New Dates from Old Samples: A Revised Radiocarbon Chronology for the Wai'ahukini Rockshelter Site (H8), Ka'ū District, Hawai'i Island

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Abstract

In the Ka'ū District of Hawai'i Island, several sites were excavated by Bishop Museum archaeologists during the 1950s and 1960s, and have been noted by previous researchers as a possible location of initial settlement by Ancient Hawaiians. This paper presents the results of a recent re-dating effort that was initiated at the Wai'ahukini Rockshelter Site. Samples housed in the collections of Bishop Museum and the University of Hawai'i, Hilo were selected, identified, and re-dated using AMS radiocarbon dating in order to refine the chronology for the settlement of this key site. The results suggest that the site was probably initially occupied from at least the 14th to early 15th century A.D. onwards, with the well-known pavement probably being laid down sometime during the mid-17th to early 18th century A.D. This is much later than the original radiocarbon dates suggested.

Introduction

Beginning in the 1950s, archaeologists working in the Hawaiian Islands initiated major research projects directed at identifying the initial settlement of the archipelago. The Ka'ū District of southern Hawai'i Island was central in this effort because sites there provided the archipelago's first material culture-based chronology, which was based on changing frequencies of fishhook types anchored in time by radiocarbon dates (Emory et al. 1969). However, these initial efforts have been sidelined in more recent discussions about early Hawai'i due to potential problems with in-built age that have invalidated previously reported dates (e.g., Anderson and Sinoto 2002; Dye 2011; Kirch 2011; Rieth et al. 2011; Wilmshurst et al. 2011; Allen and Huebert 2014; Athens et al. 2014).

In this paper we present the results of the re-dating of a key early site in southern Hawai'i Island that was excavated by Bishop Museum archaeologists during the 1950s. The Wai'ahukini Rockshelter (Site H8; Bishop Museum Site No. 50-Ha-B21-006) includes layers that were initially considered to represent the colonization period of the Hawaiian Islands (Emory and Sinoto 1969; Kirch 1985; Dye 1992), but the reliability of those dates has been called into question. Building on recent efforts to re-date key sites across the archipelago using more rigorous protocols and

techniques (e.g., Tuggle and Spriggs 2001; Kirch and McCoy 2007; Dye and Pantaleo 2010; Kahn et al. under review), we have selected a suite of short-lived wood charcoal from stratigraphically controlled contexts. By obtaining AMS ^{14}C dates on these samples, we have been able to acquire a more accurate and precise estimate of the chronological sequence represented at this site. This approach gives us the opportunity to assess the integrity of stratigraphic deposits at the Wai‘ahukini Rockshelter with the goal of securely establishing the site’s chronology.

Background

The first major archaeological excavations in the South Point area (Figure 1) began 60 years ago in 1954. Working together with William J. Bonk (University of Hawai‘i, Hilo), Bishop Museum archaeologists Kenneth P. Emory and Yosihiko H. Sinoto conducted major excavations at a number of open habitation and rockshelter sites. From 1954 until 1958, they conducted large-scale excavations at the H1 Sand Dune Site (Ka Lae; South Point), the Makalei Rockshelter Site (H2), and the Wai‘ahukini Rockshelter Site (H8). A large suite of radiocarbon dates (n=70) and a detailed analysis of artifacts from these three sites (especially focused on the morphological analysis of fishhook forms) suggested that the H1 and H8 sites were occupied during initial settlement of the Hawaiian Islands, and that H2 was only occupied later in time (Emory and Sinoto 1969). From the radiocarbon estimates, the researchers posited that H8 was occupied beginning around A.D. 750, and that new fishhook forms were in use by around A.D. 1250 to 1350. Based on the presence of European artifacts in the uppermost cultural layer at the site, the researchers concluded that the Wai‘ahukini Rockshelter was probably occupied until ca. A.D. 1850, and therefore contained an occupational sequence of approximately 1,000 years (Emory and Sinoto 1969:10). “Thus, the Waiahukini shelter, H8, bridge[d] the gap in the South Point area between the abandonment of the Sand Dune site and the occupation of Makalei shelter, H2” (Emory and Sinoto 1969:1).

