

## EFFECTS OF $^{14}\text{C}$ SAMPLE SELECTION IN ARCHAEOLOGY: AN EXAMPLE FROM HAWAI'I

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**ABSTRACT.** A comparison of radiocarbon histograms of samples controlled and uncontrolled for sample provenance and composition factors indicates that differences are sufficiently large to influence the discrimination of alternative hypotheses on the age of the important, early Bellows Dune site in Hawai'i.

### INTRODUCTION

The importance of radiocarbon sample collection in archaeology to control sample provenance and composition factors (Waterbolk 1971) is widely appreciated in the archaeological community (Taylor 1987:105 ff). In the Pacific, McFadgen et al. (1994) have shown that the probable effects of in-built age are sufficiently great to support “fallacious inferences” about the chronology of New Zealand prehistory. They compared  $^{14}\text{C}$  histograms of 338 marine shell and 425 wood and charcoal samples, and of 101 short-lived and 131 long-lived woods. In both comparisons, the sample type with greatest potential for in-built age yielded a histogram with a relatively long, heavy tail extending back in time and an earlier peak. In Hawai'i, where the shallow time depth of prehistory, between 1000 (Spriggs and Anderson 1993) and 2000 yr (Hunt and Holsen 1991), is comparable to New Zealand, archaeologists have often failed to control sample provenance and composition factors in  $^{14}\text{C}$  sample selection (Davidson 1992). This paper identifies effects of sample provenance and composition in a suite of  $^{14}\text{C}$  dates from two sites adjacent to the Bellows Dune Site, with implications for tests of hypotheses on the age of this important traditional Hawaiian archaeological site.

The Bellows Dune Site is often cited as an example of an early Hawaiian settlement (Kirch 1998, 1974, 1985; Shun 1992b; Miller 1991). The  $^{14}\text{C}$  chronology of the site is a matter of dispute among prehistorians over the timing of initial Polynesian settlement of the Hawaiian Islands, with arguments for a “long” chronology with settlement prior to AD 600 (Kirch 1974, 1985; Hunt and Holsen 1991) countered by arguments from the same data for a “short” chronology with settlement around AD 900 (Spriggs and Anderson 1993; Tuggle 1997). An attempt in 1987 to clarify the site chronology by dating archived wood charcoal samples, the results of which are partially reported (Spriggs and Anderson 1993; Hunt and Holsen 1991), yielded ambiguous results. The site has been mostly destroyed since it was last excavated in 1975 and there is some question whether archaeological contexts from the site's earliest levels are preserved. Given this state of affairs,  $^{14}\text{C}$  dates from archaeological contexts immediately inland of the Bellows Dune site provide potentially important information with which to distinguish between the “long” and “short” chronologies. In particular, contextually secure  $^{14}\text{C}$  dates that yield a calibrated age older than AD 600 would counter-indicate the short chronology and provide strong support for the long chronology.

The Bellows Dune Site, designated Site 50-80-15-4852 in the State of Hawaii site numbering system, is located north of the mouth of Puhā Stream on the seaward margin of the Waimānalo plain (Figure 1), a series of calcareous sand beach ridges and swales that formed as local sea level fell from a mid-Holocene high stand of about +1.8 m (Fletcher and Jones 1996) to its present level by about 2000 yr ago (Athens and Ward 1993; Fletcher and Jones 1996). Two archaeological sites, designated Sites 50-80-15-4851 and -4853, are located inland of the Bellows Dune Site; Site 4853 is immediately adjacent and Site 4851 is on the south side of Puhā Stream. Both sites consist of extensive, discontinuous, and somewhat variable subsurface deposits. The basic stratigraphic sequence at both sites can be described as a series of three horizons. The surface Horizon I consists primarily of secondarily

deposited sediments including traditional Hawaiian cultural materials, WWII-era construction fill, and recently deposited aeolian sands. The composition, thickness, and appearance of this horizon vary considerably over the sites. Horizon II includes intact traditional Hawaiian land surface and cultural deposits. This horizon is absent in many places, and in others only the lower portion is intact; both situations appear to be the result of sediment removal by heavy equipment. Horizon II lacks internal stratification and generally does not preserve cultural features, which usually can be distinguished only when they cut into Horizon III, the basal Holocene deposit of white calcareous sand.

There are at least three sources of wood with high in-built age at or near Sites 4851 and 4853. The heartwood of old trees growing on the plain might, at one time, have been the most ubiquitous source. There is little information on the longevity of most native taxa, but it can be assumed that many trees live on the order of 100 yr. Waterlogged wood is commonly found buried in and near the banks of Puhā Stream (Athens 1988; Rolett 1992). Two pieces of wood have been dated, yielding  $^{14}\text{C}$  dates of  $770 \pm 80$  BP (I-16734) and  $450 \pm 70$  BP (Beta-18237). Driftwood from the Pacific Northwest (Strong and Skolmen 1963) that washes ashore at Waimānalo Beach (Hall 1839) is a final source.  $^{14}\text{C}$  dates on Pacific Northwest driftwood collected on the south shore of Hawai'i Island (Emory and Sinoto 1969) indicate the magnitude of in-built age from this source. A piece of Douglas fir (WSU 424) returned a date of  $470 \pm 160$  BP, and a piece of Western red cedar (WSU 428) returned a date of  $1200 \pm 325$  BP.

