When Did the Polynesians Settle Hawai‘i?

A Review of 150 Years of Scholarly Inquiry and a Tentative Answer[1]

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Abstract

The question of when Polynesians first discovered the Hawaiian Islands—the most remote archipelago in the world—has engaged scholars for two centuries. Abraham Fornander, Edward Handy, Te Rangi Hiroa, Kenneth Emory, and others proposed theories and projected dates of first settlement based on oral traditions, genealogies, and linguistic comparisons. With the advent of stratigraphic archaeology and radiocarbon dating, new models of Polynesian settlement emerged, seeming to push back the date of Polynesian settlement in Eastern Polynesia. Until recently, orthodox opinion put initial Polynesian discovery of Hawai‘i between ca. AD 300–750. In the past two decades, significant advances in radiocarbon dating and the targeted re-dating of key Eastern Polynesian and Hawaiian sites has strongly supported a “short chronology” model of Eastern Polynesian settlement. It is suggested here that initial Polynesian discovery and colonization of the Hawaiian Islands occurred between approximately AD 1000 and 1200. The only habitation site in the archipelago which has been securely dated to this time frame is the O18 Bellows Beach site at Waimānalo, O‘ahu Island.

Among the general public and professional archaeologists alike, one of the most pervasive questions concerning the Hawaiian past is: when did the Polynesian ancestors of the Hawaiians first discover and settle the islands? The Hawaiian archipelago is one of the most remote on Earth, thousands of kilometers from the probable immediate Polynesian homelands of the Marquesas and Society Islands in the South Pacific. It is even more distant from the Americas and Asia. The very fact that Polynesian seafarers in their double-hulled voyaging canoes were able to carry out such a feat of exploration and discovery is astounding. Our curiosity naturally drives us to ask--at what period in history did this occur? Indeed, scholars have been posing this question for at least a century and a half, and attempting to answer it by various means. Over this time, the methods at our disposal for resolving questions of ancient chronology have been greatly refined. Not surprisingly, the proposed answers to the question of Hawaiian settlement have also changed.

This article surveys changing views about initial Polynesian discovery and settlement of Hawai‘i, beginning with Abraham Fornander in the late 19th century, continuing through early archaeological investigations of the mid-20th century, to the radical re-thinking of Eastern Polynesian chronology of the past two decades. My personal involvement with this question now spans almost a half-century, beginning with my participation in the excavation of several key sites at the center of the debates. My aim here, however, is not to propose a definitive new date for the Polynesian discovery of Hawai‘i, so much as to show how interpretation is affected by changes in theory and method. I will, in my conclusion, summarize what I believe to be the best current estimate for the timeframe of first Polynesian colonization of Hawai‘i. But--*caveat lector*--the debate will continue.

Before Radiocarbon Dating: Early Theories of Hawaiian Settlement

Various European explorers, traders, missionaries, and others--from Captain James Cook onwards--speculated about where the ancestors of the Hawaiians and other Polynesians came from, and about when they had made their migrations into and across the vast Pacific. But the first to systematically compile a large body of empirical data relevant to these questions, and to lay out a formal argument and theory, was Abraham Fornander, primarily in his classic *An Account of the Polynesian Race* (1878–1885), but also in a posthumously published summary (Fornander 1919). Fornander was not an archaeologist (indeed his main profession was law, and he practiced as a Magistrate of the Hawaiian Kingdom’s courts); he did not draw upon the material record of ancient sites or artifacts. Fornander, who became fluent in Hawaiian, regarded the Hawaiian traditions as historical accounts of real individuals. He also realized that these accounts could be placed into a relative chronology using the genealogies of the chiefly lines which he also collected and analyzed.

Based on his careful study of the Hawaiian genealogies, Fornander realized that "Hawaiian traditions on Hawaiian soil . . . do not go back with any historical precision much more than twenty-eight generations from the present (about 1865), or say 840 years" (1919:232). On this basis, Fornander felt he could safely assert "that these islands were inhabited 800 or 900 years ago. . ." (1919:233). Fornander did not believe that this was the time of initial Polynesian arrival, but simply the greatest time depth that could be traced with historical accuracy based on the genealogies. In fact, Fornander argued that the islands had already been occupied for some centuries, " . . . by the same race of people that inhabits them now" (1919:233). Fornander's overall theory of Polynesian origins traced them back to "the Asiatic Archipelago" (i.e., Island Southeast Asia), and he allowed some centuries for the period of initial migrations into the central Pacific. His succinct views on the chronology of Hawaiian origins follow:

> We get, then, the following leading propositions as chronological sign-posts, approximately at least, of the Polynesian migrations in the Pacific: 1. During the close of the first and the beginning of the second century of the present era, the Polynesians left the Asiatic Archipelago and entered the Pacific, establishing themselves on the Samoa and Tonga groups and spreading eastward and northward. 2. During the 5th century Polynesians settled on the Hawaiian Islands and remained there comparatively unknown until 3. the eleventh century when several parties of fresh immigrants from the Marquesas, Tahiti and Samoa groups arrived at the Hawaiian Islands, and for the space of five or six generations revived and maintained an active intercourse with the first-named groups and the mother-stock (1919:233–34).

The "fresh immigrants" referred to were the several lineages of voyaging chiefs (especially Māweke and his descendants Moʻikeha and ʻOlopana, followed by Kila and Laʻamaikahiki; and Pāʻao) who traveled back and forth between Hawaiʻi and "Kahiki" and whose exploits are recounted in the traditions collected by Fornander.

Fornander's theory in many ways foreshadows much of what came later in discussions of Hawaiian origins and chronology. It is remarkably modern in the overall scenario proposed for Polynesian migrations, and interesting in the two-phase sequence for Hawaiian settlement (later to be a key element in the "orthodox model" of Kenneth Emory and Yosihiko Sinoto, see below).