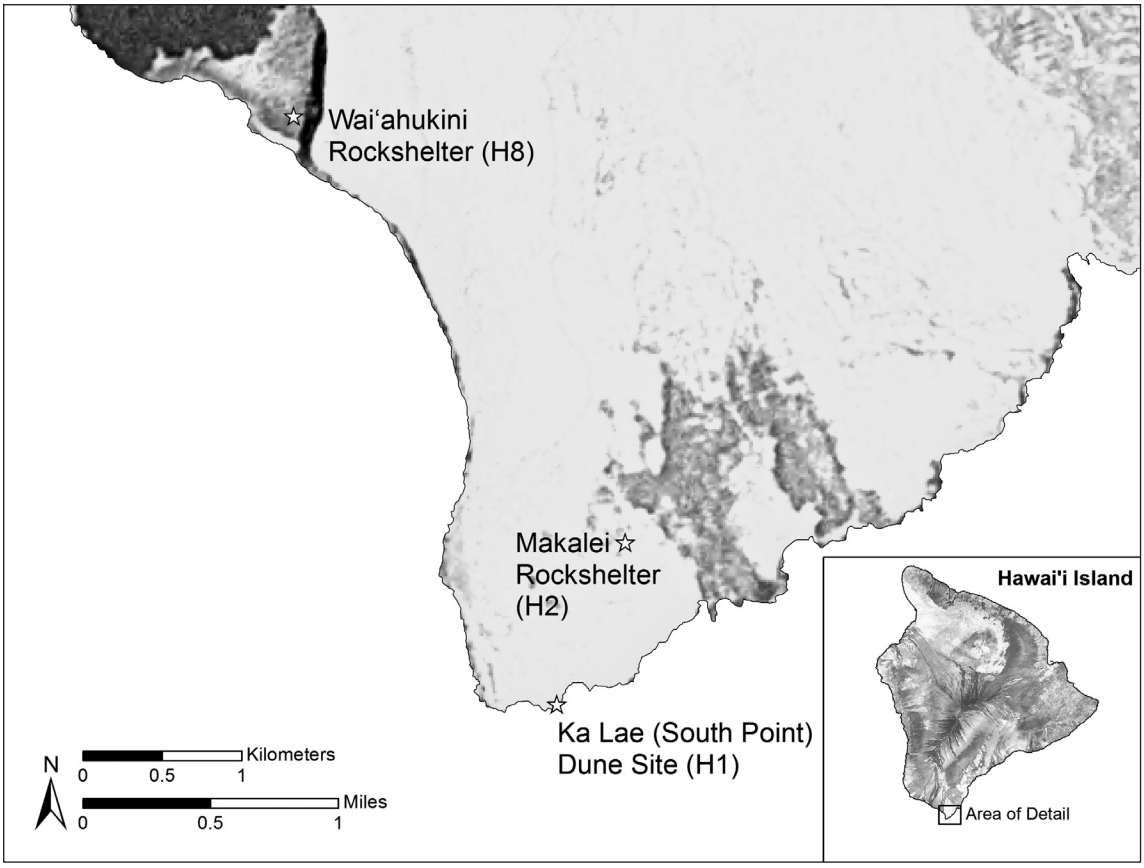

Figure 1. Map of the South Point area with the locations of Sites H1, H2, and H8.

The Wai'ahukini Rockshelter Site

Site H8 is situated in Pakini Iki Ahupua'a in a *kīpuka* bordered by the 1868 lava flow to the north and the Pali-o-Kulani in the east. The small rockshelter is located approximately 200 meters from the coastline of this sheltered, sandy bay (see Figure 1). The site was identified by Emory and Ivan Rainwater in August, 1954 (Kelly 1969) and archaeological investigation subsequently began with the excavation of a test unit and mapping of the shelter in 1954. Under the direction of Bonk, the excavation team continued working at the site from 1956 until 1958 and excavation of virtually the entire rockshelter was completed during this time (Figures 2 and 3). A report outlining the mapping and excavations at the site was published in the Bishop Museum's *Pacific Anthropological Records* (Emory et al. 1969).

Figure 2. Archaeologist William J. Bonk examines the stratigraphic profile of unit G8 at the Wai'ahukini Rockshelter, January 30, 1958 (photo by Kenneth P. Emory, copyright Bishop Museum).