Archaeological investigations at Sites 4851 and 4853 since 1986 have produced a corpus of 44  $^{14}\text{C}$  dates, nearly all of which are reported in unpublished proprietary or manuscript documents of limited circulation. Before 1997, 22 samples of wood charcoal were dated, most of which derived from the general Horizon II matrix or alluvial deposits along the banks of Puhā stream and were not securely associated with a particular cultural event. Samples taken from the Horizon II matrix contain materials of a potentially wide range of ages, not all of which are related directly to human activity. Sample material was identified in only one case (Beta-89698), and the material chosen for dating was not a short-lived taxon. Thus, all of the samples dated before 1997 did not control for the effects of in-built age. Since 1997, 22 samples of identified wood charcoal, securely associated with burning events in small scoop hearths and earth ovens or with infilling of refuse pits, have been dated. The identified and dated charcoals represent twigs, short-lived taxa, and nutshells selected to minimize in-built age.

A comparison of  $^{14}\text{C}$  histograms for the 22 samples selected to control for the effects of sample provenance and composition and the 22 uncontrolled samples (Figure 2) reveals a pattern similar to the one identified by McFadgen et al. (1994). The  $^{14}\text{C}$  histogram for controlled samples starts at AD 1150 and peaks at AD 1600. The shape of the  $^{14}\text{C}$  histogram for uncontrolled samples has a long tail that starts at AD 160. The histogram peaks about AD 1490, 100 yr earlier than the histogram for controlled samples. The long tail on the histogram of uncontrolled samples represents three  $^{14}\text{C}$  dates, the two oldest of which, Beta-25783 and Beta-31518, were collected from the banks of Puhā Stream. Their  $2\sigma$  calibrated age ranges (Stuiver and Pearson 1986) of AD 350–650 and AD 440–960, respectively, are sufficiently old potentially to disconfirm the short chronology. However, neither date is securely associated with a cultural event and both dates possibly incorporate materials with a high in-built age, such as are present today in the banks of the stream. The third  $^{14}\text{C}$  date in the tail, Beta-30891, calibrates to a  $2\sigma$  range of AD 770–1170 and would not disconfirm the short chronology.

In conclusion, suites of  $^{14}\text{C}$  dates from two sites adjacent to the Bellows Dune site show the effects of sample selection factors. These effects, which are likely due to in-built age and to the use for dat-

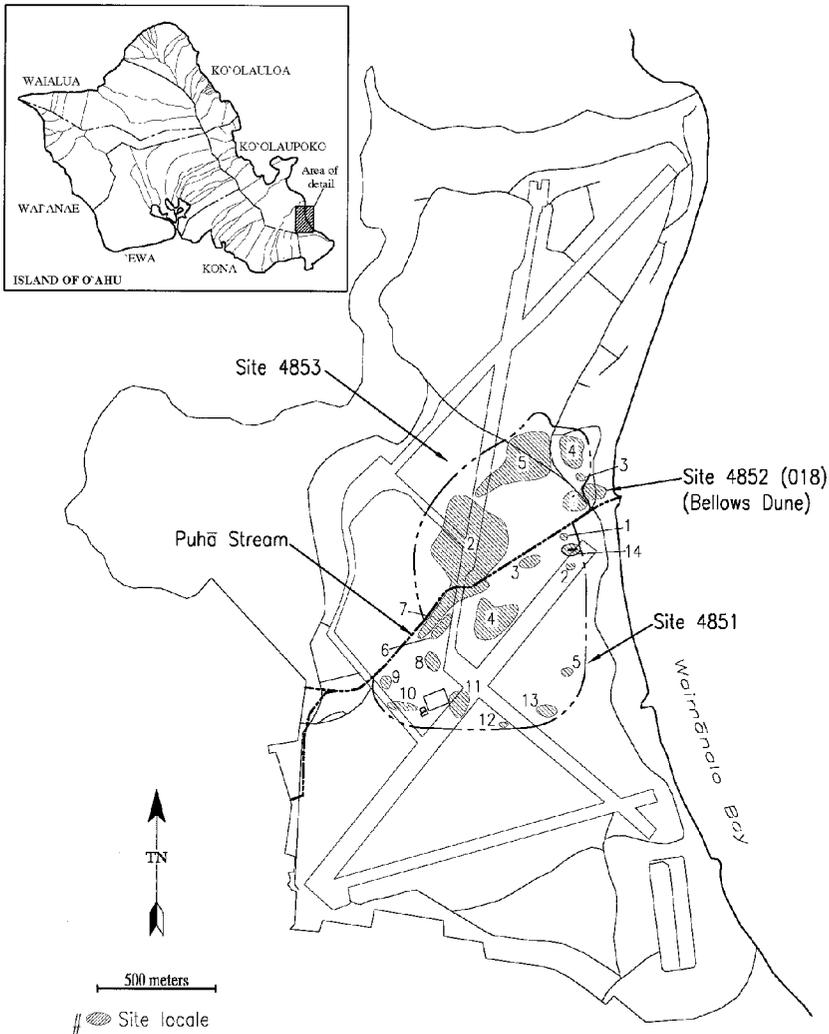


Figure 1 Locations of sites 50-80-15-4851, -4852 (Bellows Dune), and -4853. Site locales based on Tuggle (1997).

ing of materials not directly associated with human activity, are sufficiently large to influence the discrimination of alternative hypotheses on the age of the Bellows Dune site. The suite of controlled  $^{14}\text{C}$  dates contains no evidence for traditional Hawaiian use of sites immediately inland of the Bellows Dune site before AD 1150. The short chronology for the Bellows Dune site is not contradicted by the dating evidence from adjacent sites.

