Guide to Radiocarbon Dating in Hawai‘i: An Annotated Bibliography

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Contents

1 Introduction

This annotated bibliography was distributed to the attendees of the Society for Hawaiian Archaeology's Radiocarbon Dating Workshop, which was held at Bishop Museum on January 21, 2014. The bibliography is organized topically, with separate sections for the general and Hawaiian literature. It contains sources that I've found useful in my study of radiocarbon dating and also detailed citations for the sources of information used to construct graphics for the workshop. The reader should be aware that many of the entries discuss a variety of topics, so that their placement in one section or another of the bibliography involves some choice.

2 Radiocarbon Dating in General

The sources in this section are drawn from the world literature on radiocarbon dating. They are mostly standard references that justify the procedures used by modern radiocarbon dating programs.

2.1 Overviews

These texts explain the theory, physics, and statistics of radiocarbon dating and its use as evidence in historical accounts. During the early years of radiocarbon dating, through about 1990, the radiocarbon dating community was concerned to teach archaeologists about what goes on in a dating laboratory, the nature of the physical processes that make radiocarbon dating possible, and how to understand the probabilistic nature of the dating evidence. The last 25 years have seen more attention given to modeling the relationship of radiocarbon dates to the other kinds of historical information available to archaeologists. This is the subject of Bayesian calibration.

Dilette Polach. *Radiocarbon Dating Literature, The First 21 Years, 1947–1968. Annotated Bibliography*. San Diego, CA: Academic Press, 1988 There are 80 references to archaeological radiocarbon dating in Oceania, two of which are from Hawai‘i, in this review of the first 21 years of the radiocarbon dating literature. It is a reminder of how little archaeologists knew about chronology at the time CRM archaeology got its start in Hawai‘i.

Sheridan Bowman. *Radiocarbon Dating*. Interpreting the Past. Berkeley, CA: University of California Press, 1990 This is the best general introduction to radiocarbon dating for archaeologists. Written by the Keeper of the Department of Scientific Research in the British Museum, it is short at only 62 pages and concise. Sample composition and issues of association and context are discussed in Chapter 5, Radiocarbon and Archaeology. The book has a good description of calibration, but it was written before the Bayesian techniques were fully developed and is now a bit outdated.

R. E. Taylor. *Radiocarbon Dating: An Archaeological Perspective*. New York: Academic Press, 1987 This is a longer, very thorough, treatment written by an archaeologist who, early in his career, had the opportunity to intern at the UCLA Institute of Geophysics and Planetary Physics. An excellent reference book, it is more technical and less accessible than Bowman's book. Chapter 5, *Evaluation of Radiocarbon Data*, discusses sample composition and issues of association and context.

Caitlin E. Buck, William G. Cavanagh, and Clifford D. Litton. *Bayesian Approach to Interpreting Archaeological Data*. Statistics in Practice. Chichester, UK: John Wiley & Sons, 1996 This book contains the classic description of the Bayesian approach to radiocarbon calibration, set within a rigorous mathematical discussion of modeling in archaeology, quantification of uncertainty, and statistical modeling. The Bayesian approach to radiocarbon calibration is designed to permit the use of various kinds of contextual information, such as stratigraphy, to yield age estimates that are archaeologically interpretable. Bayesian methods provide a theoretical bridge between the results supplied by the dating laboratory and the other types of relative and absolute chronological information typically collected by the archaeologist in the field and during background research into the historical record. Chapter 9, *Interpretation of Radiocarbon Results*, presents five case studies to illustrate the application of Bayesian methods to practical archaeological situations, including routine incorporation of stratigraphic information, dating of a multi-phase sequence based on artifact classification, and outlier detection, among others.

Alex Bayliss. "Rolling Out Revolution: Using Radiocarbon Dating in Archaeology". In: *Radiocarbon* 51.1 (2009), pp. 123–147 A brief history and prospect of how technological advances in radiocarbon dating have revolutionized archaeological interpretation. The author works for English Heritage, the government agency responsible for archaeology in England. English Heritage was quick to recognize the potential of routine Bayesian modeling and in 2009 there were more than 500 sites in England where ages had been estimated using Bayesian methods. Notes that Bayesian techniques have had greatest impact on periods of English history where artifact chronologies aren't well developed (like Hawai'i), and that the impact of the Bayesian technology on interpretation took about 15 years to become apparent to the archaeological community.