Professional anthropology incorporating archaeology took hold in Polynesia in the early 20th century, especially after the appointment of Herbert E. Gregory as Director of the Bishop Museum in 1920. Gregory proclaimed "the problem of Polynesian origins" as the major scientific question to be tackled by the Museum's scientists; expeditions using a multi-pronged approach combining ethnography, archaeology, and physical anthropology were dispatched to most of Polynesia's major islands and archipelagos (see Kirch 2000:20–24 for a summary of this period in Polynesian research). Archaeology at this

time lacked any direct methods for dating Polynesian sites or artifacts, and was largely relegated to the mapping of surface architecture. Oral traditions, along with detailed ethnographic comparisons, were the main sources for historical reconstruction. The Maori ethnographer Te Rangi Hiroa (Sir Peter H. Buck), who succeeded Gregory as Director of the Bishop Museum, synthesized the results of the Museum's major research program in his popular book *Vikings of the Sunrise* (1938).

In spite of the decades of research by Bishop Museum's and other anthropologists, Hiroa's account of Hawaiian settlement differs little from that of Fornander. Hiroa places the first arrival of Polynesians in Hawai'i at AD 450 (Hiroa 1938:249). He states that this may have been by the legendary voyager Hawai'i-loa, but argues "it is more likely that the name of the first settler was forgotten, and the [Polynesian] historians gave him the name of the island in order to establish their claim that he was the first settler." Like Fornander, Hiroa then picks up the thread of colonization with a "later influx of people from Tahiti . . . led by chiefs who became distinguished ancestors of the chiefly families of Hawai'i" (1938:249). Hiroa identifies the people who had already settled the Hawaiian archipelago prior to the arrival of the Tahitian voyaging chiefs as "the Menehune people". He argues that they were especially associated with Kaua'i Island, and speculates that eventually they were pushed out of the main islands and ". . . withdrew to the barren and rocky islets of Nihoa and Necker" (1938:250). Hiroa dates the last voyage between Hawai'i and Tahiti--which he says was that of Pā'ao--to AD 1275.

Kenneth P. Emory joined the Bishop Museum staff in 1920 and was a major contributor to the Museum's research program synthesized by Hiroa. Following the research hiatus imposed by World War II, Emory matriculated at Yale University to obtain his long-delayed doctorate. His 1946 dissertation (never published but available on microfilm, Emory [1946]) broke new methodological ground by turning to the evidence from Polynesian languages in order to infer migrations and times of divergence between the cultures of Eastern Polynesia. Emory used an early form of lexicostatistics or comparison of vocabularies (including estimates of percentage agreement in word lists) to assess the relationships among the various Polynesian cultures. Among his key conclusions were that the original Polynesian homeland was situated in Western Polynesia (Tonga and Samoa in particular), and that these Polynesian ancestors "remained a considerable time in West Polynesia before moving on [to Eastern Polynesia]" (1946:274). Emory thus anticipated the later debate regarding the so-called "long pause" between the settlement of Western and Eastern Polynesia (on which see more below).

Emory's model for the settlement of Polynesia--and the dates associated with the divergence of various branches of Polynesian culture--was encapsulated in a "tree" diagram, reproduced here as Figure 1.

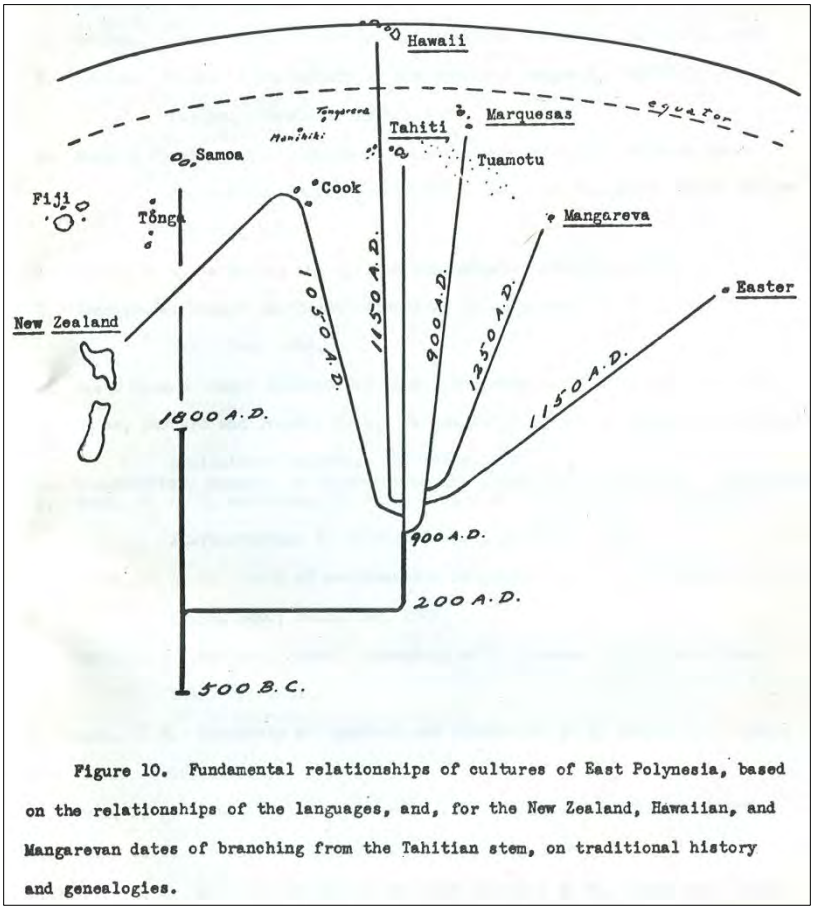

Figure 10. Fundamental relationships of cultures of East Polynesia, based on the relationships of the languages, and, for the New Zealand, Hawaiian, and Mangarevan dates of branching from the Tahitian stem, on traditional history and genealogies.

Figure 1. Emory's tree diagram of Polynesian cultural relationships, from his 1946 Yale dissertation, showing estimated "dates of branching." The settlement of Hawai'i from Tahiti is estimated by Emory to have occurred about AD 1150.

He situated the initial arrival of Polynesians from the Western Polynesian homeland to the Society Islands, dating their arrival to around AD 200. Emory then inferred a diaspora out of Tahiti, beginning around AD 900, with various "dates of branching" estimated on the basis of the oral traditions and genealogies. The date of arrival in Hawai'i was estimated to have been around AD 1150. Echoing Fornander and Hiroa, however, Emory left open the possibility of an earlier visit by Marquesan voyagers to Hawai'i (1946:278). He wrote: "At least we have good evidence of direct contact between Hawai'i and the Marquesas, after enough time had elapsed for Marquesan culture to take on peculiarities of its own."