### Controlled Samples

Twenty-two samples of identified materials from Sites 50-80-15-4851 and -4853, selected to minimize the effects of in-built age. Wood species identification by Gail M Murakami, International Archaeological Research Institute, Inc. Wood Identification Laboratory. All samples associated with

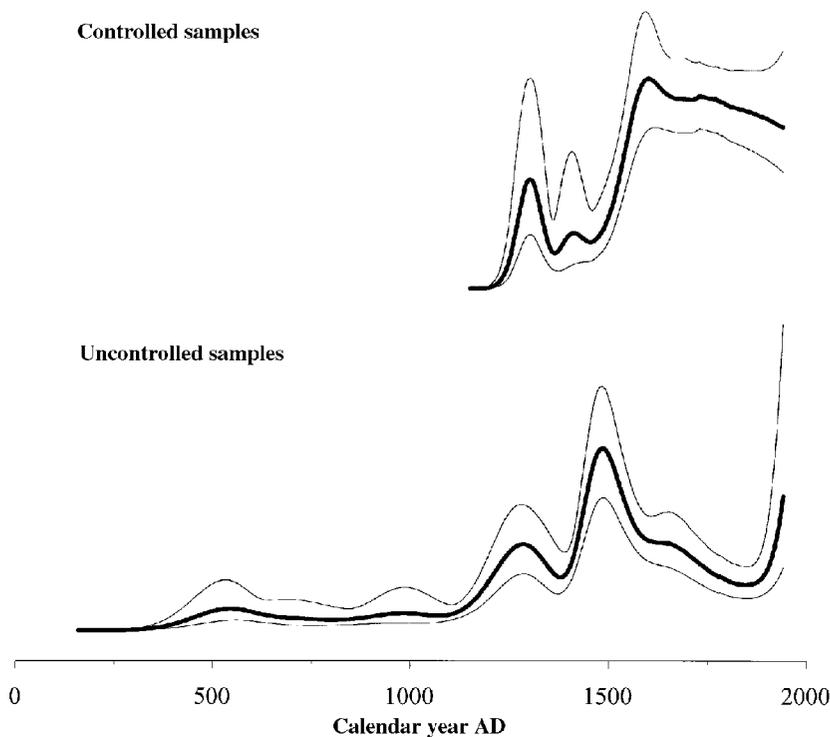


Figure 2  $^{14}\text{C}$  histograms of 22 controlled and 22 uncontrolled samples at Sites 50-80-15-4851 and -4853. Samples calibrated with the  $\sigma_s = 100$  smoothed calibration curve described by Törnqvist and Bierkens (1994). Nonparametric  $1\sigma$  confidence intervals generated with an approximate bootstrap technique (Efron and Tibshirani 1993:188). The y-axis scale, called “intensity” by Stolk et al. (1994), is omitted as unimportant in the comparison of histogram shapes.

a traditional Hawaiian cultural event from either the prehistoric period (pre AD 1778) or early historic period prior to AD 1850 (Desilets and Dye 1998:97 ff). Unless otherwise noted, all samples stratigraphically associated with Horizon II.

**Beta-101868.**

**$220 \pm 40$**

$\delta^{13}\text{C} = -24.2\text{‰}$

Sample identified as cf. *Sida fallax*, 0.09 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 3, Unit BT-1. Collected and submitted January 1997. Feature 3 was exposed in a backhoe trench, where it was “V” shaped in profile, 2 m wide and 0.9 m deep. Feature fill appeared “banded” (Addison 1997: 25).

*Comment:* Feature 3 interpreted by the excavator as a “refuse pit” (Addison 1997:25). Wood charcoals identified from Feature 3 include 6 native and Polynesian-introduced taxa and *Pinus* sp., a genus alien to the Hawaiian Islands. Feature 3 was subsequently excavated by Desilets and Dye (1998). This excavation showed the feature to be a depression or trench >8 m long, subsequently filled in. Food remains and combustion related artifacts indicate that cooking was performed at or near the feature. Identification of *Pinus* sp. was interpreted as evidence that the feature “was in the process of formation during the early historic period” (Desilets and Dye 1998:154–5).

**Beta-101869.****30 ± 60**

$$\delta^{13}\text{C} = -12.9\%$$

*Chamaesyce* sp., 0.07 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 6, Unit BT-5. Collected and submitted January 1997. Feature 6 is a “shallow depression with two distinct dark lenses” (Addison 1997:29).

*Comment:* Identification of wood charcoals yielded 6 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified. The lensing in this feature is unusual for traditional Hawaiian pit features in the region.

**Beta-101870.****170 ± 60**

$$\delta^{13}\text{C} = -22.5\%$$

*Chenopodium oahuense*, 0.19 g, Site 50-80-15-4853, Locale 5 (Figure 1), Unit TP-1, Layer II. Collected and submitted January 1997. Sample taken from cultural layer near Feature 1, “a pit shaped depression with fill slightly darker” (Addison 1997:49) than the layer from which it was cut.

*Comment:* The excavator interpreted Feature 1 as an earth oven based on its size and associated fire-altered rock. Wood charcoal identification yielded 6 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified.

