1). The remaining three determinations (GX 12473, GX 12469, and GX 12472) date the Nambillo phase, a Late Formative period complex that Lippi (1998: table 8.4) places between 1600 and 400 B.C. Two of these determinations (GX 12469 and GX 12472), however, have very large standard errors (260 years) and do not provide accurate age estimates, although they fall squarely within the Chorrera time range. The remaining determination (GX 12473) yielded an age estimate of 3330 ± 80 RCYBP, which in turn yields a calibrated age range of 1740 to 1510 B.C. (at the 68.2% CI). The somewhat early start date for Early Nambillo at 1600 B.C. is based upon this single determination coupled with the nature of the associated pottery. The ceramic assemblage of this complex appears to be a mix of highland Cotocollao (and La Chimba) ceramic traits, with a blend of several coastal Formative ceramic traits derived from Terminal Valdivia, Machalilla, and Chorrera cultures (Lippi 1998). The end date of ca. 400 B.C. is marked by the eruption of Pululahua. While Early Nambillo might be loosely considered Chorrera-like or Chorreroid in nature, it is important to note the strong highland influences as well as the earlier coastal influences (especially Machalilla) in the ceramic complex.

At the Nueva Era site, just 18 km to the north in the Tulipe valley, Isaacson (1987) reported a series of four radiocarbon determinations associated with his Late Formative Nueva Era phase. The earliest and latest of these (ISGS 1182 and ISGS 1187) were rejected by Isaacson (1987) as too early and too late, respectively (see Table A1). The ISGS-1182 determination was 3070 ± 250 RCYBP, which corresponds to the earliest Late Formative determinations from La Plata Island and the Jama valley in Manabí province, as well as the single determination from the Santa Marta site farther south. However, its rather large standard error reduces it utility. The remaining two Late Formative determinations from the Nueva Era site (ISGS 1176 and ISGS 1175) fall within 100 radiocarbon years of one another. The former is 2710 ± 100 RCYBP and the latter is 2620 ± 80 RCYBP (see Table A1). At the 68.2% CI, their respective calibrated age ranges are 1000 to 790 B.C. and 900 to 560 B.C., placing them well within the suite of calibrated determinations from Chorrera contexts on La Plata Island and at Salango in southern Manabí. They are also contemporaneous with the later portion of the Early Nambillo phase in the nearby Mindo valley. Stylistically, the Nueva Era ceramic assemblage shows a variable mix of highland (Cotocollao) and coastal lowland (primarily Chorrera) ceramic traits (Isaacson 1987), as does the Nambillo site. In spite of its partial contemporaneity and close proximity to Nambillo, however, Lippi (1998) sees notable differences in their respective ceramic assemblages. While their histories may have been different, both sites functioned as major gateway communities on trade routes between the Quito basin and the coastal lowlands, and both Late Formative communities were obliterated by the Pululahua eruption. Since both sites are not pure Chorrera manifestations, their associated radiocarbon determinations are referred to in Table A1 only by their local phase names.

The final Late Formative radiocarbon determination from western Pichincha is the single assay from the Santa Marta site, located on the Hacienda La Florida in the Toachi valley west of Santo Domingo de Los Colorados. Excavations by Earl Lubensky and Allison Paulsen (Lubensky n.d.a,b) at the base of a mound at the Santa Marta site yielded a charcoal specimen with an estimated age of

2950 ± 80 RCYBP. When calibrated at the 68.2% CI, it yields a calendrical age range from 1290 to 1020 B.C., placing it coeval with the early Tabuchila occupation of the Jama valley (e.g., the Dos Caminos site near San Isidro), the Nueva Era occupation of the Tulipe valley, and the later portion of the Early Nambillo phase in the Mindo valley. Stylistically, the associated Late Formative ceramics seem to share stronger similarities with other Chorrera manifestations from the coastal lowlands and somewhat less influence from the highlands than is the case with the Nueva Era and Nambillo assemblages.

In summary, the combined radiocarbon determinations for the Late Formative period in western Pichincha province are consistent with those from Manabí province in suggesting a relatively early start date of ca.1200 to 1300 B.C. for Chorrera culture and an end date of ca. 300 to 350 B.C., the latter marking the eruption of Pululahua.

In Esmeraldas province, Chorrera and Chorrera-like manifestations have been documented in several different regions: the Chévele complex on the Atacames coast (Guinea 1986), the Tachina complex at the mouth of the Esmeraldas River (López y Sebastián 1986; López y Sebastián and Caillavet 1979), the Mafa and Early Selva Alegre complexes in the interior Santiago–Cayapas River region (DeBoer 1996), and the Early La Tolita complex at the mouth of the Santiago River on the far northern coast (Bouchard 1996; Valdez 1987). Of these, only Early La Tolita and Early Selva Alegre have yielded radiocarbon determinations (see Table A1). Valdez's excavations at Tola Pajarito within the La Tolita site yielded a series of four radiocarbon determinations assigned to the Early La Tolita phase (Valdez 1987), characterized by a ceramic assemblage having marked Chorreroid features (Bouchard 1996; Valdez 1987). These determinations are in descending radiocarbon age: 2540 ± 75 RCYBP (GX 12374); 2502 ± 70 RCYBP (GX 12373); 2450 ± 80 RCYBP (GX 12380); and 2265 ± 80 RCYBP (GX 12379). As their corresponding calibrated age ranges demonstrate (see Table A1), these determinations all fall toward the late end of the Chorrera time range.