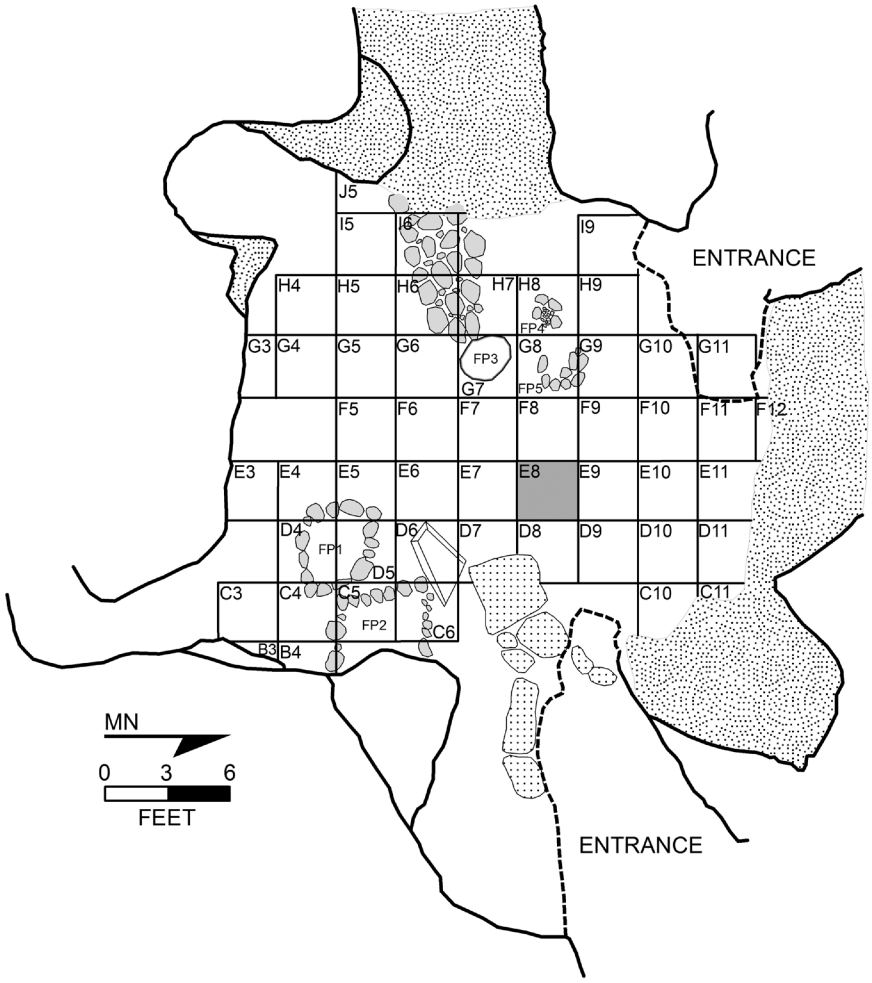

Figure 3. Excavation plan map of the Wai'ahukini Rockshelter (H8) with the "quantitative" unit E8 shaded in grey (adapted from Emory et al. 1969:3, Figure 4).

Emory, Bonk, and Sinoto identified three major cultural layers at the site (Figure 4). Layer I-1 extended from the surface to approximately 6 inches below the surface and was directly above Layer I-2, which extended from approximately 6 to 12 inches below the surface. The lowest identified layer, Layer II, was capped by a stone slab pavement at approximately 12 inches below the surface. Across the rockshelter, they excavated in 3- to 6-inch arbitrary levels, and all material was sieved, with the exception of a central unit, E8, which was excavated in 3-inch and 1.5-inch levels. From this unit, the researchers collected a "quantitative sample" which was bulk-collected in order to examine midden material more closely. Excavated materials from unit E8 were collected from six 3-inch levels (which extended from 0 to 18 inches below surface) and five 1.5-inch levels (which were from 18 inches to bedrock, at 25.5 inches below the surface). According to the researchers, the midden collected from this unit suggested that "… the shelter was the setting for about the same degree of activity throughout its occupation, with the exception of some intensification immediately prior to and following the laying down of the pavement…" (Emory et al. 1969:8).

Based on the extensive artifact assemblage recovered from the site, the Wai'ahukini Rockshelter was interpreted as a fisherman's shelter that was continuously occupied from its initial use until the site's abandonment, presumably at or before the time of the 1868 lava flow, when the entire surrounding area was abandoned (Kelly 1969). Major activities at the site centered on fishhook manufacture. The research team compiled copious notes describing stratigraphy throughout the site, including more than a dozen detailed stratigraphic profile drawings for individual excavation units (Figure 5). They also documented major changes in material culture as well as the midden material collected from the rockshelter in several key publications.

Chronology-building at Wai'ahukini

The chronological sequence of occupation at H8 was initially established through artifact typology and radiocarbon dating (Emory and Sinoto 1969). The artifact typology was based on Sinoto's analysis of more than 1,200 fishhooks from the site (Emory et al. 1959). This analysis documented a general shift from notched bases to knobbed bases of points of two-piece fishhooks, as well as shifts in the frequency of certain head types of one-piece fishhooks (also see Sinoto 1962). The presence of four metal fishhooks in the upper-most layer of H8 verified the post-European contact historic occupation of the site. These changes of fishhook morphology suggested that the site was occupied continuously throughout the entire cultural sequence, as compared to the supposed early occupation of site H1 and the late occupation of site H2.

In total, 40 samples were processed in the radiocarbon dating of the site. Of these, 24 came from unit E8. From nine out of eleven excavation levels of the overall "quantitative sample" from this unit, the researchers submitted nine samples of charcoal, seven samples of *Cypraea* shell, four sea urchin (*Heterocentrotus mammillatus*) spines, two fish scales, and two fish bones for dating. The remaining 16 dates were from samples of charcoal (n=11) and sea urchin spines (n=5) that were collected from various excavation units across the site. They noted that the determination of absolute dating had been "beset with difficulties" and that "contamination of the samples of charcoal seemed certainly involved" (Emory and Sinoto 1969:3). Nonetheless, they created a chronological model for the site (Emory and Sinoto 1969:9, Figure 4; reproduced here as Figure 6), which bracketed Layer II deposits between A.D. 750 and A.D. 1250 and placed initial occupation at A.D. 750.