The Radiocarbon Revolution and Polynesian Settlement Chronology

At the time that Emory submitted his Yale dissertation, Pacific anthropology was on the cusp of a sea-change. Until then, archaeology in Polynesia had largely

contented itself with surface surveys of monumental architecture and studies of stone artifacts. Excavation had rarely been ventured and even when it was, stratigraphy was ignored (J.F.G. Stokes' 1913 excavations on Kahoʻolawe Island being a notable exception). More critically, there was no means to independently date the few artifacts recovered. But in 1947 Edward Gifford of the University of California at Berkeley led an archaeological expedition to Fiji, on the western boundary of Polynesia, revealing a deeply stratified succession of pottery types (see Kirch 2000:27–29 for an overview of these developments). In 1950, Emory commenced excavations at a rockshelter site at Kuliʻouʻou, Oʻahu; the shelter had been unsystematically probed by Jack Porteus as early as 1938, and Emory knew that its earthen floor contained a variety of artifacts (Emory and Sinoto 1961).

These and other tentative forays into island sites might have had little impact on Polynesian anthropology were it not for the contemporaneous development of the method of radiocarbon dating by chemist Willard Libby (Libby 1952). By the late 1940s Libby had confirmed that his method worked by dating wooden lintel beams from Egyptian temples whose age had been independently given by hieroglyphic dates. With the support of the Viking Fund of New York, Libby put out a call for archaeological samples from different parts of the world. Emory was the first in the Pacific to respond, sending a charcoal sample from the base of the Kuliʻouʻou Rockshelter (Gifford followed shortly thereafter with samples from Fiji, and then from New Caledonia). Emory's account reveals the excitement provoked by the invention of a means for directly dating the age of an archaeological site:

> While this [excavation] was in progress, in May of 1950, word came of W. F. Libby's momentous discovery of a method for dating charcoal through measuring radioactivity. A sample of charcoal from a fireplace . . . was submitted . . . revealing that the shelter had been occupied about AD 1004. This was the first radiocarbon date from any island in the Pacific and it opened up undreamed of possibilities for reconstructing the prehistory of the area. (Emory, in Emory et al. 1959:ix).

The invention of radiocarbon dating helped to spark a boom in Polynesian and Pacific archaeology. Emory launched a multi-year Hawaiian Archaeology Program under the auspices of the Bishop Museum, searching nearly every island for rockshelter and sand-dune sites rich in artifacts which could be radiocarbon dated to develop a cultural sequence for the Hawaiian Islands. He was soon joined by University of Hawaiʻi student William J. Bonk, and Japanese archaeologist Yosihiko Sinoto. Other field teams were also mobilized during the 1950s and early 60s, including Robert Suggs (from the American Museum of Natural History) in the Marquesas, the Norwegian Expedition in Easter Island and other parts of Eastern Polynesia, Jack Golson and then Roger Green in New Zealand (and the latter in Mangareva as well). Emory and Sinoto extended the Bishop Museum's program to the Society Islands and the Marquesas in the

early 1960s. Golson, Green, and their students and colleagues also initiated programs in Tonga and Samoa in Western Polynesia. (For an overview of these developments, see Kirch [2000:29–32].) As a result, by the mid-to-late 1960s, a new *archaeologically-based and radiocarbon-date defined chronology* for Polynesia was emerging. The use of oral traditions and genealogies was regarded as *passé*, having been superseded by a new and thoroughly "scientific" methodology privileging stratigraphic excavation of material remains, and dating the associated charcoal using the increasingly sophisticated radiocarbon technique.

Among the major outcomes of this burst of excavation and radiocarbon dating, the following were especially significant in shaping views concerning the sequence of timing of settlement in Polynesia: (1) First, the primacy of the Western Polynesian archipelagoes as the original Polynesian homeland was confirmed by the much older archaeological sequences there, dating back to at least 400 BC in Samoa and possibly as early as 1,500 BC in Tonga (Groube 1971). In both Samoa and Tonga, the early periods were marked by the presence of pottery, signaling a connection to Fiji and Melanesia to the west. (2) The surprisingly old radiocarbon dates obtained by Suggs (1961:Table 1) in the Marquesas, 150 BC in the case of the Haʻatuatua dune site on Nukuhiva, combined with small quantities of potsherds, suggested that the Marquesas had played a hitherto unsuspected role in the initial settlement of Eastern Polynesia. Sinoto (1966), expanding the Marquesan work to Ua Huka and other islands of the group, also found pottery but his dates suggested to him that first settlement was somewhat later, perhaps around AD 300. Nonetheless, Sinoto believed that his data supported a primary role for the Marquesas as a "dispersal center" in Eastern Polynesia. (3) Relatively early Polynesian dispersal throughout at least parts of Eastern Polynesia was also reinforced by the early date obtained by the Norwegian Expedition at Poike Ditch on Easter Island, AD 380 (Heyerdahl and Ferdon, eds., 1961:394).

By the early 1960s, a consensus model for the radiocarbon-based chronology of Polynesian settlement was emerging (Emory 1959; Green 1966, 1967; Emory and Sinoto 1965). Based largely on the new archaeological evidence, the model also incorporated rapidly developing insights from historical linguistics, which also indicated a later branching of the Eastern Polynesian languages off of a considerably older Proto Polynesian stem situated in the Western Polynesian homeland. In brief, this model had the ancestors of the Polynesians arriving in the Tonga-Samoa region, possibly as early as 1500 BC, where they developed a distinctive Proto Polynesian language and culture. Further expansion eastwards--possibly directly from Samoa to the Marquesas--took place by AD 300 if not slightly earlier (Figure 2). Easter Island appeared to have been settled around the same time. Exactly when the Society Islands (which had played such a key role in Fornander's and Hiroa's theories) were