Farther inland, in the Santiago–Cayapas river basins, DeBoer (1996) has defined a Late Formative ceramic complex, the Mafa phase, at the beginning of his long cultural sequence. While he does not equate it with the Late Formative complexes farther south along the Ecuadorian coast and falls short of proclaiming it "Chorrera-like," DeBoer does point out similarities in ceramic traits that it shares with Early La Tolita: "Tentatively then, Temprano (Early La Tolita) and Mafa can be viewed as contemporary phases or even manifestations of the same phase" (DeBoer 1996: 104; parentheses added). Unfortunately, no reliable radiocarbon determinations exist for the Mafa phase. However, since it is known to precede the Selva Alegre phase, a radiocarbon determination for the beginning of the cultural complex serves as an appropriate *terminus ante quem* to date the end of the Mafa phase. The determination in question is B 33782 from the site of Colón Eloy (R36) in the Santiago drainage, which yielded an age estimate of 2390 ± 80 RCYBP. When calibrated at the 68.2% CI, it yields a calendrical age estimate of 760 to 390 B.C., almost identical to the calibrated age range of determination GX 12380 from La Tolita (see Table A1).

Although far beyond the present scope, it is important to note that "Chorreroid" manifestations also extend northward along the coast to the adjacent Tumaco region of Colombia, with progressively less Chorrera-like ceramic traits continuing as far as the Chocó coast and the Cauca valley (Bouchard 1996). However, these complexes are not discussed in this Appendix.

Regarding the so-called *Doppler effect* in the spread of ceramic traits over large geographical areas, the archaeological result is a mosaic of regional ceramic complexes that share many broad similarities, yet may vary considerably in their relative contemporaneity or coevalness. Such is the case with the Late Formative Chorrera manifestations of western Ecuador. Indeed, relative start dates may vary by several centuries and end dates vary depending on the extent to which they were affected by the major eruption of Pululahua.

From radiocarbon evidence, it appears that Chorrera culture had an earlier start in southern and northern Manabi province, as well as western Pichincha province, than elsewhere, perhaps as early as 1300 to 1200 B.C. It would have been coeval with a flourishing Machalilla culture on the coast of Guayas province. On the other hand, we cannot discount the possibility that early radiocarbon determinations in this same time range will eventually be found in the lower Guayas basin in the general area of the Chorrera type site (Evans and Meggers 1954, 1957) and Peñón del Río (Zedeño n.d.). Precise dating of these Chorrera manifestations represents one of the critical gaps in our current knowledge of the Ecuadorian Formative.

I argue for 300 B.C. as the best ending date for the Late Formative, at least in Manabí and western Pichincha, where Chorrera occupations were abruptly terminated by the eruption of Pululahua (Engwall n.d.; Isaacson 1987, 1994; Lippi 1998; Lubensky n.d.a; Zeidler 1994a,b; Zeidler and Isaacson this volume). The same eruptive event probably affected the La Cadena–Quevedo area of Los Ríos province as well. Along the coastal strip, the southernmost "footprint" of this eruption has been traced to the Agua Blanca valley in southern Manabí, while the northernmost footprint extends from the Quito basin westward to Cojimíes in northern Manabí (Zeidler and Isaacson this volume). Therefore, we should expect to find truncated Chorrera sequences with hiatuses of varying lengths immediately following the ashfall of the Pululahua eruption. Obviously, this would be an attenuating effect so that regions at the distal end of ashfall in far southern Manabí may not have been affected as dramatically (see Zeidler and Isaacson this volume).

Jama–Coaque I (Muchique Phase 1) from the Jama valley as well as Bahia I from the Esteros (M8) and Tarqui (M7) sites at Manta (Estrada 1962; Meggers et al. 1965; Stirling and Stirling 1963) are posteruptive phenomena and should be considered early Regional Developmental in age, as originally suggested by Estrada (1962: cuadro 4) and Meggers et al. (1965). Whether one agrees with that stage-based nomenclature (see Zeidler et al. 1998 for a detailed discussion), both ceramic complexes mark a major cultural break in their respective cultural sequences. Some continuity in Chorrera ceramic traits exists (Cummins 1992; Zeidler and Sutliff 1994), but overall, they represent new ceramic complexes.