The 8th century date for initial occupation for the Wai'ahukini Rockshelter continued to be cited in subsequent overviews of Hawaiian prehistory (e.g., Kirch 1985:86; 2000:235). In 1992, Dye re-interpreted the dating results from the South Point sites and his analysis suggested that the site was initially occupied during the 7th century A.D., and that the pavement was laid down around A.D. 1650 (Dye 1992:92). When Spriggs and Anderson introduced their chronometric hygiene protocols in 1993, they accepted four of the wood charcoal dates from Layer II at the Wai'ahukini Rockshelter and cited H8 as "the best dated early site in Hawaii… with both shell and charcoal series for Layer II suggesting initial occupation beginning around AD 650–850" (Spriggs and Anderson 1993:208). More recently, however, researchers have expanded upon and refined Spriggs and Anderson's chronometric hygiene criteria. As a result, all of the published dates from the Wai'ahukini Rockshelter have been classified as unreliable because the standard error ranges were greater than 10% and/or submitted samples included unidentified wood taxa, marine-influenced bone, or marine shell or other marine invertebrates (Rieth et al. 2011, Table S1).

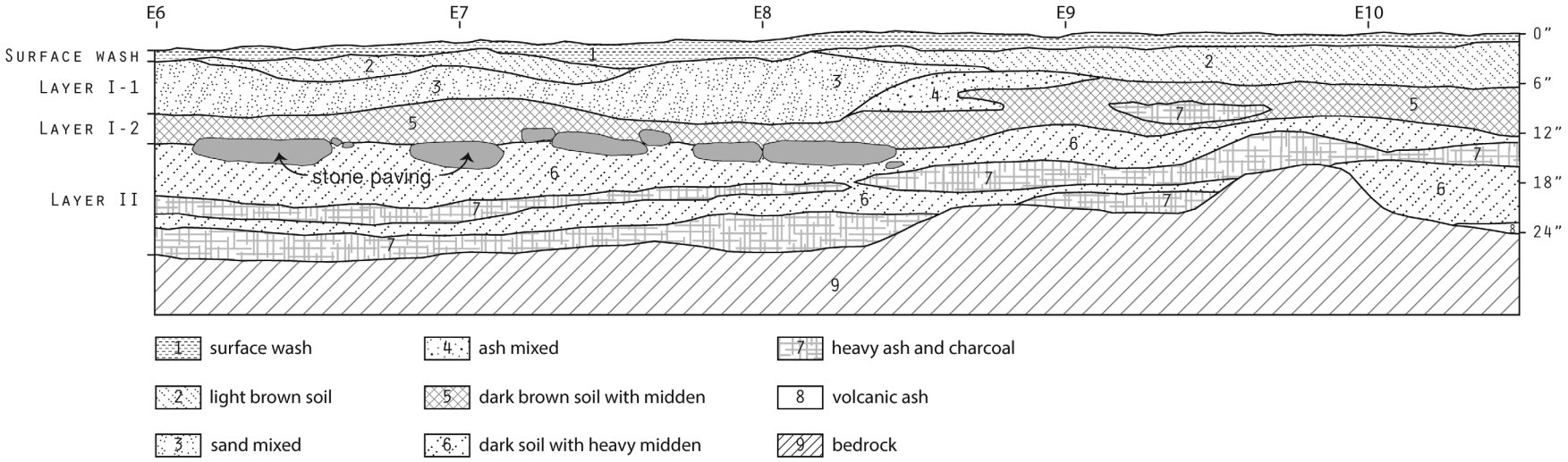

Figure 4. Cross-section diagram on the E line, looking west. The cross-section shows the stone pavement and original stratigraphic layers documented by the excavation team (after Emory and Sinoto 1969:7, Figure 3).