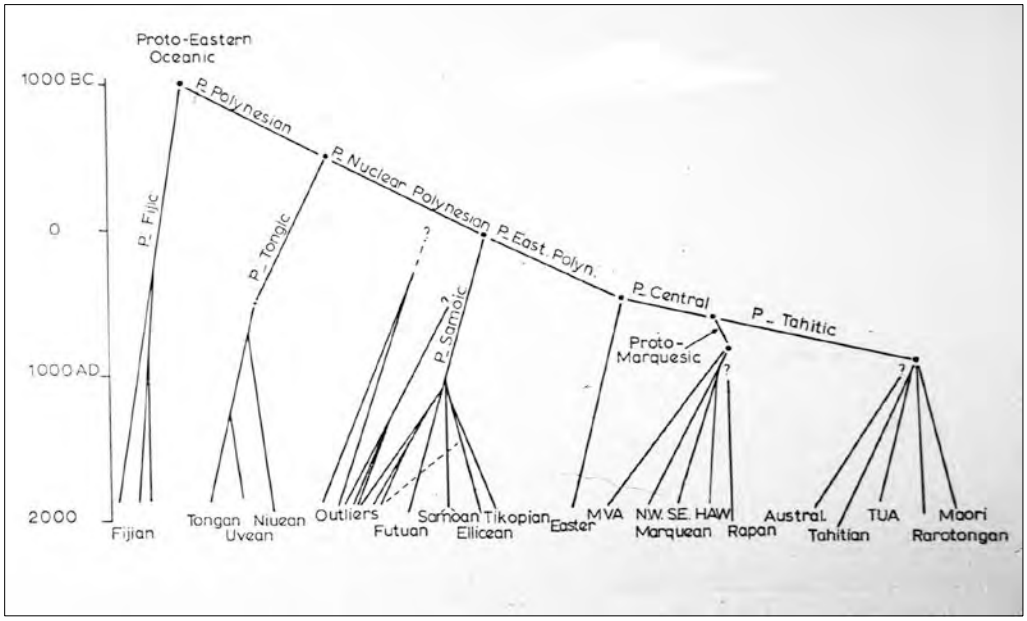

Figure 2. Roger Green's "family tree for the Polynesian languages" (Green 1966:Table 9). In this model, Hawaiian diverges from the Proto-Marquesic branch around the middle of the first millennium AD.

colonized was somewhat uncertain, as no early sites containing pottery were discovered by Emory and Sinoto's explorations. This led to the view that Tahiti was settled from the Marquesas, and that it became a second "dispersal center" for Eastern Polynesia by around AD 1200 (thus continuing to fit the evidence from oral traditions).

Early Radiocarbon-Dated Sites in the Hawaiian Islands

It was within this emerging Polynesian settlement model that the empirical archaeological and radiocarbon evidence from several key Hawaiian sites first had to be evaluated, in order to establish the place of Hawai'i in the model, including a probable date for Polynesian discovery and settlement of the islands. Throughout the 1950s, Emory and his colleagues Bonk and Sinoto had scoured the archipelago for stratified sites, testing at least 33 locations on all of the major islands except for Maui. But it was in the vicinity of Ka Lae (South Point) on Hawai'i Island that Emory's team discovered and excavated three sites which together seemed to provide a framework for the entire Hawaiian cultural sequence, from first settlement up until historic times. The Pu'u Ali'i (H1) sand dune site anchored the sequence at the base, the Waiahukini Shelter (H8) continued the sequence through the middle time period, and the Makalai Shelter (H2) capped the sequence at the late end (Emory et al. 1959:6–7, Figs. 23, 25). The rich quantities of bone and shell fishhooks from these sites provided a sequence of typological changes which Emory's team used to construct a master chronology for the islands, reported in detail in their classic

monograph *Hawaiian Archaeology: Fishhooks* (Emory et al. 1959).

Whereas the initial excavations at Kuli‘ou‘ou on O‘ahu had returned a radiocarbon date of AD 1004 ± 180, a much older age was obtained from the base of the Pu‘u Ali‘i sand dune site at South Point: AD 124 ± 60. This was far older than anyone had previously postulated for initial Polynesian settlement in Hawai‘i--Fornander and Hiroa had estimated that event at around AD 450, and Emory’s linguistic analyses had led him to propose a date of around AD 1150. But in light of the new archaeological dates emerging from the Marquesas and Easter Island, not to mention the much earlier sites in Western Polynesia, a date in the second century AD for Polynesian arrival in Hawai‘i was entirely plausible. In his preface to the *Fishhooks* monograph, Emory therefore wrote: “Radiocarbon dates for excavations reveal that the Hawaiian Islands were well populated by AD 1000, and that the first settlers may have arrived by AD 125” (Emory, in Emory et al. 1959:ix).

By the mid-1960s, Emory and Sinoto (Bonk had dropped out of the team) began to harbor doubts about the single early date from H1 that had anchored their initial Hawaiian fishhook chronology at AD 125. An extensive program of radiocarbon dating of 59 samples from the H1 and H8 South Point sites, carried out in conjunction with the Washington State University radiocarbon laboratory (Emory and Sinoto 1969) failed to replicate the early age first suggested for the base of site H1. Reviewing the expanded radiocarbon corpus, Emory and Sinoto revised their Hawai‘i fishhook chronology. They now proposed that the earliest deposits were those at the bottom of the H8 Waiahukini rockshelter, which they interpreted as beginning around AD 750 (1969:15). The H1 sand dune site was believed to overlap in time with the lower part of H8, and the fishhook-rich deposits of the dune were suggested to have been deposited between roughly AD 1000 to 1350. A revised settlement date for Hawai‘i of AD 750 was seen by Emory and Sinoto as fitting better with Sinoto’s sequence for the Marquesas Islands, which began at AD 300 (Sinoto 1979). If the Marquesas were the immediate homeland of the first voyagers to Hawai‘i, as seemed to be the case based on both material culture and linguistic evidence, then a date for initial Hawaiian settlement several centuries after the Marquesas themselves were first occupied was appropriate.