**Beta-101871.****720 ± 40**

$$\delta^{13}\text{C} = -25.3\%$$

Sample identified as cf. *Osteomeles anthyllidifolia*, 0.65 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 9, Unit BT-23. Collected and submitted January 1997. Feature 9 is a depression with “heavily charcoal-stained fill” (Addison 1997:45).

*Comment:* Identification of wood charcoal yielded 3 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified. Feature 9 is buried by secondarily deposited material.

**Beta-101872.****680 ± 40**

$$\delta^{13}\text{C} = -24.7\%$$

Sample identified as cf. *Osteomeles anthyllidifolia*, 0.26 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 10, Unit BT-23. Collected and submitted January 1997. Feature 10 is a depression with “heavily charcoal-stained fill” (Addison 1997:45).

*Comment:* Identification of wood charcoal yielded 4 native taxa; no Polynesian or historic introductions were identified. Feature 10 is buried by secondarily deposited material.

**Beta-101873.****320 ± 40**

$$\delta^{13}\text{C} = -21.8\%$$

*Dodonea viscosa*, 0.45 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 16, BT-13. Collected and submitted January 1997. “Feature 16 is a shallow pit feature with more charcoal than the surrounding sediments” (Addison 1997:40).

*Comment:* The dated specimen, a native species, was the only charcoal identified from the feature.

**Beta-111022.****150 ± 40**

$$\delta^{13}\text{C} = -27.5\%$$

*Sida* cf. *fallax*, 0.5 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 1, Trench 5, Layer IIC/2. Collected 1997 and submitted October 1997. The Feature 1 pit, greater than 55 cm in diameter, was filled with sand stained dark by charcoal and with numerous coarse-grained and vesicular angular to

rounded pebbles and gravel, many pieces of which show evidence of alteration by heat (Dye 1998: 55 ff).

*Comment:* Feature 1 is inferred to be an earth oven based on its morphology and the nature of the fill. 13 native and Polynesian-introduced taxa were identified in a charcoal assemblage collected from the base of the feature; no historically introduced taxa were identified.

**Beta-111023.**

**310 ± 40**

$\delta^{13}C = -26.9\%$

Sample identified as cf. *Rauvolfia sandwicensis*, 0.34 g, Site 50-80-15-4851, Locale 14 (Figure 1), Feature 3, Trench 4. Collected 1997 and submitted October 1997. Feature 3 is a shallow pit cut into the basal Holocene sand from the Horizon II cultural layer (Dye 1998:48 ff).

*Comment:* The feature is interpreted as a scoop fire pit. Identification of wood charcoal yielded 5 native and Polynesian-introduced taxa; no historic introductions were identified.

**Beta-111024.**

**140 ± 60**

$\delta^{13}C = -26.8\%$

*Sida* cf. *fallax*, 0.36 g, Site 50-80-15-4851, Locale 14 (Figure 1), Feature 2, Trench 4. Collected 1997 and submitted October 1997. Feature 2 is a shallow fire pit cut into the basal Holocene sand (Dye 1998:46 ff).

*Comment:* Feature 2 is interpreted as a fire pit. Identification of wood charcoal yielded 9 native and Polynesian introduced taxa; no historically introduced or alien taxa were identified.

**Beta-111025.**

**540 ± 50**

$\delta^{13}C = -24.2\%$

*Sida* cf. *fallax*, 0.31 g, Site 50-80-15-4851, Locale 14 (Figure 1), Feature 1, Trench 4, Excavation Unit 3, Layer III/2. Collected 1997 and submitted October 1997. Sample collected from a shallow pit feature sealed stratigraphically by debitage from a lithic reduction event (Dye 1998:46).

*Comment:* Identification of wood charcoal yielded 11 native and Polynesian-introduced taxa; no historically introduced taxa were identified. Sample provides a terminus post quem for the lithic deposition event.

**Beta-120317.**

**140 ± 50**

$\delta^{13}C = -21.3\%$

*Sida* cf. *fallax*, 0.25 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 1, Unit IIA2, Layer II. Collected 1998 and submitted July 1998. Bowl-shaped Feature 1 measures roughly 90 cm in diameter and is 20 cm at maximum thickness (Desilets and Dye 1998:111 ff). Feature matrix consists of very dark gray unconsolidated calcareous sand with small amounts of bone and marine invertebrates.

*Comment:* Identification of wood charcoal yielded 4 native taxa and *Pinus* sp., a genus alien to the Hawaiian Islands. *Pinus* sp. is believed by the excavator to have entered the site as lumber, rather than driftwood, an interpretation consistent with the age of the sample.

**Beta-120318.**

**150 ± 50**

$\delta^{13}C = -26.1\%$

*Sida* cf. *fallax*, 0.09 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 5, Unit IIIB6, Layer II. Collected 1998 and submitted July 1998. Bowl shaped Feature 5 is circular in plan, measures 40 cm in diameter, and is 12 cm thick at its center (Desilets and Dye 1998:161 ff). It contains small amounts of bone and marine invertebrate as well as some thermally altered rock, coral, and charcoal.

*Comment:* Identification of wood charcoal yielded 8 native and Polynesian-introduced taxa and *Pinus* sp., a genus alien to the Hawaiian Islands. *Pinus* sp. is believed by the excavator to have entered the site as lumber, rather than driftwood, an interpretation consistent with the sample's age.