Some nine radiocarbon determinations are available from the Manta excavations (Meggers et al. 1965: table H), eight from Los Esteros, and one from Tarqui. Seven of these nine determinations, when calibrated at the 68.2% CI would likely fall after the 350 to 300 B.C. estimate for the eruption of Pululahua. It should also be noted that the two determinations that might predate the eruption are not in stratigraphic order (i.e., they do not derive from the lowest part of the excavation units). The two determinations from the deepest levels of the Los Esteros site (M1316 and M734) yielded age estimates of 2120 ± 120 RCYBP and 2170 ± 200 RCYBP, respectively, which when calibrated at the 68.2% CI, would fall well after the Pululahua eruption. They are quite consistent with radiocarbon determinations for the early portion of the Regional Developmental period elsewhere in Manabí, such as the Muchique I phase from the Jama valley (see Zeidler et al. 1998: table 2).

In Esmeraldas province, a somewhat different pattern emerges. Chorrera manifestations appear to begin somewhat later than in Manabí and Guayas provinces, yet they continue without the truncation caused by the Pululahua eruption. Thus the Late Formative manifestations such as Chévele, Early La Tolita, Mafa, and Tachina appear to have more gradual transitions into the succeeding Regional Developmental cultures represented by Early Atacames for Chévele, Tiaone for Tachina, Classic La Tolita for Early La Tolita, and Selva Alegre for Mafa. Even here, however, these transitions appear to occur in the 350 to 300 B.C. time range (Bouchard 1996).

In Guayas province, the situation is also different. In this area, the Chorrera/Engoroy occupation of the Santa Elena peninsula and southern Manabí coast from Salango southward was unaffected by the Pululahua eruption. In these regions, a more gradual transition to the succeeding Guangala and Bahía cultures appears to have occurred. Engoroy on the Santa Elena peninsula (Paulsen and McDougle n.d.a,b) and northern Guayas coast (Bischof 1975a; 1982) appears to evolve out of Machalilla, while at Salango in southern Manabí (Lunniss and Mudd n.d.; Norton et al. 1983), it appears to overlie classic Chorrera deposits. Fase Guayaquil in the lower Guayas basin (Parducci and Parducci 1975), and Bella Vista on Puná Island (Aleto 1988) probably represent uninterrupted continuities out of classic Chorrera extending up until the time of Christ. In these cases, then, the Late Formative may very well persist up to 100 B.C., as argued by Aleto (1988), but it would be a mistake to uncritically apply that scheme to the entire coastal lowlands.

Table A1
Formative Period Radiocarbon Chronology for the Coast and Western Lowlands of Ecuador, by Province and Site, from Earliest Uncalibrated Date to Most Recent Radiocarbon Year before Present (RCYBP)

Site, culture, and phase	Lab and lab no.	Uncalibrated date RCYBP	Probability calibrated range 68.2% (year B.C.)	Probability calibrated range 95.4% (year B.C.)	Reference
		Guayas			
Real Alto					
Valdivia 1a	Geochron Labs and Ill. State Geological Survey				
	GX 5269	6195 ± 215	5400–4850	5650–4600	Damp n.d.
	ISGS 448	5620 ± 250	4800–4100	5200–3800	Damp n.d.; Liu, Riley, and Coleman 1986
	GX 5267	5495 ± 200	4540–4040	4800–3800	Damp n.d.
Loma Alta	Geochron Labs				
Valdivia 1a	GX 7704	5275 ± 175	4340–3940	4500–3700	Stahl 1984
Valdivia 1	GX 9457	5240 ± 420	4600–3500	5000–2900	Stahl 1984
Valdivia	Univ. Michigan				
Valdivia A*	M 1320	5150 ± 150	4200–3760	4350–3650	Meggers, Evans, and Estrada 1965
Loma Alta					
Valdivia 1	Geochron Labs				
	GX 9459	5050 ± 240	4250–3500	4500–3100	Stahl 1984
Valdivia 1a	Teledyne Isotopes and Ill. State Geo. Survey				
	I 7076	5010 ± 120	3950–3700	4050–3500	Norton n.d.a,b
	ISGS 142	5000 ± 190	4040–3530	4250–3350	Norton n.d.a,b
Valdivia 1	Geochron Labs and Simon Fraser Univ.				
	GX 9458	4960 ± 210	3990–3510	4440–3100	Stahl 1984
	SFU 123	4920 ± 200	4000–3350	4300–3100	Stahl 1984
Valdivia 1a	Teledyne Isotopes				
	I 7075	4920 ± 120	3940–3530	4000–3350	Norton n.d.a,b
Real Alto	Geochron Labs				
Valdivia 1b	GX 5268	4900 ± 170	3940–3510	4300–3100	Damp n.d.
Loma Alta	Simon Fraser Univ.				
Valdivia 1	SFU 110	4790 ± 160	3760–3360	4000–3100	Stahl 1984

(*cont.*)

Table A1 (*cont.*)
Formative Period Radiocarbon Chronology for the Coast and Western Lowlands of Ecuador, by Province and Site, from Earliest Uncalibrated Date to Most Recent Radiocarbon Year before Present (RCYBP)