At the same time that Emory and Sinoto were revising their estimate for initial Hawaiian settlement from AD 125 to AD 750, two new sites were discovered and excavated which added evidence to the emerging picture about the timing of Polynesian colonization of the archipelago. The Bellows dune site (O18) at Waimānalo, O‘ahu, was excavated in 1967 under the direction of Richard Pearson of the University of Hawai‘i, and published a few years later by Pearson et al. (1971).[2] A well-stratified coastal dune adjacent to Waimānalo Stream, O18 yielded a small but striking assemblage of adzes, fishing gear, and other artifacts, many of which appeared closer to early Marquesan forms than to later Hawaiian types. Five radiocarbon dates were

obtained; with the exception of one late date (<380 years), the dates spanned a range from 1600 to 700 BP (Pearson et al. 1971:Figs. 13, 14). However, two of the dates from Layers II and III were stratigraphically inverted. Based on these dates, Pearson et al. (1971:230–231, Fig. 14) argued that the two deepest layers spanned a period between about AD 600 to 1100, and were contemporaneous with the older deposits at South Point sites H1 and H8.

On Molokaʻi Island, Kirch discovered a sand dune site (Mo-A1-3) at the mouth of the Hālawa Valley in the mid-1960s, and excavated the deposits over two seasons in 1969–70 (Kirch 1971; Kirch and Kelly, eds., 1975). The Hālawa dune site also yielded artifact types arguably similar to early Marquesan forms (and with simple two-piece fishhooks very much like those from the O18 site on Oʻahu), as well as the stone foundations and postholes from simple oval-ended houses. A radiocarbon date of 1380 ± 90 BP from a hearth at the base of the cultural deposit was taken to indicate initial settlement between ca. AD 560–740 (Kirch and Kelly, eds., 1975:Table 41).

The 'Orthodox Scenario' and the Debate Over Long Versus Short Chronologies

By the close of the 1970s, a synthetic model of Polynesian settlement chronology had emerged, one that is well reflected by various chapters in *The Prehistory of Polynesia* volume edited by Jesse Jennings (1979). In his Introduction, Jennings provided a graphic summary of the model, reproduced here as Figure 3. His succinct text summed up the achievements of three decades of excavations and radiocarbon dating:

> Pioneer explorers called Lapita . . . reached both Tonga and Samoa by 1000 BC. The first eastwards movement farther into the Pacific is recorded for the Marquesas by AD 300. Thence went two groups, one to Easter Island by AD 400 and the other to Hawaii by AD 500. It is possible that another group went to the Societies shortly after their arrival in the Marquesas, but that thrust has not been proved. Certainly, a second movement to Tahiti (the Societies) occurred by AD 600 and from thence to New Zealand by AD 800. Secondary dispersals from Tahiti to Hawaii and New Zealand after AD 1000 are possible but debated (Jennings 1979:2).

Re-reading this summary, it is remarkable how faithful it remained to the old Fornander and Hiroa theories, at least in so far as Hawaiʻi is concerned. An initial migration ca. AD 500 from the Marquesas (e.g., Hiroa's "Menehune" people), was followed by the arrival of Tahitian voyagers after AD 1000 (e.g., the Māweke and Pāʻao voyaging sagas). Even though the new model was based on the scientific evidence of archaeology and radiocarbon dating, it was still one that Fornander clearly would have recognized!

The first book-length synthesis of Hawaiian archaeology, including a cultural sequence of four named phases, was published by Kirch (1985).[3] With respect to initial

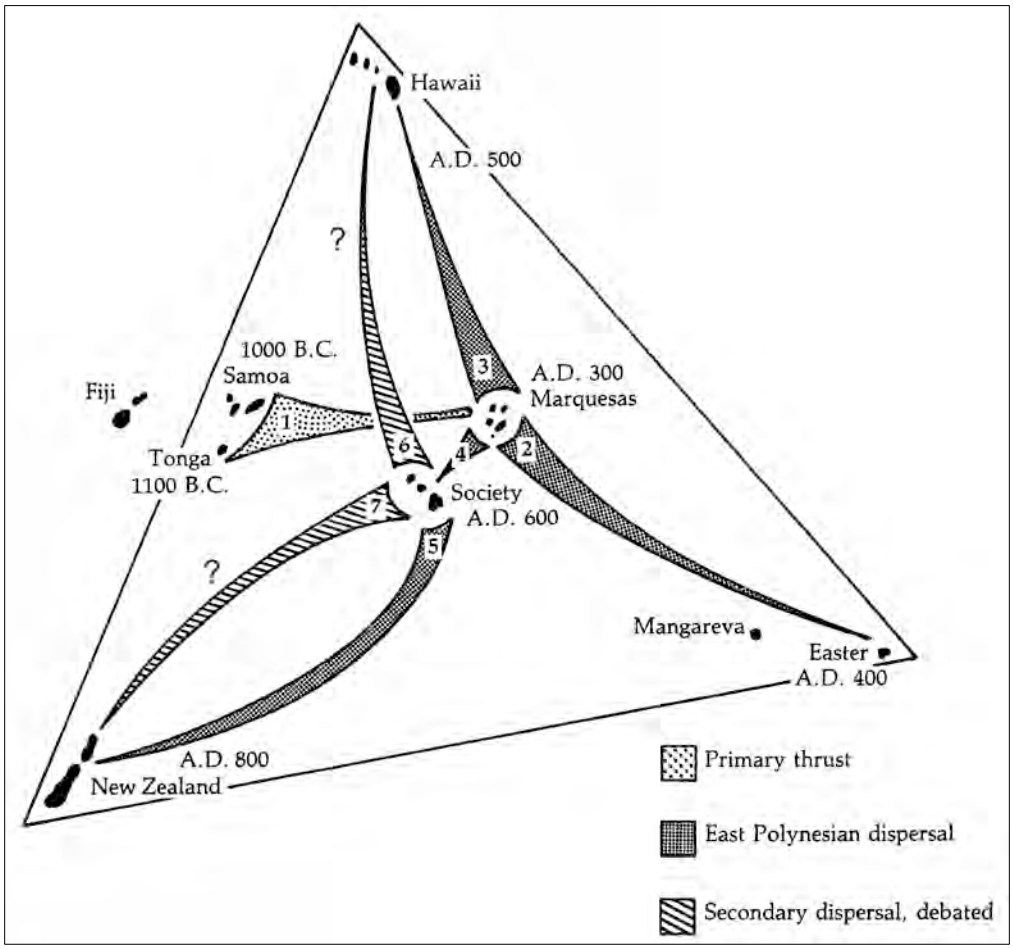

Figure 3. The orthodox model of Polynesian settlement as summarized by Jennings in 1979 (from Jennings 1979, fig. 3).