**Beta-120319.**

**350 ± 80**

$\delta^{13}\text{C} = -25.9\%$

*Aleurites moluccana* nutshell, *Chenopodium oahuense*, *Sida* cf. *fallax*, and *Osteomeles anthyllidifolia*, 3.04 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 9, Unit IIIA8, Layer II. Collected 1998 and submitted July 1998. Feature 9, round in plan and bowl-shaped in cross-section, measures 44 cm in diameter, with a maximum thickness of 21 cm (Desilets and Dye 1998:165 ff). It contains large amounts of coral, charcoal and thermally altered rock, with scant vertebrate and marine invertebrate remains.

*Comment:* A concentration of thermally altered basalt cobbles is located immediately north of the feature. These cobbles are likely "oven stones" used in Feature 9, which is interpreted to be an earth oven. Identified wood charcoal includes 12 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified.

**Beta-120320.**

**230 ± 50**

$\delta^{13}\text{C} = -25.6\%$

*Aleurites moluccana* nutshell, 20.63 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 13, Unit IVA8, Layer II. Collected 1998 and submitted July 1998. Feature 13 is round in plan, 65 cm diameter, and bowl-shaped in cross-section with a 19 cm maximum thickness (Desilets and Dye 1998:133 ff). Contents include bone, charcoal, marine invertebrate, thermally altered rock, 1 basalt flake, and 1 bone tool blank.

*Comment:* Feature 13 is interpreted as an open fire used for cooking or otherwise preparing a variety of marine flesh foods and possibly pig. Identified wood charcoal includes 14 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified.

**Beta-120321.**

**110 ± 70**

$\delta^{13}\text{C} = -25.0\%$

*Aleurites moluccana* nutshell, 5.84 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 15, Unit IVB8, Layer II. Collected 1998 and submitted July 1998. Feature 15 is round in plan with a 50 cm diameter and bowl-shaped with a maximum thickness of 13 cm (Desilets and Dye 1998:136 ff). Materials recovered from Feature 15 include bone, charcoal, coral, unburned *Aleurites moluccana* nutshell, marine invertebrates, and thermally altered rock.

*Comment:* Wood charcoal identification yielded 11 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified. The relatively small amount of cultural material yielded by Feature 15 makes it difficult to infer a function for the feature.

**Beta-120322.**

**310 ± 60**

$\delta^{13}\text{C} = -16.8\%$

*Chamaesyce* spp., 7.85 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 16, Unit IVA, B8.7, Layer II. Collected 1998 and submitted July 1998. Feature 16 is round in plan with an approximate diameter of 65 cm and bowl shaped in cross-section with a maximum thickness of 12 cm (Desilets and Dye 1998:138 ff). Feature 16 matrix is unconsolidated black calcareous sand and includes bone, charcoal, coral, historic debris, marine invertebrate, and thermally altered rock.

*Comment:* The feature is interpreted as a firepit used to cook fish and shellfish. Wood charcoal identification yielded 12 native and Polynesian-introduced taxa; no historically introduced or alien taxa

were identified. The sample has a moderate probability of association with use of the feature, which yielded some evidence of post-depositional disturbance.

**Beta-120323.****170 ± 60** $\delta^{13}C = -27.5\%$ 

*Aleurites moluccana* nutshell, *Chamaesyce* spp., *Sida* cf. *fallax*, 5.25 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 17, Unit IVA7, Layer II. Collected 1998 and submitted July 1998. Feature 17, only partially revealed by excavation, appears round in plan with an estimated 70 cm diameter, and is bowl shaped in cross-section with a maximum thickness of 17 cm (Desilets and Dye 1998:140 ff). Matrix is a very dark grayish brown unconsolidated calcareous sand that grades gradually to the underlying basal sand. Material recovered from Feature 17 includes bone, charcoal, coral, a small piece of metal, unburned *Aleurites moluccana* nutshell, marine invertebrate, thermally altered rock, and one basalt flake.

*Comment:* A small piece of metal is likely to be intrusive to the feature. The feature is interpreted as a small earth oven. Wood charcoal identification yielded 9 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified in the assemblage.

**Beta-120324.****250 ± 50** $\delta^{13}C = -25.2\%$ 

*Aleurites moluccana* nutshell, 37.27 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 18, Unit IVC7, Layer II. Collected 1998 and submitted July 1998. Feature 18 is oblong in plan and measures 45 cm along its major axis and 25 cm along its minor axis (Desilets and Dye 1998:142 ff). It is bowl-shaped in cross-section with a 6 cm maximum thickness. Feature 18 contains bone, charcoal, coral, a large amount of unburned *Aleurites moluccana* nutshell, marine invertebrate, and thermally altered rock.

*Comment:* The feature is interpreted as an earth oven in which coral was the dominant “oven stone.” Wood charcoal identification yielded 5 native and Polynesian-introduced taxa; no historically introduced taxa were identified.

**Beta-120325.****270 ± 70** $\delta^{13}C = -25.2\%$ 

*Aleurites moluccana* nutshell, 5.42 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 19, Unit IVC7, Layer II. Collected 1998 and submitted July 1998. Feature 19 is oblong in plan and trends to the northeast along its 67 cm major axis (Desilets and Dye 1998:144 ff). In cross-section, the feature is bowl-shaped with a maximum thickness of 15 cm. Matrix is a very dark gray unconsolidated calcareous sand with bone, charcoal, coral, marine invertebrate, thermally altered rock, one basalt flake, and a waterworn pebble.