Site, culture, and phase	Lab and lab no.	Uncalibrated date RCYBP	Probability calibrated range 68.2% (year B.C.)	95.4% (year B.C.)	Reference
		Guayas (*cont.*)			
Real Alto Valdivia 1b/2a?	Ill. State Geo. Survey ISGS 468	4760 ± 120	3650-3370	3800-3100	Damp n.d.; Liu et al. 1986
Loma Alta Valdivia 2a	Ill. State Geo. Survey ISGS 146	4750 ± 120	3650-3370	3800-3100	Norton n.d.a,b
Punta Concepción Valdivia 1	Lamont-Doherty L 1042D	4700 ± 100	3640-3360	3700-3100	Hill 1972/74; Stothert 1976
Loma Alta Valdivia 1	Ill. State Geo. Survey GX 9460	4700 ± 270	3800-3000	4100-2600	Stahl 1984
Real Alto Valdivia 1b/2a?	Ill. State Geo. Survey ISGS 452	4700 ± 300	3800-3000	4300-2500	Liu et al. 1986
Valdivia Valdivia aceramic	Ill. State Geo. Survey ISGS 275	4700 ± 80	3630-3370	3700-3100	Bischof and Viteri Gamboa 1972; Liu et al. 1986
OGSE-63 Valdivia 1	Teledyne Isotopes I 7069	4685 ± 95	3630-3360	3700-3100	Hill 1972/74; Stothert 1976
Loma Alta Valdivia 2a	Geochron Labs GX 7699	4630 ± 160	3650-3100	3700-2900	Stahl 1984
Valdivia Valdivia A*	Univ. Michigan M 1322	4620 ± 140	3650-3100	3650-2900	Meggers et al. 1965
Loma Alta Valdivia 1b/2a?	Ill. State Geo. Survey ISGS 192	4590 ± 120	3520-3090	3650-2900	Norton n.d.a,b
Valdivia	Hannover, Ill. State Geo. Survey, and Smithsonian Inst.				
Valdivia aceramic	ISGS 274	4580 ± 80	3500-3100	3650-3000	Bischof and Viteri Gamboa 1972; Liu et al. 1986
Valdivia A*	SI 84	4540 ± 150	3510-3020	3650-2850	Meggers et al. 1965
Valdivia aceramic	Hv 4839	4535 ± 55	3360-3100	3500-3030	Bischof and Viteri Gamboa 1972
Valdivia A*	SI 83	4530 ± 55	3360-3100	3490-3020	Meggers et al. 1965
Colimes Valdivia 2a	Ill. State Geo. Survey ISGS 477	4525 ± 75	3360-3090	3500-2900	Raymond, Marcos, and Lathrap 1980

Colimes (Perinao) Valdivia 2a	Ill. State Geo. Survey ISGS 478a	4510 ± 100	3360–3030	3550–2900	Liu et al. 1986
Valdivia Valdivia aceramic	Hannover Hv 4674	4510 ± 95	3360–3030	3500–2900	Bischof and Viteri Gamboa 1972
	Hv 4840	4495 ± 100	3360–3030	3500–2900	Bischof and Viteri Gamboa 1972
Real Alto Valdivia 2a	Geochron Labs GX 5266	4495 ± 160	3370–2920	3650–2700	Damp n.d.
Valdivia Valdivia A*	Univ. Michigan M 1317	4480 ± 140	3360–2920	3650–2850	Meggers et al. 1965
Loma Alta Valdivia 2	Simon Fraser Univ. SFU 122	4460 ± 130	3350–2920	3550–2750	Stahl 1984
Colimes (Perinao) Valdivia 2a	Ill. State Geo. Survey ISGS 478b	4460 ± 100	3340–2940	3500–2850	Liu et al. 1986
Punta Concepción Valdivia 1	Teledyne Isotopes I 7167	4460 ± 90	3340–3010	3370–2900	Hill 1972/74
Loma Alta Valdivia 2	Simon Fraser Univ. SFU 105	4450 ± 120	3340–2920	3550–2850	Stahl 1984
Punta Concepción Valdivia 1	Lamont-Doherty L 1042C	4450 ± 100	3340–2920	3400–2850	Hill 1972/74; Stothert 1976
Valdivia Valdivia A*	Smithsonian Inst. and Nat. Ctr. of the U.S. Geo. Survey SI 22	4450 ± 90	3340–2920	3360–2900	Meggers et al. 1965
	W 631	4450 ± 200	3500–2850	3700–2500	Meggers et al. 1965
El Encanto Valdivia A*	Smithsonian Inst. SI 1311	4405 ± 90	3310–2910	3350–2880	Porras 1973
Real Alto Valdivia 2b	Ill. State Geo. Survey ISGS 466	4390 ± 80	3270–2900	3340–2880	Liu et al. 1986
Loma Alta Valdivia 2	Geochron Labs GX 7703	4375 ± 135	3330–2880	3400–2600	Stahl 1984
El Encanto Valdivia B*	Smithsonian Inst. SI 1184	4370 ± 85	3260–2880	3350–2850	Porras 1973
Loma Alta Valdivia 2b	Smithsonian Inst. SI 1055	4370 ± 65	3090–2900	3330–2880	Norton n.d.a,b
Colimes Valdivia 2b	Geochron Labs GX 5271	4365 ± 245	3400–2600	3700–2300	Raymond et al. 1980
Loma Alta Valdivia 2	Simon Fraser Univ. and Hannover SFU 120	4360 ± 160	3350–2750	3500–2500	Stahl 1984
	Hv 4673	4335 ± 100	3350–2750	3350–2650	Norton n.d.a,b
Valdivia Valdivia A*	Smithsonian Inst. SI 81	4270 ± 60	3010–2700	3030–2660	Meggers et al. 1965