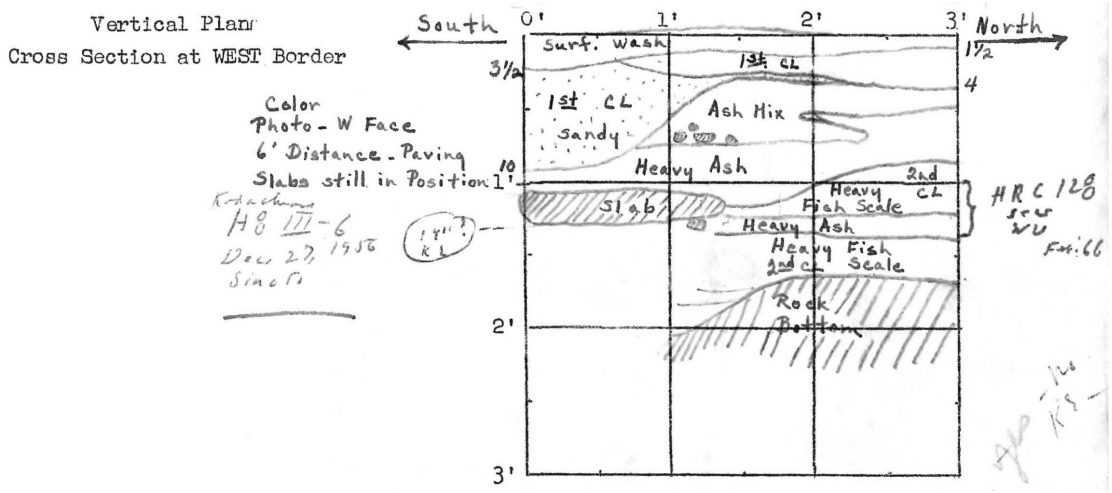

Figure 5. Page from the original excavation field notes showing the profile of the west wall of unit E8 (re-drafted below as Figure 7). Note the presence of handwritten notations indicating collection location of charcoal sample HRC-128 (copyright Bishop Museum).

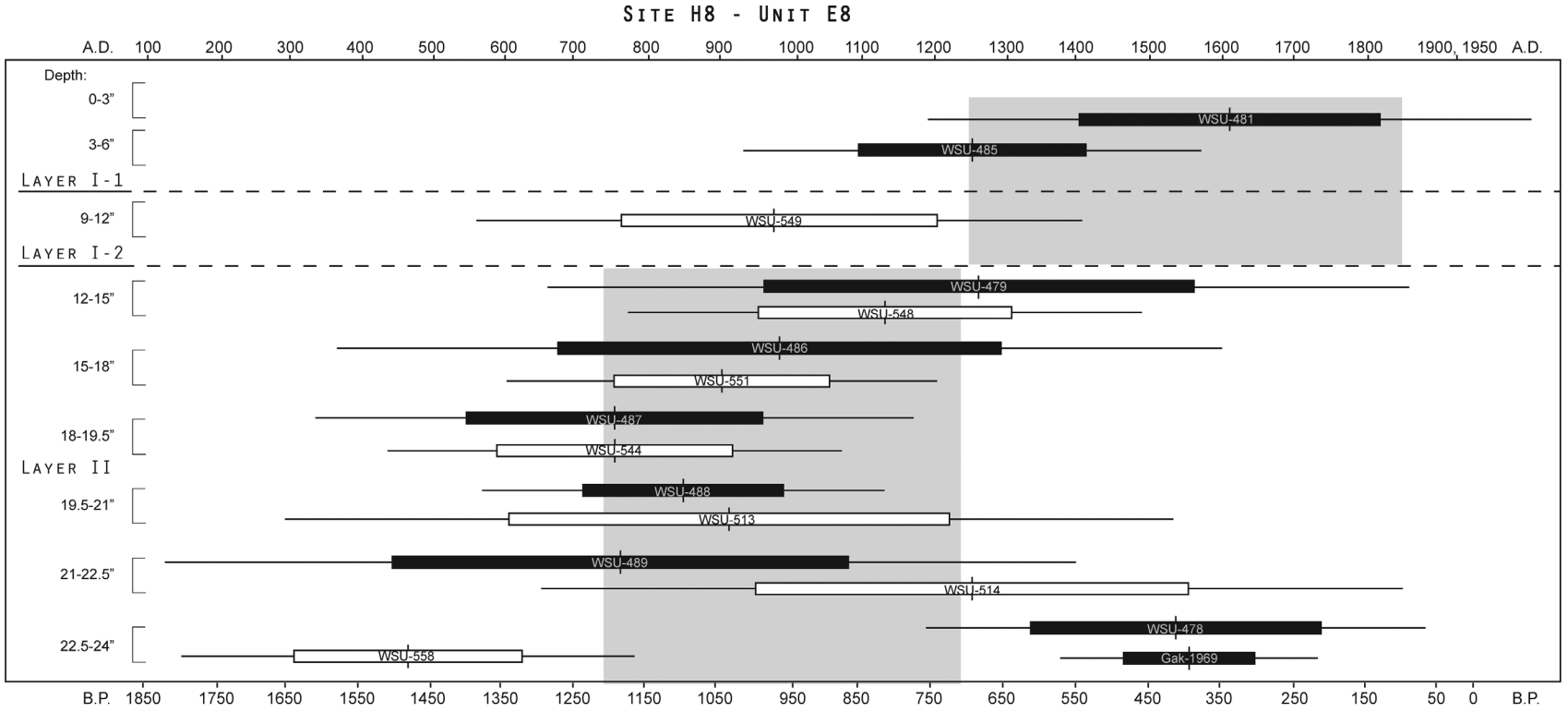

Figure 6. Original radiocarbon dates from site H8. Dark bars represent one standard deviation, lines represent two standard deviations. The shaded area represents the original estimation of the duration of site occupation (modified from Emory and Sinoto 1969:9, Figure 4; dates from units outside unit E8 have been removed).