2.2 Sample Composition

M. Stuiver and H.A. Polach. "Discussion: Reporting of ^{14}C data". In: *Radiocarbon* 19 (1977), pp. 355–363 The definition of "conventional radiocarbon age" as one that (i) uses 5568 as the radiocarbon half-life, (ii) uses National Bureau of Standards oxalic acid to define "zero" age, (iii) uses AD 1950 as the zero point from which to count radiocarbon time, and (iv) corrects the sample to a common δ^{13}C value.

M. Niu et al. "The Bayesian Approach to Radiocarbon Calibration Curve Estimation: The INTCAL13, MARINE13, and SHCAL13 Methodologies". In: *Radiocarbon* 55.4 (2013), pp. 1905–1922 Outlines the Bayesian methods used to estimate the calibration curves used by software such as `Calib`, `OxCal`, and `BCal`.

2.3 Association and Context

The archaeological association problem was first dealt with systematically by the Dutch archaeologist, H. T. Waterbolk. A comprehensive framework for analyzing association and context is the Harris matrix. As radiocarbon dating techniques advanced and it became possible to date ever smaller samples, archaeologists learned to pay closer attention to association and context.

H. T. Waterbolk. "Working with Radiocarbon Dates". In: *Proceedings of the Prehistoric Society* 37 (1971), pp. 15–33 Waterbolk was one of the first archaeologists to think through the problems of archaeological dating with radiocarbon. The following quote was his motivation for publishing this article.

> C-14 datings can not only provide us with estimates of the absolute age of objects or occupation layers, but also, when available in sufficient numbers, with initial and terminal datings for cultural phases, thus defining their duration.

Waterbolk considered it axiomatic that the dated event was always older than its archaeological context.

> A C-14 sample always has, unless contaminated with younger material, a date older than that at which it was buried in the ground and became associated with other objects.

He noted that the dated event had to be associated with the reference event.

> There is great variation in the degree of certainty with which measured C-14 samples are associated with the archaeological material they are intended to date.

He suggested that archaeologists evaluate the confidence of the association between dated event and reference event with a four step scale: **full certainty,** the archaeological object itself furnished he measured sample; **high probability,** there is a direct functional relationship between the organic material which is measured and the diagnostic archaeological finds; **probability,** there is no demonstrable functional relation between measured sample and archaeological material, but the quantity of organic material and the size of the fragments argue in favor of a relationship; **reasonable possibility,** small, scattered fragments.

Waterbolk recommended that samples collected from "brief test excavations" should not be assigned "high probability."

Although it would be about twenty years until Bayesian techniques were developed to integrate stratigraphic information into calibration, Waterbolk clearly pointed to the desirability of combining the two sources of information.

> A sounder judgment can be formed of the reliability of a dating if one has … datings of a series of samples from the same vertical profile.

Edward C. Harris. *Principles of Archaeological Stratigraphy*. Second. London: Academic Press, 1989 The Harris matrix was developed to facilitate recording the complex stratigraphy of urban archaeological sites in Great Britain. It defines two types of stratigraphic unit—deposits and interfaces—and sets out a protocol for recording their characteristics and relationships to one another. Use of the Harris matrix solves the problems of association and context.

David M. Pendergast. "The Problems Raised by Small Charcoal Samples for Radiocarbon Analysis". In: *Journal of Field Archaeology* 27.2 (2000), pp. 237–239 Development of AMS dating greatly reduced the sizes of charcoal samples required for archaeological dating. This short article points out potential association and context problems introduced by the ability to date small pieces of charcoal.

Jeffrey S. Dean. "Independent Dating in Archaeological Analysis". In: *Advances in Archaeological Method and Theory*. Ed. by M. B. Schiffer. Vol. 1. New York: Academic Press, 1978, pp. 223–265 A difficult, highly formalized, paper written when behavioral archaeology was the rage at the University of Arizona and the author was active in the Laboratory of Tree Ring Research there. Dean's work with dendrochronology alerted him early to the difficulties of archaeological dating. Distinguishes four meanings of "event" in archaeological dating, three of which are most useful: **dated event (E_d),** the event that is actually dated by the laboratory—in radiocarbon dating, this is typically the growth of the plant or the death of the animal that makes up the dating sample; **reference event (E_r),** the potentially datable event that can be related to the event of interest; and **target event (E_t),** the event of archaeological interest.