*Comment:* The feature is interpreted as an open firepit. Wood charcoal identification yielded 12 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified.

**Beta-120326.****330 ± 60** $\delta^{13}C = -14.0\%$ 

*Aleurites moluccana* nutshell, *Chamaesyce* spp., *Sida* cf. *fallax*, 5.28 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 20, Unit VA1, Layer II. Collected 1998 and submitted July 1998. Feature 20, partially excavated, is round in plan with some irregularity in its southwest portion and with an estimated diameter of 110 cm (Desilets and Dye 1998:122 ff). In cross-section, Feature 20 is irregularly bowl-shaped with a maximum thickness of 26 cm. Feature matrix consists of dark grayish brown (10YR 4/2) loosely consolidated calcareous sand and included large quantities of bone, charcoal,

coral, lithic debitage, *Aleurites moluccana* nutshell, marine invertebrate, thermally altered rock, and traditional artifacts.

*Comment:* Feature 20 is interpreted as a “trash pit associated with... cooking” (Desilets and Dye 1998:126).

**Beta-120327.**

**400 ± 70**

$\delta^{13}\text{C} = -23.0\text{‰}$

*Aleurites moluccana* nutshell, 3.99 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 24. Collected 1998 and submitted July 1998. Feature 24 was identified in the wall of a utility trench. It is bowl shaped in cross-section with an approximate maximum thickness of 13 cm. Based on the visible profile, the feature has a diameter in excess of 45 cm. Materials recovered from Feature 24 include charcoal, a very small amount of waterworn and unidentified marine invertebrate, and a bit of thermally altered rock.

*Comment:* The feature is interpreted as a fire pit. The identified wood charcoal includes 7 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified.

**Beta-120328.**

**220 ± 50**

$\delta^{13}\text{C} = -25.5\text{‰}$

*Sida cf. fallax*, 0.23 g, Site 50-80-15-4853, Locale 5 (Figure 1), Feature 25. Collected 1998 and submitted July 1998. Feature 25 was identified in the wall of a utility trench. It is bowl-shaped in cross-section with an approximate thickness of 22 cm and diameter in excess of 60 cm. Materials recovered from Feature 25 include thermally altered rock, bone fragments, and charcoal.

*Comment:* The size, shape, and contents of Feature 25 suggest that it functioned as an earth oven. The identified wood charcoal includes 7 native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified.

**Uncontrolled Samples**

Twenty-two wood charcoal samples on unidentified materials and/or unassociated with a cultural event. The Layer designations in the descriptions follow the source documents, which reflect local stratigraphic sequences. Samples are stratigraphically associated with Horizon II unless otherwise noted.

**Beta-18237.**

**450 ± 70**

$\delta^{13}\text{C} = -27.7\text{‰}$

Unidentified partially carbonized wood, 114.5 g, Site 50-80-15-4851, Locale 7 (Figure 1), Unit ST-20, Layer III, 110-116 cm bs. Collected 1986 and submitted October 1986. Sample from a log that was deposited on a light gray, very fine sand and covered with very dark gray clay, approximately 15 m from Puhā Stream (Athens 1988:65,97–8).

*Comment:* The excavator interpreted the sample date as evidence for human use of the region. The sample was not associated with a cultural event. The stratigraphy of Unit ST-20 reflects alluvial deposition along Puhā Stream rather than the sequence of horizons described above. Date provides an indication of the potential in-built age of waterlogged wood at Site 4851 (see also I-16,688).

**Beta-19043A.**

**420 ± 60**

$\delta^{13}\text{C} = -30.9\text{‰}$

Unidentified wood charcoal, 23.5 g, Site 50-80-15-4851, Locale 7 (Figure 1), Unit TP-4, Layer III. Collected 1986 and submitted December, 1986. Dispersed charcoal taken from the periphery of a

pickleweed marsh adjacent to Puhā Stream (Athens 1988:58–63,65). Layer III contained preserved wood and cultural material in a waterlogged environment.

*Comment:* The excavator interpreted the sample as associated with natural “infilling of what was formerly a marine embayment or estuary” (Athens 1988:62). It was not associated with a cultural feature. Layer III reflects alluvial deposition along Puhā Stream rather than the sequence of horizons described above. *Note:* The dating laboratory assigned Beta-19043 to 2 samples (see Beta-24362).

**Beta-24362.**

**250 ± 50**

$\delta^{13}C = -22.8\%$

Unidentified wood charcoal, 18.8 g, Site 50-80-15-4851, Locale 3 (Figure 1), Unit TP-2, Layer IV/2. Collected 1986 and submitted December 1987. Sample from dispersed charcoal within the cultural layer.

*Comment:* Not associated with a cultural event. Charcoal from the layer (not dated) was identified and included mango, an early 19th century introduction to the Hawaiian Islands. A second sample (Beta-19043B, see Beta-19043A) collected from “a probable hearth feature with abundant charcoal” (Athens 1988:54) near the provenience of Beta-24362 was more active than the modern standard (Athens 1988:56).

**Beta-25783.**

**1540 ± 80**

$\delta^{13}C = -12.8\%$

Unidentified wood charcoal, Site 50-80-15-4853, Locale 2 (Figure 1). Collected 22 Feb 1988.

*Comment:* Sample taken from “a probable prehistoric oven” (Streck and Watanabe 1988:5) exposed in the bank of Puhā Stream. There are few contextual details for this early date.