Re-Dating the Site

A total of seven samples were selected for AMS radiocarbon dating to firmly establish the timing of initial occupation at the site and assess the integrity of the stratigraphic sequence. Samples were selected from the "quantitative" unit E8. The original researchers submitted the majority of samples for radiocarbon dating (n=24) from this unit, and the unit was excavated in thinner excavation levels (1.5-inch and 3-inch levels) than many of the other units, which were excavated in thicker 6-inch levels.

Four remnant wood charcoal samples were selected from the Bishop Museum Archaeology Collections, as well as one previously undated sample of wood charcoal housed at the University of Hawai'i, Hilo (from the basal excavation level of 24-25.5 inches below the surface). From these, seven individual short-lived specimens of wood charcoal were submitted to Beta Analytic following identification by Gail Murakami at the Wood Identification Laboratory at the International Archaeological Research Institute, Inc. Wood charcoal identification and AMS dating methods were utilized in order to ensure that the resulting chronometric determinations would meet the recently revised chronometric hygiene criteria for radiocarbon dates as outlined by Rieth et al. (2011) and Wilmshurst et al. (2011).

Five of the individual samples submitted for AMS dating were identified as *Chenopodium oahuense* (*āheahea*), one was identified as a coconut endocarp (*Cocos nuciferia*; *niu*), and one was identified as *Euphorbia spp.* (*'akoko*). Paired samples were submitted from the two lower excavation levels (21–22.5 inches below surface, 24–25.5 inches below surface). Individual samples were submitted from the excavation levels immediately above and below the pavement, which was noted as the interface between the two major cultural layers by the original researchers (9–12 inches, 12–15 inches) and an additional sample was submitted from the 18–19.5 inch excavation level to further examine the depositional history at the site. The re-dating results are listed in Table 1. The stratigraphic profile of unit E8 is shown with sampling locations and AMS dating results in Figure 7.

Results

The re-dating results indicate that unit E8 has good stratigraphic integrity. The paired samples from the lower levels (samples HRC-140 and HRC-140b; HRC-1590 and HRC-1591) exhibit uncalibrated radiocarbon ages of 320 ± 30 BP and 330 ± 30 BP, and 540 ± 30 BP and 550 ± 30 BP, respectively (see Table 1; Figure 7). Samples HRC-1590 and HRC-1591 came from the layer immediately above the bedrock, and so they provide us with an appropriate estimate for initial occupation at site H8. The individual samples from the excavation levels surrounding the pavement also appear to have good stratigraphic integrity, with sample HRC-129 (from a depth of 9–12 inches below surface) yielding an uncalibrated radiocarbon age of 220 ± 30 BP and sample HRC-128 (from 12–15

Table 1. Wood charcoal identifications and dating results from samples submitted for AMS dating in 2013-2014.

Sample No.	Depth	Wood Charcoal ID	Beta Lab No.	CRA	Date Range (2 SD)
HRC-129	9-12 in.	*Chenopodium oahuense* (*Āheahea*)	Beta-370000	220 ± 30 BP	Cal AD 1640-1680, 1740-1760, 1760-1800, 1940-post-1950
HRC-128	12-15 in.	*Chenopodium oahuense* (*Āheahea*)	Beta-369999	240 ± 30 BP	Cal AD 1640-1670, 1780-1800, 1940-post-1950
HRC-138	18-19.5 in	*Cocos nuciferia* (*Niu*)	Beta-370001	280 ± 30 BP	Cal AD 1520-1590, 1620-1660
HRC-140	21-22.5 in.	*Chenopodium oahuense* (*Āheahea*)	Beta-368306	320 ± 30 BP	Cal AD 1470-1650
HRC-140b	21-22.5 in.	*Chenopodium oahuense* (*Āheahea*)	Beta-370002	330 ± 30 BP	Cal AD 1460-1650
HRC-1591	24-25.5 in.	*Euphorbia spp.* (*'Akoko*)	Beta-377383	540 ± 30 BP	Cal AD 1320-1350, 1390-1435
HRC-1590	24-25.5 in.	*Chenopodium oahuense* (*Āheahea*)	Beta-377382	550 ± 30 BP	Cal AD 1315-1355, 1390-1430