Develops a terminology to describe relationships among E_d, E_r, and E_t: **disjunction,** when E_d is older than E_t; **gap,** when, in a disjunction, E_d is older than E_r; **hiatus,** when, in a disjunction, E_r is older than E_t; and **disparity,** when E_d is younger than E_t.

2.4 Substantive Contributions

There are many good examples of radiocarbon dating, but *Gathering Time* stands head and shoulders above anything that came before and has been done since. The main argument is that the kinds of histories that archaeologists can conceive are shaped by the precision with which they can measure time.

A.W.R. Whittle et al. *Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland*. Oxford: Oxbow Books, 2011 This two-volume work describes the results of a project to date the early Neolithic causewayed enclosures of Southern Britain and Ireland. It is the largest application of the Bayesian approach to modeling archaeological chronologies ever undertaken. Chapter 2, *Towards generational time-scales: the quantitative interpretation of archaeological chronologies*, written for "Bayesian virgins," describes in detail how the project was able to achieve resolution on the order of a human generation from archaeological materials more than 5,000 years old. The best example, from Hambledon Hill, is described in Chapter 4, *South Wessex*, and should be required reading for every archaeologist using radiocarbon dating.

2.5 Calibration Software

Calibration software has been available since the mid 1980s. Software capable of implementing Bayesian models was introduced around 2000 and is now widely available.

M. Stuiver and P.J. Reimer. "A computer program for radiocarbon age calibration". In: *Radiocarbon* 28.2B (1986), pp. 1022–1030 One of the first widely available calibration programs, it is available on the Internet and as a stand-alone application for the Windows platform. `CALIB` does not support Bayesian models and is thus somewhat outdated.

Caitlin E. Buck, J. Andrés Christen, and Gary N. James. "BCal: An on-line Bayesian radiocarbon calibration tool". In: *Internet Archaeology* 7 (1999). URL: http://intarch.ac.uk/journal/issue7/buck/ `BCal` is an on-line calibration program designed specifically to implement Bayesian models. The software follows a step-by-step procedure that guides the user through data entry and calibration. Informative context-sensitive help is available at each step. Input data are stored on the `BCal` server in binary format, which makes them somewhat difficult to share. Also, output is restricted to a (useful) subset of the information generated during the calibration and might not be sufficient for unusual situations.

Christopher Bronk Ramsey. "Development of the radiocarbon calibration program OxCal". In: *Radiocarbon* 43.2A (2001), pp. 355–363 `OxCal` is available on the Internet and also as a stand-alone application that runs in certain versions of the FireFox web browser. It calibrates individual dates like `CALIB`, and also supports Bayesian models. `OxCal` is actively developed and supports a wide variety of models.

3 Radiocarbon Dating in Hawai‘i

Radiocarbon dating has a long history in Hawaiian archaeology, but it is only recently that it has begun to address the sample composition and association issues in a meaningful way.

3.1 Overviews

Rob Hommon's experience researching and writing *The Ancient Hawaiian State* led him to propose that the Society for Hawaiian Archaeology set out best practices for radiocarbon dating. Tim Rieth and Steve Athens at International Archaeological Research Institute put together a useful programmatic statement, with a focus on sample composition issues.

Tmothy Rieth and J. Stephen Athens. "Suggested Best Practices for the Application of Radiocarbon Dating to Hawaiian Archaeology". In: *Hawaiian Archaeology* 13 (2013), pp. 3–29 Sets out "Best Practices" guidelines for acquiring radiocarbon dates. Distinguishes the dated event from the target event of archaeological interest and recommends that archaeologists develop a "bridging argument" that explicitly establishes the chronological relationship of the two events. Illustrates with a paleontological example from Barbers Point an interpretive error tied to a naive bridging argument. Discusses how to select and date wood charcoal, marine shell, bone, bulk soil, and ash, and recommends that dates on bulk soil and ash be avoided, if possible. Provides an example tabular report of a radiocarbon date that does not clearly distinguish the dated event from the archaeological target event and reports a date on unidentified material. Table 1 gives lifespans for 32 common Hawaiian plants as an aid to radiocarbon dating sample selection. Table 2 summarizes the apparent ages of marine shells from Oʻahu, Molokaʻi, and Hawaiʻi Island. Reports an apparent age, ΔR, of 54 ± 20 for petrel bones.