(*cont.*)

Table A1 (*cont.*)
Formative Period Radiocarbon Chronology for the Coast and Western Lowlands of Ecuador, by Province and Site, from Earliest Uncalibrated Date to Most Recent Radiocarbon Year before Present (RCYBP)

Site, culture, and phase	Lab and lab no.	Uncalibrated date RCYBP	Probability calibrated range 68.2% (year B.C.)	Probability calibrated range 95.4% (year B.C.)	Reference
		Guayas (*cont.*)			
Real Alto Valdivia 2b/3?	Ill. State Geo. Survey ISGS 446	4270 ± 80	3020–2690	3100–2590	Liu et al. 1986
Loma Alta Valdivia 2	Geochron Labs GX 7701	4260 ± 145	3090–2590	3350–2450	Stahl 1984
Valdivia Valdivia 2	Hannover Hv 4838	4260 ± 100	3020–2660	3350–2450	Bischof and Viteri Gamboa 1972
Punta Concepción Valdivia 2	Lamont-Doherty L 1232	4250 ± 100	3020–2620	3350–2450	Hill 1972/74; Stothert 1976
Loma Alta Valdivia 2	Geochron Labs GX 7700	4245 ± 145	3030–2580	3350–2450	Stahl 1984
Real Alto Valdivia/Valdivia 6?	Geochron Labs GX 7439	4240 ± 180	3100–2500	3400–2300	Marcos and Michczynski 1996
Valdivia Valdivia B*	Smithsonian Inst. SI 18	4230 ± 100	2920–2620	3100–2450	Meggers et al. 1965
	SI 16	4220 ± 100	2920–2620	3100–2450	Meggers et al. 1965
Real Alto Valdivia 6?	Geochron Labs GX 7438	4205 ± 160	3050–2450	3350–2300	Marcos and Michczynski 1996
Valdivia Valdivia B*	Nat. Ctr., U.S. Geo. Survey W 632	4190 ± 200	3050–2450	3400–2200	Meggers et al. 1965
Real Alto Valdivia 5?	Geochron Labs GX 7437	4175 ± 165	2920–2470	3400–2200	Marcos and Michczynski 1996
Valdivia Valdivia B*	Smithsonian Inst. SI 85	4170 ± 90	2880–2620	2920–2490	Meggers et al. 1965
Valdivia Valdivia B*	Univ. Michigan M 1318	4170 ± 140	2910–2490	3100–2300	Meggers et al. 1965
Real Alto Valdivia 5?	Geochron Labs GX 7436	4145 ± 170	2910–2470	3400–2200	Marcos and Michczynski 1996
Valdivia 2	Ill. State Geo. Survey ISGS-467	4140 ± 190	3050–2350	3400–2100	Liu et al. 1986