**Beta-25784.**

**360 ± 80**

$\delta^{13}C = -18.2\%$

Unidentified wood charcoal, Site 50-80-15-4853, Locale 2 (Figure 1). Collected 22 Feb 1988.

*Comment:* Sample collected from “a postmold feature” exposed in the bank of Puhā Stream (Streck and Watanabe 1988:5). Few contextual details.

**Beta-26702.**

**170 ± 80**

$\delta^{13}C = -27.3\%$

Bulk sample of *Diospyros* sp., *Metrosideros* sp., *Aleurites moluccana* nutshell, and unidentified wood charcoal, 6.7 g, Site 50-80-15-4851, Locale 3 (Figure 1), Feature 3, TP-5, Layer IV. Collected 1988 and submitted July 1988. Feature 3 described as “a circular basin shaped feature filled with fire-cracked basalt cobbles, charcoal, and midden remains. The feature was 40 cm in diameter and 20 cm deep” (McNeill 1989:28). The feature also contained small flakes of volcanic glass.

*Comment:* Identified wood charcoal contains native and Polynesian-introduced taxa; no historically introduced or alien taxa were identified. Feature 3 is a rare example of a cultural feature preserved within Horizon II.

**Beta-30888.**

**240 ± 80**

$\delta^{13}C = -23.3\%$

Unidentified wood charcoal, 12 g, Site 50-80-15-4851, Locale 11 (Figure 1), Trench 15 B, Layer III. Collected 1989 and submitted April 1989. Layer III described as “buried A-horizon containing plentiful midden and artifacts” (Hammatt and Shideler 1989:32).

*Comment:* Sample not securely associated with a cultural event.

**Beta-30889.****440 ± 60**

$$\delta^{13}\text{C} = -26.0\%$$

Unidentified wood charcoal, 3 g, Site 50-80-15-4851, Locale 11 (Figure 1), Trench 15 B, Layer III. Collected 1989 and submitted April 1989. Layer III described as “buried A-horizon containing plentiful midden and artifacts” (Hammatt and Shideler 1989:32).

*Comment:* Sample described as coming from an undisturbed cultural deposit (Hammatt and Shideler 1989:58). Sample not securely associated with a cultural event.

**Beta-30890.****730 ± 120**

$$\delta^{13}\text{C} = -24.3\%$$

Unidentified wood charcoal, 8 g, Site 50-80-15-4851, Locale 10 (Figure 1), Trench 18B, Layer III. Collected 1989 and submitted April 1989. Layer III described as a “gray sandy loam with well sorted very fine sand and silt containing historic artifacts in upper portion. Contains fire-cracked rocks, basalt flakes, charcoal and midden” (Hammatt and Shideler 1989:33).

*Comment:* The excavator interpreted Layer III as an undisturbed cultural deposit (Hammatt and Shideler 1989:58). Sample depth (135–145 cm) is below the reported lower boundary of Layer III (115 cm) (Hammatt and Shideler 1989:33), but a profile of Trench 18B (Hammatt and Shideler 1989:38) shows a pit feature at the northern end that extends from the base of the cultural layer into the sterile Holocene sand layer to a depth consonant with the sample depth. The apparent pit feature is not described. Sample not securely associated with a cultural event.

**Beta-30891.****1060 ± 90**

$$\delta^{13}\text{C} = -24.5\%$$

Unidentified wood charcoal, 5 g, Site 50-80-15-4851, Locale 10 (Figure 1), Trench 18C, Layer III. Collected 1989 and submitted April 1989. Layer III described as a “gray well sorted fine to very fine sand, top 10 cm compacted massive structure. Contains basalt flakes, shell, volcanic glass, charcoal, midden” (Hammatt and Shideler 1989:34).

*Comment:* Sample described as coming from an undisturbed cultural deposit (Hammatt and Shideler 1989:58). Sample not securely associated with a cultural event.

**Beta-30892.****750 ± 90**

$$\delta^{13}\text{C} = -23.2\%$$

Unidentified wood charcoal, 5 g, Site 50-80-15-4851, Locale 10 (Figure 1), Trench 18C, Layer III. Collected 1989 and submitted April 1989. Layer III described as a “gray well sorted fine to very fine sand, top 10 cm compacted massive structure. Contains basalt flakes, shell, volcanic glass, charcoal, midden” (Hammatt and Shideler 1989:34).

*Comment:* Sample described as coming from an undisturbed cultural deposit (Hammatt and Shideler 1989:58). Sample not securely associated with a cultural event.

**Beta-30893.****640 ± 90**

$$\delta^{13}\text{C} = -25.9\%$$

Unidentified wood charcoal, 5 g, Site 50-80-15-4851, Locale 10 (Figure 1), Trench 18E, Layer III. Collected 1989 and submitted April 1989. Layer III is described as a white sand (Hammatt and Shideler 1989:35).

*Comment:* Layer description appears to be incorrect. Sample described as coming from an undisturbed cultural deposit (Hammatt and Shideler 1989:58). Sample not securely associated with a cultural event.

**Beta-31518.****1340 ± 130** $\delta^{13}C = -25.4\%$ 

Unidentified wood charcoal, Site 50-80-15-4853, Locale 2 (Figure 1), NW Quad., Layer VI. Collected 1989. Sample collected from a charcoal concentration exposed in bank of Puhā Stream.