3.2 Sample Composition

The suitability of different sample materials was investigated during the early years of radiocarbon dating in Hawaiʻi. Unlike other places in the Pacific, Hawaiian archaeologists have made only limited use of marine shells for dating and issues surrounding local variations in the apparent age of the marine environment haven't been fully worked out. The effects of old wood have been amply documented.

Kenneth P. Emory and Yosihiko H. Sinoto. *Age of the Sites in the South Point Area, Kaʻu, Hawaii*. Pacific Anthropological Records 8. Honolulu, 1969 Reports the work of Roy Chatters and Roald Fryxell of the Radioisotopes and Radiation Laboratory at Washington State University and Lars Engstrom of the Radiocarbon Laboratory at Stockholm. They dated a wide variety of materials from the H8 site, including driftwood, *Cypraea* shell, sea-urchin spines, fish scales, and fish bones. Establishes the potentially great age of driftwood that washes ashore. Concludes that sea urchin spines, fish scales, and fish bones produce "erratic dates" and are unsuited for radiocarbon dating.

Thomas S. Dye. "Effects of ^{14}C sample selection in archaeology: An example from Hawai'i". In: *Radiocarbon* 42.2 (2000), pp. 203–217 Argues that "old wood" has a demonstrable effect on radiocarbon dates from Hawai'i. Compares the age distribution of 22 dates on identified, short-lived wood charcoal collected from fire-pits at Bellows Air Force Station with 22 dates on unidentified wood charcoal mostly collected from non-feature contexts. Shows that differences in the distributions are similar to the differences between large samples of short-lived and long-lived woods dated in New Zealand. Points to three potential sources of "old wood," including driftwood, waterlogged wood in alluvial deposits of Puhā Stream, and the heartwood of old trees.

Thomas S. Dye. "Apparent ages of marine shells: Implications for archaeological dating in Hawai'i". In: *Radiocarbon* 36 (1994), pp. 51–57 Dated 8 marine shells of known age from Bishop Museum collections and reviewed 11 paired marine shell and wood charcoal dates from the H8 site and sites at Barbers Point, O'ahu. Identified relatively great variation in the apparent ages of Hawaiian marine shells and demonstrated that grazing herbivores from limestone coasts have apparent ages up to 620 years greater than similar shells from volcanic coasts. Recommended that archaeological marine shells for dating should be sourced to a particular local environment and that the apparent age of shells in that environment should be determined for best results.

Fiona Petchey. "Dating marine shell in Oceania: Issues and prospects". In: *New Directions in Archaeological Science*. Ed. by A. Fairbairn, S. O'Connor, and B. Marwick. Terra Australis 28. Canberra, AU: ANU E Press, 2009. Chap. 11, pp. 157–172 Dating marine shells requires that the species be identified and the dietary and habitat preferences of that species known. Algae grazers and deposit-feeders aren't suitable for dating because they can ingest carbon from old limestone or a terrestrial source. Filter-feeders, typically sessile bivalves, are preferred for dating and will be most reliable when the bivalves grew in environments with free water exchange with the open ocean, away from limestone exposures and from estuaries that carry terrestrial carbon into the ocean.

Marshall I. Weisler, Quan Hua, and Jian xin Zhao. "Late Holocene ^{14}C marine reservoir corrections for Hawai'i derived from U-series dated archaeological coral". In: *Radiocarbon* 51 (2009), pp. 955–968 Using paired U-series and radiocarbon dates on twelve pieces of *Pocillopora* sp. branch coral from various locations on Moloka'i Island, establishes that the apparent age of the marine environment of southern Moloka'i did not vary spatially in the seventeenth century and that it was also consistent over the period AD 700–1800.

3.3 Association and Context

Nowadays, discussions of association and context are carried out in the context of Bayesian calibration.

Thomas S. Dye. "Traditional Hawaiian Surface Architecture: Absolute and Relative Dating". In: *Research Designs for Hawaiian Archaeology: Agriculture, Architecture, Methodology*. Ed. by Thomas S. Dye. Special Publications 3. Honolulu: Society for Hawaiian Archaeology, 2010. Chap. 2, pp. 93–155 An attempt to introduce Bayesian calibration to Hawaiian archaeologists. Develops and illustrates a simple Bayesian model that can be used to estimate the construction date of a surface architectural feature. Describes a set of field procedures to support the data requirements of the model and recommends they be applied generally in Hawai‘i. Proposes a dynamic settlement pattern hypothesis: "There are two components to the diachronic settlement pattern of traditional Hawai‘i, with a fixed set of temple structure locations surrounded by a more transient set of habitation structures."