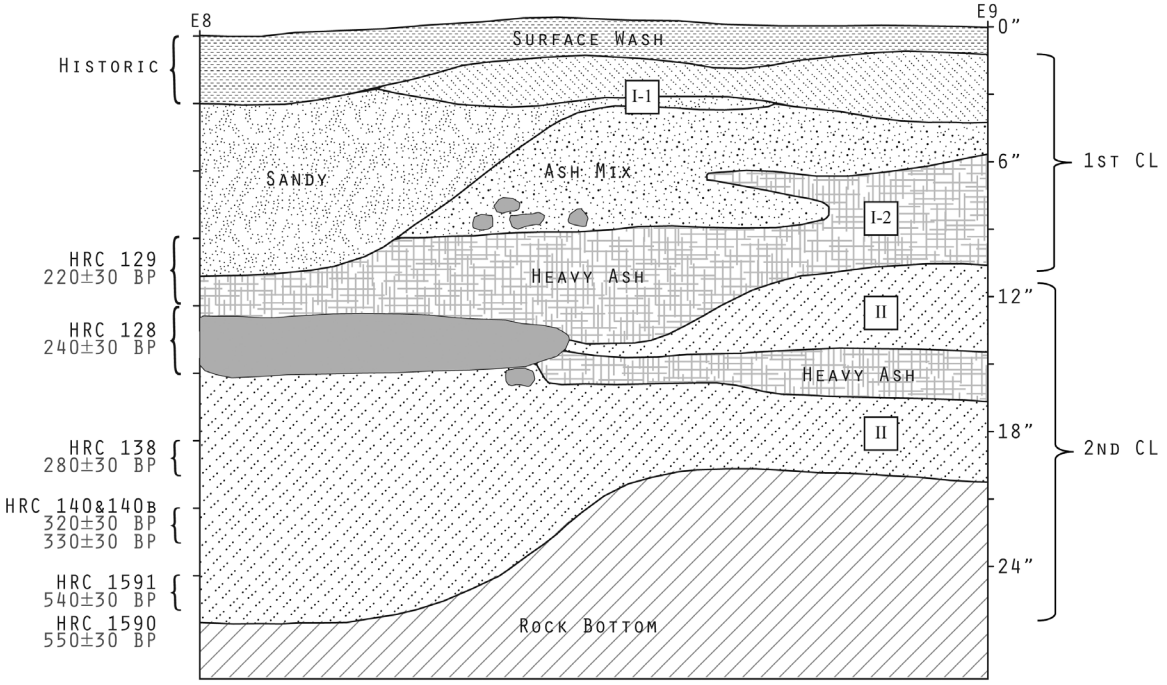

Figure 7. Stratigraphic profile of the west wall of Unit E8 listing remnant samples that were re-dated by excavation level (depth in inches) (after Emory et al. 1969:8, Figure 8).

inches below surface) dating to 240 ± 30 BP. Sample HRC-138 (from a depth of 18–19.5 inches below surface) yielded an uncalibrated radiocarbon age of 280 ± 30 BP. The overall stratigraphic integrity at unit E8 indicates that the 1.5-inch and 3-inch excavation levels were sufficiently precise to yield acceptable chronometric estimates. These samples were derived from the general matrix at the site, and not from individual features that can be confidently associated with specific archaeological events. Nonetheless, samples submitted from deeper levels yielded older dates, which suggests that stratigraphic mixing in unit E8 did not invert the dated materials.

The AMS dating results were calibrated and modeled using OxCal version 4.2 (Figure 8). In order to constrain the dates and achieve more precise chronological information, a Bayesian analysis was applied and the calibrated dates were placed into a sequence with boundary conditions and constraints that reflect the excavation levels and documented cultural layers. As Figure 8 shows, these results indicate that the earliest likely occupation date for the site spans A.D. 1320 to 1440 at two standard deviations. The pavement was likely laid down sometime around the mid-17th to 18th century based on the distribution of the calibrated and modeled radiocarbon estimates. These estimates are different from those of the original researchers, who posited that the site was initially occupied around A.D. 750, and that the pavement was laid down around A.D. 1250 (Emory and Sinoto 1969; see Figure 6). Although Dye's (1992) estimate for initial occupation at A.D. 700 is equally as unsupported by the present analysis, his estimate of A.D. 1650 for the laying down of the pavement appears to be more closely aligned with the results yielded by the present re-dating model.

Conclusion

Like other key sites excavated by Sinoto and colleagues during the early years of Hawaiian archaeology, the Wai'ahukini Rockshelter has long been viewed as fundamental to our understanding of Hawaiian prehistory. The site's well-stratified deposits have been discussed at length throughout the past 60 years, and numerous scholars have suggested that assemblages from sites like H8 possess a great deal of research potential (e.g., Kirch 1985; Dye 1992). The re-dating of these sites provides the necessary first step in re-examining these significant assemblages.