Polynesian arrival in the islands, Kirch wrote: "Although the information concerning the first few centuries of Polynesian occupation in Hawai'i is scant, there is sufficient evidence to state that the archipelago was colonized sometime during the three centuries prior to AD 600" (1985:298). He argued that Layer III at the O18 Bellows site, and Layer III at the Pu'u Ali'i sand dune site (H1) were the only two assemblages that could actually be assigned to this initial Colonization Period. Given the problems of radiocarbon dating at H1, the ascription of the Layer III assemblage there to this period was based on its material culture (especially adze and fishhook types). Kirch agreed with the orthodox synthesis in pointing to the Marquesas Islands as the immediate homeland of the voyagers who discovered Hawai'i. He also opined that "there is some element of historical reality in the Hawaiian traditions of multiple contacts" (1985:66), thus reinforcing the interpretation of a secondary phase of contact with the Society Islands.

As is often the case in science, just when a particular paradigm appears to be

unassailably constructed, cracks already have begun to appear in the foundations. Such was the case for the "orthodox scenario" of Polynesian settlement in the early 1980s. The model which was so succinctly summarized by Jennings (1979), based on the work of Emory, Sinoto, Green, Suggs, Golson, and others began to come under attack by the early 1980s. In a provocative essay, Irwin (1981) questioned whether there had actually been a significant "pause" in the eastward expansion of early Polynesians from Western Polynesia to Eastern Polynesia. Referencing the early dates of Suggs in the Marquesas, Irwin suggested that the loss of pottery may have made initial colonization sites in Eastern Polynesia less visible to archaeologists. Kirch (1986) followed with a more explicit critique of the "orthodox scenario" as this applied to Eastern Polynesia, arguing that the earliest settlement phases through the central Eastern Polynesian archipelagoes of the Societies, Marquesas, Cook Islands, and Australs were as yet inadequately defined. Again, the implication was that the "pause" between the initial Lapita settlement of Tonga-Samoa and central Eastern Polynesia may have been shorter than the orthodox scenario allowed for.

A very different perspective on Eastern Polynesian chronology was advanced by Spriggs and Anderson (1993). Influenced by radiocarbon dating developments in New Zealand which had increasingly supported a very late colonization of those large, temperate Eastern Polynesian islands (Anderson 1991), Spriggs and Anderson opined that there had been quite a long pause between the settlement of Western and Eastern Polynesia. They proposed applying "chronometric hygiene" to the available radiocarbon dates from Eastern Polynesian sites, eliminating from the body of evidence dates which did not meet a set of strict criteria. Using their method of screening, Spriggs and Anderson claimed that only for the Marquesas was there possible support for colonization ca. AD 300–600, with the "central, northern, and eastern archipelagoes" being settled ca. AD 600–950, and New Zealand between AD 1000–1200 (1993:211).

Refinements in Radiocarbon Dating

The "chronometric hygiene" approach advocated by Spriggs and Anderson (1993) was based in part on the increasing recognition of various problems with radiocarbon dating. Some of these had to do with laboratory methods (e.g., questions about pretreatment methods used by the Gakushuin Laboratory in Japan), while others concerned issues of sample type and collection. Many of the early ^{14}C dates, such as those obtained by Emory and his colleagues from the Hawaiian archaeology program in the 1950s, had rather large standard errors, a reflection of the crude solid-carbon counting methods first used by Libby and other pioneers of the radiocarbon method. The shift to gas-proportional counting, or to liquid scintillation counting methods, were significant improvements but the greatest advance came with Muller's use

of accelerator mass spectrometry or AMS (Muller 1977). By the late 1980s, AMS ^{14}C dating was rapidly becoming the standard, largely replacing the older laboratory methods. This advance in laboratory methods had two major consequences for archaeological dating: (1) standard errors were reduced; and (2) samples of relatively small size could now be dated. For charcoal, sample sizes as small as 10 milligrams could be dated by AMS, opening up the possibility of dating individual seeds or small twig fragments.

Equally important to the refinements in laboratory methods was the realization by archaeologists that they needed to pay close attention to the kinds of samples they submitted for dating. This was especially the case for wood charcoal, perhaps the most commonly dated material from Polynesian sites. In the early years of radiocarbon dating, when the crude laboratory methods required large sample sizes, there was a tendency to select the largest pieces of charcoal. Indeed, the entire contents of hearths or earth ovens (often including tens or even hundreds of individual charcoal fragments) were often submitted in bulk to the dating laboratory. The problem, of course, was that such samples in many cases included old growth timber, which had an "in built" age that was potentially much older than the time at which the wood was actually burnt in the hearth or oven. The date returned by the radiocarbon lab may have been an accurate indication of the age of the timber, but not of the "target date" of human use of the site. With many coastal sites, there was also the likelihood of old driftwood being collected and used for fuel. With dating materials other than charcoal, there were additional potential complications deriving from isotopic fractionation (especially in bone samples) and from reservoir effects (especially for marine shell or other materials grown in the ocean).

The most important step in developing new protocols for radiocarbon sample selection was the taxonomic identification of wood charcoal based on anatomical characteristics by comparison to a reference collection of known woody plant species for the particular region or island. In Hawai‘i, the first efforts at archaeological wood charcoal identification were made when Kirch, then directing several large projects for the Bishop Museum, approached University of Hawai‘i botanist Charles Lameroux about the problem. Lameroux's laboratory assistant, Gail Murakami started to develop a reference collection for Hawaiian wood charcoal, and she has continued to be the main contributor to Hawaiian and other Pacific wood identification (Murakami 1983). In the 1990s, Kirch also encouraged James Coil to establish a reference collection at Berkeley's Oceanic Archaeology Laboratory (Coil 2004). These and similar efforts have now made it possible for wood charcoal from Hawaiian and other Polynesian sites to be identified prior to ^{14}C dating. Most importantly, taxonomic identification allows the archaeologist to select short-lived species, and to reject wood samples that are likely to have a significant in-built age factor.