3.4 Substantive Contributions

The changes brought about by archaeologists paying attention to sample composition, association, and context are most easily seen in the changing estimates for the age of early sites and estimates for Polynesian settlement of Hawai‘i. The firewood contents of fire-pits can be precisely located in both space and time—they provide a unique data set with great potential for interpretation.

3.4.1 Early Sites

The three sites thought to represent early settlement are now thought to date several hundred years later than the initial estimates.

Thomas S. Dye. "The South Point radiocarbon dates 30 years later". In: *New Zealand Journal of Archaeology* 14 (1992), pp. 89–97 Uses an ad hoc graphical technique to estimate the duration of time represented by individual layers at the H1 and H8 sites. Concludes that the duration of Layer II at the H8 site was about 1,000 years, from the late seventh century to about AD 1650, and that the duration of Layer I at H8 was about 200 years, from AD 1650 to site abandonment around AD 1850. Also concludes that Layers III and II at H1 were both deposited in the first half of the fifteenth century. Favorably compares these results to a cross-dating of the sites based on the relative frequencies of one-piece fishhook head types 1A, 1B, and 4.

Patrick V. Kirch and Mark D. McCoy. "Reconfiguring the Hawaiian Cultural Sequence: Results of Re-dating the Hālawa Dune Site (Mo-A1-3), Moloka'i Island". In: *Journal of the Polynesian Society* 116 (2007), pp. 385–406 Reports radiocarbon dates on three pieces of bone and three carbonized twigs collected from non-feature contexts at the Halawa Dune Site, Moloka'i. Concludes that the site was unlikely to have been settled prior to AD 1300, some seven to eight centuries later than initially estimated. "Old wood" and problematic procedures at the dating laboratory are thought to have contributed to anomalously early age estimates.

Thomas S. Dye and Jeffrey Pantaleo. "Age of the O18 Site, Hawai'i". In: *Archaeology in Oceania* 45 (2010), pp. 113–119 Seven new radiocarbon age determinations indicate that the O18 site was established in AD 1040–1219, quite a bit later than previous estimates of the seventh, fourth, and eighth centuries AD. Implicates the effects of dating "old wood" as one reason for the erroneously old age estimates.

3.4.2 Polynesian Settlement

Archaeologists are naturally interested in "firsts." The date Polynesians discovered and settled Hawai'i has pride of place as the first of the firsts.

Kenneth P. Emory. *Archaeology of Nihoa and Necker Islands*. B. P. Bishop Museum Bulletin 53. Honolulu: B. P. Bishop Museum, 1928 Before radiocarbon dating, the settlement date was estimated with genealogical records, using an average generation length of 25 years.

Yosihiko H. Sinoto. "An Archaeologically Based Assessment of the Marquesas Islands as a Dispersal Center in East Polynesia". In: *Studies in Oceanic Culture History*. Ed. by Roger C. Green and Marion Kelly. Pacific Anthropological Records 11. Honolulu, 1970, pp. 105–132 An estimate based on work at South Point and the Marquesas.

Peter S. Bellwood. *Man's Conquest of the Pacific: The Prehistory of Southeast Asia and Oceania*. New York: Oxford University Press, 1979 Hawai'i settlement as seen from the context of Oceania and Southeast Asia.

Patrick V. Kirch. *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. Honolulu: University of Hawaii Press, 1985 The classic textbook of Hawaiian archaeology. Argues from a consideration of "early" sites and comparisons with dates from the Eastern Polynesian homeland.

Terry L. Hunt and Robert M. Holsen. "An early radiocarbon chronology for the Hawaiian Islands: A preliminary analysis". In: *Asian Perspectives* 30 (1991), pp. 147–161 The earliest estimate of Polynesian settlement, based on a consideration of a large corpus of radiocarbon dates, few of which controlled for sample composition or association and context.

M. Spriggs and A. Anderson. "Late colonization of East Polynesia". In: *Antiquity* 67 (1993), pp. 200–217 Chronometric hygiene scrubs away many early dates, yielding a "late" chronology.

Michael W. Graves and David J. Addison. "The Polynesian Settlement of the Hawaiian Archipelago: Interpreting Models and Methods in Archaeological Interpretation". In: *World Archaeology* 26.3 (1995), pp. 380–399 Another plea for the usefulness of the early dates, this time based on the idea that settlement was a multi-stage process.