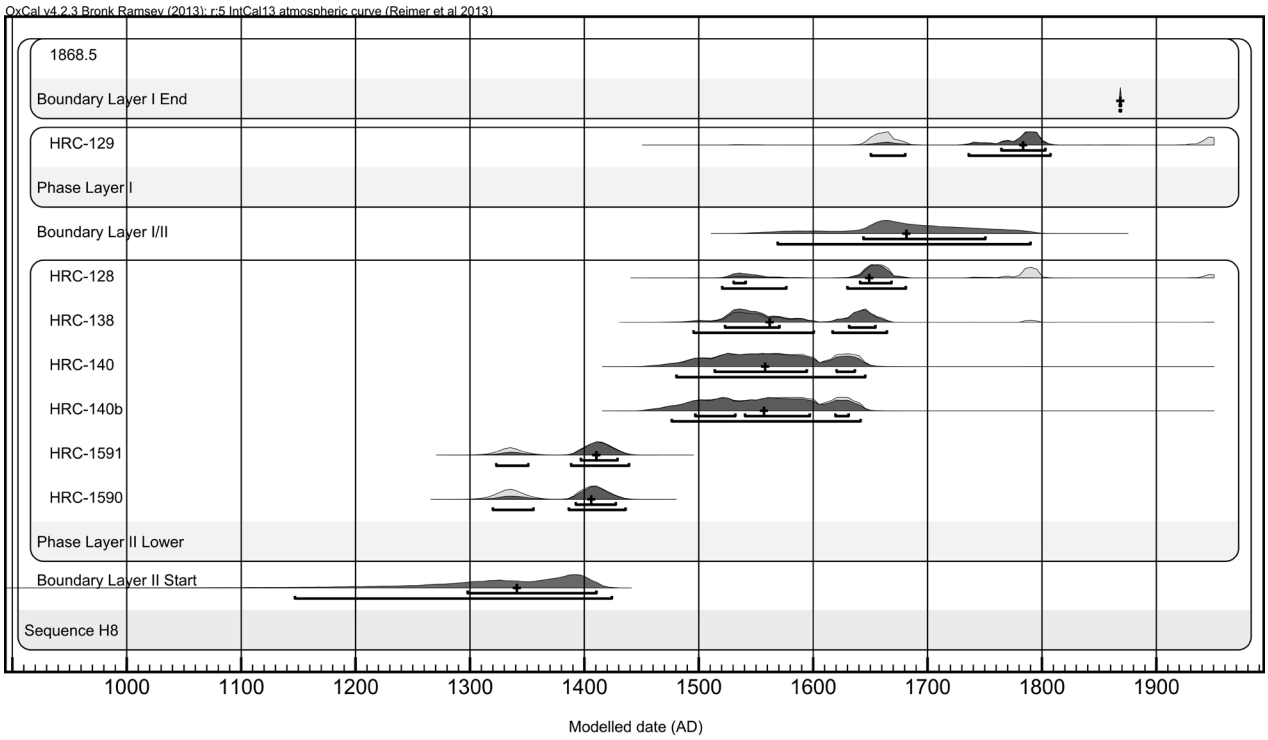

Figure 8. Calibrated new radiocarbon dates from unit E8 modeled using OxCal version 4.2.

Our analysis lends further support to the initial observation that occupation of the Wai‘ahukini Rockshelter spans much of the cultural sequence of old Hawai‘i. This observation was based largely on the monumental efforts of Sinoto in addressing issues of chronology through detailed morphological analysis of fishhooks. By re-dating curated samples using the most current methods in AMS radiocarbon dating, we have been able to refine the chronology at this key site. This analysis indicates that the Wai‘ahukini Rockshelter does not represent a site of early colonization in the archipelago. However, these results show that the site’s use does span a significant portion of the recently revised Hawaiian cultural sequence (Kirch 2011; Rieth et al. 2011; Athens et al. 2014) from as early as the mid-14th century onwards. The chronological estimate for the laying down of the pavement during the mid-17th to early 18th century A.D. is also much later than previously proposed. Initial analyses of the faunal (Esh et al. 2013) and lithic assemblages (Lundblad et al. 2014) from unit E8 and elsewhere at the site suggest that major changes occurred around this time in relation to resource acquisition and access. The anchoring of the results of these and other recent analyses in a reliable chronological framework provides an opportunity to more securely establish the precise timing of important changes in Hawaiian society.

When Emory, Bonk, and Sinoto initiated archaeological research in South Point, they quickly recognized that this area was important for understanding Hawaiian prehistory. Following their extensive fieldwork undertaken at the Wai‘ahukini Rockshelter and other neighboring South Point sites, this area became fundamental to interpretations in the field of Hawaiian archaeology. Today, over 60 years later, there is still great potential for renewed analyses of these and other legacy museum collections using modern techniques.

Acknowledgements

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