Unfortunately, not all archaeologists working Polynesia have availed themselves of the ability to identify their samples prior to dating; it is still necessary when reviewing suites of dates from particular sites to consider whether the samples in question meet the new standards for sample selection.

The methodological advances just summarized--both in laboratory methods and in sample selection criteria--have had a major impact on the evolving radiocarbon chronology for Eastern Polynesia. Targeted AMS re-dating of identified samples from previously excavated Eastern Polynesian sites such as Hane or Vaitoʻotia-Faʻahia (Anderson and Sinoto 2002) have typically shortened the chronologies for those sites, while dating of newly excavated sites such as the Tangatatau Rockshelter (MAN-44) on Mangaia (Kirch et al. 1995) or Onemea in Mangareva (Kirch et al. 2010) have failed to replicate the kinds of early first-millennium AD dates for initial Polynesian settlement obtained by Suggs or Sinoto. In short, the argument in favor of a "long pause" and a "short chronology" for Eastern Polynesia have been greatly strengthened by the advances in radiocarbon dating over the past two to three decades.

The Emerging Chronological Picture for Eastern Polynesia

Over the past decade or so, dating of a number of key Eastern Polynesian sites, using AMS radiocarbon methods on better controlled (identified) samples has lent considerable support to a "short chronology" whereby the central archipelagoes of Eastern Polynesia did not begin to be colonized until after AD 800 or later (Allen, 2004; Anderson et al., 1994, 1999; Anderson and Sinoto 2002; Conte and Anderson 2003; Green and Weisler 2002; Kirch et al. 1995; Rolett 1998; Rolett and Conte, 1995 Weisler 1994, 1995). Recently, Wilmhurst et al. (2011) have advanced claims that the settlement of all but the Society Islands occurred after AD 1190–1290; their argument, however, depends on a fairly extreme form of chronometric hygiene, which rejects dates on any samples other than charcoal from identified, short-lived taxa.

Most important from the perspective of Hawaiian settlement are the colonization dates for the Society Islands and the Marquesas, as these two archipelagoes have long been considered to be the immediate source regions for the first Polynesian voyagers to Hawaiʻi. For the Society Islands, the oldest dates potentially indicating a human presence are two ^{14}C dates on anaerobically preserved coconuts from water-logged sediments in the lower ʻOpunohu Valley on Moʻorea Island (Lepofsky et al. 1992), with ages of 1270 ± 60 and 1360 ± 60 BP, possibly indicating settlement by about AD 600. However, no cultural materials were associated with these putatively domesticated coconuts, and until confirmed by additional results, it is not certain that these dates indicate human activity on Moʻorea. The Vaitoʻotia-Faʻahia site on Huahine, originally thought to date as

early as AD 800–850, was re-dated by Anderson and Sinoto (2002). Although there is considerable range in the ages of the newly dated samples (Anderson and Sinoto 2002:Table 1, Fig. 1), they conclude that the "most reliable" suite of shell dates from the site has a range of about AD 1050–1450.

The Marquesas, as noted above, initially produced the earliest dates in Eastern Polynesia, as old as 150 BC in the case of Suggs's excavations at Haʻatuatua (Suggs 1961). The Hane dune site on Ua Huka Island, excavated by Sinoto (1966), yielded pottery and other artifacts similar to those from Haʻatuatua, and Sinoto's original suite of ^{14}C dates led him to propose that Hane had been settled as early as AD 300–600. Anderson and Sinoto (2002:Table 2, Fig. 2) dated ten new samples from Hane, with results indicating that the site ". . . was probably not earlier than about AD 1000, according to the lower calibrated ranges of the new results, and if actually around the medians would be dated approximately AD 1100–1200" (2002:251). In 2009, Eric Conte conducted renewed excavations at Hane. A suite of as yet unpublished radiocarbon dates from these excavations yielded results similar to the Anderson and Sinoto (2002) re-dating, again suggesting that the lowest levels at Hane are unlikely to be older than AD 900–1000 (Conte, pers. comm., 2010). These revised dates from Hane are also consistent with Rolett's dating of the earliest levels at the Hanamiai site on Tahuata Island, which are bracketed in the interval between AD 1025–1300 (Rolett 1998:241, Table 4.1). In short, the emerging chronological evidence from the Marquesas strongly suggests that initial Polynesian settlement of that archipelago was unlikely to have occurred before about AD 900, and may have been as late as AD 1000.

Emerging chronologies for other Eastern Polynesian islands are also relevant here. In the southern Cook Islands, the Tangatatau Rockshelter on Mangaia was occupied by around AD 1000, based on a large suite of ^{14}C dates (Kirch et al. 1995:55, Table 2). Kirch et al. (2010) recently published a suite of ^{14}C AMS dates from the Onemea site on Taravai Island in the Gambier (Mangareva) Islands indicating initial Polynesian colonization around AD 950. This age fits well with Weisler's claims for the colonization of Henderson Island no later than AD 1050, and possibly slightly earlier (Weisler 1995:389, Table 2). Despite Hunt and Lipo's claims (2006, 2008) that Rapa Nui was not settled until AD 1200, the full corpus of dates from the Anakena Dune Site (including those of Steadman et al. 1994) are also compatible with a colonization date of around AD 1000. In sum, the southeastern archipelagoes and islands of Eastern Polynesia have a set of radiocarbon chronologies now converging on the period from AD 900–1000.

With the caveat that the Society Islands might still prove to have initial settlement dates slightly earlier than elsewhere in Eastern Polynesia, the extensive re-dating of key sites and discovery and dating of new sites throughout central Eastern Polynesia strongly supports a "short chronology" that

begins no earlier than AD 900–1000. Given that this region is widely regarded as the immediate homeland for the first Polynesian settlers to Hawai‘i, the obvious implication is that Hawaiian colonization is unlikely to be earlier than around AD 1000.