J. Stephen Athens. "Hawaiian native lowland vegetation in prehistory". In: *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change*. Chap. 12, pp. 248–270 Introduces paleoenvironmental data into the discussion of Polynesian settlement. These date point to a substantially later settlement than most Hawaiian archaeologists at the time were prepared to entertain.

Patrick Vinton Kirch. *On the Road of the Winds: An Archaeological History of the Pacific Islands Before European Contact*. Berkeley, CA: University of California Press, 2000 Kirch's "Bellwood book" begins to express some doubt about the early Hawaiian sites, but doesn't yet fully appreciate the paleoenvironmental data reported by Athens, "Hawaiian native lowland vegetation in prehistory".

Janet M. Wilmshurst et al. "High-precision radiocarbon dating shows recent and rapid initial human colonization of East Polynesia". In: *Proceedings of the National Academy of Sciences* 108.5 (2011), pp. 1815–1820 Radical chronometric hygiene yields really late estimates for settlement of East Polynesia, including Hawai'i. Contrast the settlement estimate derived after chronometric hygiene with the unhygienic estimate proposed by Hunt and Holsen, "An early radiocarbon chronology for the Hawaiian Islands: A preliminary analysis", which is about a millennium older.

Patrick V. Kirch. "When did the Polynesians settle Hawai'i? A review of 150 years of scholarly inquiry and a tentative answer". In: *Hawaiian Archaeology* 12 (2011), pp. 3–26 Reviews and summarizes the history of ideas relating to the timing of the settlement of Hawai'i; brings together the latest information, including the chronology of settlement for the Central East Polynesia region, paleoenvironmental proxy records from O'ahu and Kaua'i, dates obtained from bones of the Polynesian-introduced rat, and the re-dating of Site O18.

Timothy M. Rieth et al. "The 13th Century Polynesian Colonization of Hawai'i Island". In: *Journal of Archaeological Science* 38 (2011), pp. 2740–2749 Compiles 926 radiocarbon dates from Hawai'i Island and classifies them according to sample material and the precision reported by the dating laboratory. Table 1 provides a list of short-lived and long-lived taxa commonly used as radiocarbon dating samples in Hawai'i.

Thomas S. Dye. "A Model-based Age Estimate for Polynesian Colonization of Hawai'i". In: *Archaeology in Oceania* 46 (2011), pp. 130–138 A model-based Bayesian calibration using radiocarbon data from paleoenvironmental cores and materials introduced to the islands by Polynesian colonists estimates that the islands were likely colonized sometime late in the first millennium AD. Two calibrations, one using radiocarbon dates on floral materials and the other using radiocarbon dates on floral and faunal materials, indicate that archaeological materials yield relatively imprecise estimates of the colonization event with 95 percent highest posterior density regions 3–5 centuries long.

J. Stephen Athens, Timothy M. Rieth, and Thomas S. Dye. "A Paleoenvironmental and Archaeological Model-Based Age Estimate for the Colonization of Hawai'i". In: *American Antiquity* 79.1 (2014), pp. 144–155 Augments Dye, "A Model-based Age Estimate for Polynesian Colonization of Hawai'i", with additional data from the

pre-colonization and post-colonization periods. Derives a more precise estimate of the settlement date in the eleventh century AD. Supports this estimate with a similar age estimate derived from an age-depth model applied to a paleoenvironmental core from Ordy Pond on Oʻahu.

3.4.3 Firewood Use

Thomas S. Dye and Carl Sholin. "Changing patterns of firewood use on the Waimānalo Plain". In: *Hawaiian Archaeology* 13 (2013), pp. 30–68 Wood charcoal identifications from 35 dated traditional Hawaiian fire-pits on the Waimānalo Plain are analyzed for evidence of change over time and difference across space. Plant taxa identified in the firewood are classified according to habit, origin, and elevational distribution. Early in traditional Hawaiian times, firewood was commonly brought to the plain from inland forests and fires were made primarily with native plants. Later, firewood was more likely to be collected locally, and it typically included both Polynesian-introduced and native plants. This change in behavior appears to have taken place in the fifteenth century. It was likely associated with a vegetation change in which the native lowland forest was replaced with a variety of useful plants, especially near Puhā Stream.