Valdivia Valdivia B*	Smithsonian Inst. SI 80	4140 ± 60	2870–2600	2890–2500	Meggers et al. 1965
Valdivia Valdivia B*	Smithsonian Inst. SI 82	4120 ± 65	2870–2570	2880–2490	Meggers et al. 1965
Real Alto Valdivia 2b/3?	Ill. State Geo. Survey ISGS 439	4110 ± 80	2870–2500	2880–2470	Liu et al. 1986
Valdivia Valdivia B*	Univ. Michigan M 1321	4100 ± 140	2880–2490	3050–2200	Meggers et al. 1965
Valdivia Valdivia San Pedro	Hannover Hv 4675	4075 ± 110	2870–2470	2900–2300	Bischof and Viteri Gamboa 1972
Real Alto Valdivia 3	Geochron Labs GX 7429	4050 ± 185	2900–2350	3100–1900	Zeidler 1984
Valdivia Valdivia C*	Nat. Ctr., U.S. Geo. Survey W 630	4050 ± 200	2900–2300	3100–1900	Meggers et al. 1965
Buena Vista Valdivia C*	Smithsonian Inst. SI 71	4040 ± 55	2630–2470	2870–2450	Meggers et al. 1965
Anllula Valdivia 7	Univ. Pa. P 2761	4020 ± 220	2900–2200	3300–1800	Lubensky 1974, n.d.a
Real Alto Valdivia 6	Geochron Labs GX 7434	4015 ± 170	2900–2300	3100–1900	Marcos and Michczynski 1996
Loma Alta Valdivia 2?	Geochron Labs GX 7702	3985 ± 140	2900–2200	2900–2050	Stahl 1984
Valdivia Valdivia C*	Smithsonian Inst. SI 78	3970 ± 65	2580–2350	2700–2200	Meggers et al. 1965
Punta Concepción Valdivia 7	Lamont-Doherty L 1232H	3900 ± 150	2580–2140	2900–1950	Hill 1972/74
Real Alto Valdivia 3?	Geochron Labs GX 7430	3845 ± 240	2650–1900	3000–1600	Zeidler 1984
Loma Alta Valdivia 2?	Ill. State Geo. Survey ISGS 190	3765 ± 85	2310–2030	2500–1950	Norton n.d.
Ayalán Valdivia 8	Nishina Memorial N 2908 N 2909	 3665 ± 95 3630 ± 105	 2200–1910 2190–1780	 2350–1700 2300–1650	 Marcos and Michczynski 1996 Marcos and Michczynski 1996
Buena Vista Machalilla	Smithsonian Inst. SI 69	3450 ± 50	1880–1680	1890–1620	Meggers et al. 1965
La Cabuya Machalilla	Smithsonian Inst. SI 107	3320 ± 170	1880–1410	2050–1100	Meggers et al. 1965
Buena Vista Machalilla	Smithsonian Inst. SI 1050	3250 ± 90	1680–1420	1750–1310	Norton n.d.

(cont.)

Table A1 (*cont.*)
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Site, culture, and phase	Lab and lab no.	Uncalibrated date RCYBP	Probability calibrated range 68.2% (year B.C.)	Probability calibrated range 95.4% (year B.C.)	Reference
		Guayas (*cont.*)			
La Libertad	Teledyne Isotopes				
Machalilla	I 7013	3060 ± 90	1430–1130	1520–1040	Paulsen and McDougle n.d.a
	I 7008	3015 ± 90	1400–1120	1500–950	Paulsen and McDougle n.d.a
La Libertad	Teledyne Isotopes				
Machalilla	I 7006	2990 ± 90	1380–1050	1430–970	Paulsen and McDougle n.d.a
La Cabuya	Smithsonian Inst.				
Machalilla	SI 108	2980 ± 160	1400–1000	1600–800	Meggers et al. 1965
Buena Vista	Smithsonian Inst.				
Machalilla	SI 1051	2945 ± 115	1370–1000	1450–800	Norton n.d.a,b
La Ponga	Wisconsin				
Machalilla	WIS 1125	2925 ± 65	1260–1010	1320–920	Lippi n.d.
	WIS 1141	2880 ± 75	1210–930	1300–830	Lippi n.d.
Los Cerritos	Wisconsin				
Machalilla/Chorrera	WIS 115	2840 ± 90	1190–890	1270–820	Bischof 1982; Zevallos Menéndez 1965/66
La Cabuya	Smithsonian Inst.				
Machalilla	SI 67	2830 ± 45	1050–910	1130–840	Meggers et al. 1965
La Ponga	Wisconsin				
Machalilla	WIS 1140	2790 ± 75	1010–830	1130–800	Lippi n.d.
La Libertad	Beta Analytic				
Chorrera	Beta 15656	2720 ± 70	920–800	1050–780	Stothert 1995
Loma Alta	Simon Fraser Univ.				
Chorrera	SFU 109	2540 ± 80	810–520	820–400	Stahl 1984
Los Cerritos	Wisconsin				
Chorrera (Engoroy)	WIS 125	2540 ± 80	810–520	820–400	Bischof 1982; Zevallos Menéndez 1965/66
Bella Vista (Puná Island)	Ill. State Geo. Survey				
Chorrera (Fase Guayaquil)	ISGS-1347	2460 ± 110	760–410	850–350	Aleto 1988
Palmar 3	Hannover				
Chorrera (Engoroy 4)	Hv 1293	2385 ± 80	760–380	800–200	Bischof 1982
Palmar 2	Hannover				
Chorrera (Engoroy 4)	Hv 2978	2295 ± 75	410–200	800–100	Bischof 1982