*Comment:* Layer VI interpreted by the excavator as a secondary “alluvial river-bank deposit” (Shun 1993:5). Sample not stratigraphically associated with Horizon II. Sample interpreted by the excavator as dating cultural activity upstream from the collection location, but is not securely associated with a cultural event.

**Beta-31519.****380 ± 60** $\delta^{13}C = -22.1\%$ 

Unidentified wood charcoal, Site 50-80-15-4853, Locale 2 (Figure 1), Unit TU-1, Layer IV. Collected 1989. Layer IV described as a light yellowish brown very fine sand with traditional Hawaiian cultural material.

*Comment:* Sample “retrieved from a charcoal lens” (Shun 1993:47) located just above the water table. Also present in Layer IV were copper wire and small pieces of rubber, which the excavator believed “could easily have fallen in from the upper strata” (Shun 1993:34). Sample not securely associated with a cultural event.

**Beta-32226.****10 ± 40** $\delta^{13}C = -21.5\%$ 

Unidentified wood charcoal, Site 50-80-15-4851, Locale 3 (Figure 1), Layer III, dark gray sediment above Feature 5. Collected in late 1988 or early 1989 and submitted 1989.

*Comment:* The excavator interpreted this sample, along with Beta-32227, as dating “the terminal points of occupation” (Shun 1992b:37) associated with Horizon II, and supporting the idea that occupation of the site extended to the late prehistoric or early historic period (post AD 1778). Sample not securely associated with a cultural event.

**Beta-32227.****690 ± 110** $\delta^{13}C = -26.7\%$ 

Unidentified wood charcoal, Site 50-80-15-4851, Locale 3 (Figure 1), Fire-hearth feature 1A, Layer III base. Collected in late 1988 or early 1989 and submitted 1989.

*Comment:* Interpreted by the excavator as establishing the date of initial site occupation around AD 1300, and with Beta-32226 as indicating an occupational duration of “at least 500 years” (Shun 1992b:37 ff).

**Beta-36065.****440 ± 50** $\delta^{13}C = -20.6\%$ 

Unidentified wood charcoal, Site 50-80-15-4851, Locale 11 (Figure 1), Unit TU 18, Layer III/3. Collected 1989. Sample collected near a feature interpreted by the excavator as a “probable fire hearth” in a portion of Layer III “with pockets of charcoal concentrations and fire-cracked rocks” (Shun 1992a:40).

*Comment:* Although the sample was not securely associated with a cultural event the excavator interpreted it as “material put aside from fire-hearth cleaning” (Shun 1992a:46).

**Beta-89698.****450 ± 60** $\delta^{13}\text{C} = -27.5\%$ 

*Metrosideros* sp., 0.53 g, Site 50-80-15-4851, Locale 11 (Figure 1), Unit TP-1, Layer IIIc/8. Collected 1995 and submitted January 1996. Collected from general matrix at base of cultural deposit.

*Comment:* Identified wood charcoals from the cultural deposit (not dated) include 12 endemic, indigenous, and Polynesian introduced taxa, none of which are historically introduced or alien to Hawai'i. The excavator interpreted the date as evidence for "pre-contact Hawaiian habitation" (Erkelens 1996:19). The genus *Metrosideros* contains a wide variety of forms, from low shrubs to trees. Trees in the genus are long-lived. Sample not securely associated with a cultural event.

**I-16,652.****270 ± 80** $\delta^{13}\text{C} = -26.0\%$ 

Unidentified wood charcoal, Site 50-80-15-4853, Locale 1 (Figure 1), Feature Hearth, Unit I14, Zone I. Collected 1990 and submitted June 1991.

*Comment:* Sample collected from a feature interpreted as a hearth (Rolett 1992:Table 1). Few contextual details.

**I-16,654.****240 ± 110** $\delta^{13}\text{C} = -18.7\%$ 

Unidentified wood charcoal, Site 50-80-15-4853, Locale 1 (Figure 1), Feature Imu, Unit I9-H10, Zone I. Collected 1990 and submitted June 1991.

*Comment:* Sample collected from a feature interpreted as an earth oven (Rolett 1992:Table 1). Few contextual details.

**I-16,688.****230 ± 80** $\delta^{13}\text{C} = -29.0\%$ 

Unidentified wood charcoal, Site 50-80-15-4853, Locale 1 (Figure 1), Feature Hearth, Unit H8, Zone I. Collected 1990 and submitted July 1991.

*Comment:* Sample collected from a feature interpreted as a hearth (Rolett 1992:Table 1). Few contextual details. The conventional  $^{14}\text{C}$  age of this sample was misreported by the laboratory as 290 ± 80 BP, the value reported by Rolett (1992). A report of the dating process provided by Teledyne Brown Engineering, indicates the correct age of the sample, which is consistent with the reported value  $\text{D}^{14}\text{C} = -28 \pm 10$ .

**I-16,734.****770 ± 80** $\delta^{13}\text{C} = -28.4\%$ 

Unidentified waterlogged wood and charcoal, Site 50-80-15-4853, Locale 1 (Figure 1), Unit H9, Zone I. Collected 1990 and submitted September 1991. The "materials analyzed... are not from a secure cultural context, and may thus represent natural materials unassociated with the archaeological deposits" (Rolett 1992:3).

*Comment:* Date provides an indication of the potential in-built age of waterlogged wood at Site 4853 and is not stratigraphically associated with Horizon II (see also Beta-18237).

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