San Pedro de Guayaquil	Univ. Washington				
Chorrera (Fase Guayaquil)	UW 125	2290 ± 100	520–170	800–50	Parducci and Parducci 1970, 1975
PL 18 (Daule River)	Univ. Arizona				
Chorreroid	AA 1763	2280 ± 110	520–160	800–50	Stemper 1989
San Pedro de Guayaquil	Univ. Washington				
Chorrera (Fase Guayaquil)	UW 124	2185 ± 80	380–120	400–40	Parducci and Parducci 1970, 1975
	UW 123	2175 ± 60	360–120	390–50	Parducci and Parducci 1970, 1975
		El Oro			
La Emerenciana	Southern Methodist Univ.				
Valdivia 7	SMU 4259	4109 ± 215	2950–2300	3400–2000	Marcos and Michczynski 1996
Valdivia 8	SMU 2263	3775 ± 165	2460–1970	2700–1600	Staller 1994
	SMU 2225	3707 ± 148	2310–1880	2600–1650	Staller 1994
	SMU 4549	3629 ± 303	2500–1600	2900–1200	Marcos and Michczynski 1996
	SMU 2226	3400 ± 220	2050–1400	2400–1100	Staller 1994
	SMU 2241	3361 ± 246	2050–1300	2400–1000	Staller 1994
		Manabí			
Salango	Geochron Labs				
Valdivia 2	GX 8964	4670 ± 195	3650–3100	4000–2800	Norton, Lunniss, and Nayling 1983
	GX 8962	4510 ± 210	3550–2900	3700–2600	Norton et al. 1983
San Isidro					
Valdivia 8	Ill. State Geo. Survey and Univ. Pittsburgh				
	ISGS 1221	3630 ± 70	2130–1880	2200–1770	Zeidler, Buck, and Litton 1998
	ISGS 1222	3620 ± 70	2130–1880	2200–1760	Zeidler et al. 1998
	ISGS 1223	3560 ± 70	2020–1770	2140–1690	Zeidler et al. 1998
	PITT 426	3545 ± 135	2120–1680	2300–1500	Zeidler et al. 1998
	ISGS 1220	3500 ± 70	1920–1690	2030–1630	Zeidler et al. 1998
La Plata Island	Geochron Labs				
Late Machalilla/Chorrera	GX 7821	3065 ± 135	1500–1120	1650–900	Lippi 1983; Marcos and Norton 1981
Salango	Geochron Labs				
Chorrera	GX 13027	3045 ± 150	1440–1050	1700–850	Lunnis and Mudd n.d.; Norton et al. 1983
La Mina	Ill. State Geo. Survey				
Chorrera (Tabuchila)	ISGS 2366	3030 ± 80	1400–1130	1440–1010	Engwall 2000; Zeidler et al. 1998
Dos Caminos	Ill. State Geo. Survey				
Chorrera (Tabuchila)	ISGS 3309	2930 ± 80	1260–1000	1380–910	Engwall 2000; Zeidler et al. 1998
La Plata Island	Geochron Labs				
Chorrera	GX 7823	2915 ± 140	1300–920	1450–800	Lippi 1983; Marcos and Norton 1981

(*cont.*)

Table A1 (*cont.*)
Formative Period Radiocarbon Chronology for the Coast and Western Lowlands of Ecuador, by Province and Site, from Earliest Uncalibrated Date to Most Recent Radiocarbon Year before Present (RCYBP)

Site, culture, and phase	Lab and lab no.	Uncalibrated date RCYBP	Probability calibrated range 68.2% (year B.C.)	Probability calibrated range 95.4% (year B.C.)	Reference
		Manabí (*cont.*)			
Dos Caminos	Ill. State Geo. Survey				
Chorrera (Tabuchila)	ISGS 3310	2880 ± 70	1210–930	1290–840	Engwall 2000; Zeidler et al. 1998
San Isidro	Univ. of Arizona				
Chorrera (Tabuchila)	AA 4140	2845 ± 95	1190–890	1300–810	Engwall 2000; Zeidler et al. 1998
La Plata Island	Geochron Labs				
Chorrera	GX 7816	2830 ± 245	1400–750	1700–300	Lippi 1983; Marcos and Norton 1981
Veliz (M-42)	Humble Oil				
Chorrera (Tabuchila)	HO 1307	2800 ± 115	1130–820	1400–750	Estrada 1962; Zeidler et al. 1998
Salango	Geochron Labs				
Chorrera	GX 9990	2765 ± 175	1260–780	1400–400	Beckwith 1996; Kurc n.d.
	GX 9994	2750 ± 190	1300–750	1400–400	Beckwith 1996; Kurc n.d.
La Plata Island	Geochron Labs				
Chorrera	GX 7818	2745 ± 150	1190–780	1400–400	Lippi 1983; Marcos and Norton 1981
	GX 7820	2745 ± 140	1130–790	1400–500	Lippi 1983; Marcos and Norton 1981
Salango	Geochron Labs				
Chorrera	GX 9992	2705 ± 150	1150–550	1300–400	Beckwith 1996; Kurc n.d.
	GX 9991	2650 ± 165	1010–520	1300–350	Beckwith 1996; Kurc n.d.
La Plata Island	Geochron Labs				
Chorrera	GX 7817	2640 ± 220	1050–400	1400–200	Lippi 1983; Marcos and Norton 1981
	GX 7822	2600 ± 130	900–520	1050–350	Lippi 1983; Marcos and Norton 1981
	GX 7824	2595 ± 130	900–510	1050–350	Lippi 1983; Marcos and Norton 1981
Salango	Geochron Labs				
Chorrera	GX 9995	2590 ± 170	900–410	1250–200	Beckwith 1996; Kurc n.d.
	GX 13028	2540 ± 85	810–520	820–400	Norton et al. 1983
La Sequita (M-55)	Smithsonian Inst.				
Chorrera-Bahía	SI 43	2540 ± 125	810–410	1000–350	Meggers et al. 1965
	SI 35	2525 ± 105	800–510	840–390	Meggers et al. 1965
El Mocoral	Ill. State Geo. Survey				
Chorrera (Tabuchila)	ISGS 2377	2500 ± 160	800–410	1000–200	Engwall 2000; Zeidler et al. 1998

Salango	Geochron Labs				Lunniss and Mudd n.d.;
Chorrera	GX 13026	2340 ± 485	1000- A.D. 300	1600- A.D. 700	Norton et al. 1983
		Los Ríos			
La Cadena	Bern				Reindel 1995
Chorrera	B 5560	2430 ± 80	760-400	790-390	
Palenque	Inst. of Physical and Chemical				Porras 1983
Chorrera (Fase Guayaquil)	Research of Japan				
	RK 4206	2220 ± 75	380-200	410-60	
	RK 2207	2170 ± 65	360-110	400 - A.D. 1	
		Pichincha (western)			
Nambillo	Geochron Labs				
nonapplicable	GX 12471	5325 ± 110	4320-4000	4450-3900	Lippi 1996
nonapplicable	GX 12470	4540 ± 80	3370-3090	3550-2900	Lippi 1996
Early Nambillo	GX 12473	3330 ± 80	1740-1510	1870-1430	Lippi 1996
Early Nambillo	GX 12469	3225 ± 260	1900-1100	2200-800	Lippi 1996
Nueva Era	Ill. State Geo. Survey				
Nueva Era	ISGS 1182	3070 ± 250	1650-900	2000-700	Isaacson n.d.
Santa Marta	Bern				
Chorrera	B 43348	2950 ± 80	1290-1020	1390-930	Lubensky n.d.a
Nueva Era	Ill. State Geo. Survey				
Nueva Era	ISGS 1176	2710 ± 100	1000-790	1250-500	Isaacson n.d.
	ISGS 1175	2620 ± 70	900-560	1000-450	Isaacson n.d.
Nambillo	Geochron Labs				
Early Nambillo	GX 12472	2315 ± 260	800-100	1000-A.D. 300	Lippi 1996
Nueva Era	Geochron Labs				
Nueva Era	ISGS 1187	2010 ± 160	350-A.D. 250	400-A.D. 400	Isaacson n.d.
		Esmeraldas			
La Tolita: Tola Pajarito					
Chorrera/Early La Tolita	Geochron Labs				
	GX 12374	2540 ± 75	800-520	810-400	Bouchard 1996; Valdez 1987
	GX 12373	2505 ± 70	790-520	800-410	Bouchard 1996; Valdez 1987
	GX 12380	2450 ± 80	760-400	790-400	Bouchard 1996; Valdez 1987

(*cont.*)

Table A1 (*cont.*)
Formative Period Radiocarbon Chronology for the Coast and Western Lowlands of Ecuador, by Province and Site, from Earliest Uncalibrated Date to Most Recent Radiocarbon Year before Present (RCYBP)

			Probability calibrated range		
Site, culture, and phase	Lab and lab no.	Uncalibrated date RCYBP	68.2% (year B.C.)	95.4% (year B.C.)	Reference
		Esmeraldas (*cont.*)			
Colon Eloy (R-36) Early Selva Alegre	Bern B 33782	2390 ± 80	760–390	800–250	DeBoer 1996
La Tolita: Tola Pajarito Chorrera/Early La Tolita	Geochron Labs GX 12379	2265 ± 80	400–200	550–50	Bouchard 1996; Valdez 1987

Notes: Data compiled by J. Zeidler. * = phase designation of Meggers, Evans, and Estrada 1965.

Table A2
Absolute Chronology for Valdivia Culture according to Phase

Phase	Chronology (years B.C.) Radiocarbon (68.2% probability)	TL	Phase duration (years B.C.)
8b			1600–1450
8	2090–1790	1700–1500	1800–1600
7		1900–1700	1950–1800
6		2100–1900	2100–1950
5		2400–2100	2250–2100
4		2600–2400	2400–2250
3	2870–2360	2900–2400	2800–2400
2b	3090–2695	3200–2900	3000–2800
2a	3555–3065		3300–3000
1b	3860–3340	3600–3200	3800–3300
1a	4460–3755		4400–3800

Notes: TL = thermoluminescence. After Marcos and Michczynski (1996: table 4).

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