Paleo-Environmental Evidence for the Initial Hawaiian Settlement

Evidence for human colonization of an island or archipelago can come from two different sources: (1) direct artifactual evidence from human settlements such as sand dune occupations or rockshelters; and, (2) indirect evidence in the form of proxy signals of anthropogenic disturbance, such as increases in charcoal fluxes in lake or swamp sediments, rapid changes in pollen frequencies in these sediments, or the appearance of commensal or synanthropic plants and animals such as weeds, insects, or rats. During the first few decades of Polynesian stratigraphic archaeology, the emphasis was almost exclusively on the search for early habitation sites. With the increased interest in an ecological or environmental archaeology from the late 1960s on, however, indirect evidence for anthropogenic disturbance on islands began to be considered in the debate on long versus short chronologies. The application of palynological analysis to lake and swamp sediments in Pacific islands has been especially important in this regard (e.g., Kirch and Ellison 1994).

Beginning in the early 1990s, Steve Athens and his collaborators applied the methods of sediment coring and palynology to a number of lake and swamp sites on O‘ahu Island, such as ‘Uko‘a Pond and Kawainui Marsh (Athens 1997; Athens and Ward 1993, 1997; Athens et al. 1992). Analysis of cores showed unmistakable signals of anthropogenic disturbance, especially with dramatic increases in microscopic charcoal (from near 0 in pre-human levels to 25 mm^2/cc in upper levels) and in significant declines in native plant taxa, especially the endemic palm *Pritchardia* and a now extirpated shrub *Kanaloa*. These data were revolutionary for the information they provided about changes to the O‘ahu landscape following Polynesian colonization and land use, but they also had potential to help establish the date of Polynesian arrival. In an influential article, Athens wrote:

> What, then, is the very earliest coring evidence we have for the Polynesian presence in Hawaii? The answer is approximately AD 800, which is from ‘Uko‘a Pond. The securest evidence is in the form of microscopic particulate charcoal, though it is also supported by the pollen evidence . . . Because particulate charcoal does not occur in sample intervals predating Polynesian occupation in any of our cores on O‘ahu, we feel confident that its presence in the ‘Uko‘a Pond core (and other cores) must be entirely due to anthropogenic causes (Athens 1997:266).

Figure 4 reproduces Athens’ plot of the ‘Uko‘a Pond charcoal concentrations. A ^{14}C date of approximately AD 800 (Athens did not publish the full details of the

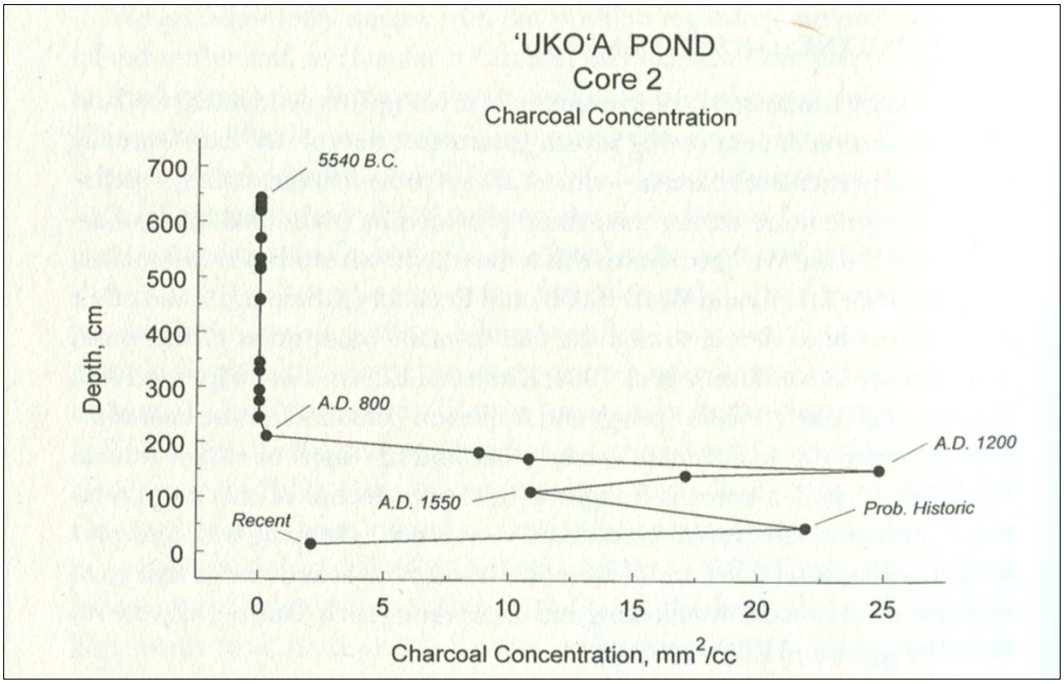

Figure 4. Athens' plot of charcoal concentrations in the 'Uko'a Pond core (Athens 1997:Fig. 12.7). Note that the dramatic rise in charcoal concentrations is bracketed between AD 800 and 1200.

radiocarbon dates from 'Uko'a Pond) is associated with the first presence of charcoal, while another date of AD 1200 is associated with a dramatic spike in charcoal concentrations. Thus, while Athens placed the approximate date of Polynesian arrival at AD 800, it would probably be more accurate say that a dramatic spike in anthropogenic charcoal is *bracketed by radiocarbon dates of approximately AD 800 and 1200*. In later work at the Ordy Pond on O'ahu, Athens et al. (1999) report that the first presence of charcoal is bracketed by two radiocarbon dates as between AD 1000–1100. And, a core in an inland location in Maunawili Valley on the windward side of O'ahu shows *Pritchardia* and other indigenous taxa beginning to decline after about AD 1200 (Athens and Ward 1997). In all, Athens' coring program on O'ahu makes it clear that by AD 1200 anthropogenic disturbance was widespread on the island. Thus initial Polynesian colonization must have occurred some time prior to AD 1200, but is unlikely to have been much before AD 1000.

On Kaua'i Island, the team of David and Lida Burney (2003) has applied sediment coring and dating of charcoal influxes to attempt to establish the earliest presence of Polynesians on various parts of the island. Their earliest reliable record for anthropogenic charcoal comes from Kekupua Fishpond on the island's southwestern coast. The first presence of charcoal in a 2.2 m deep core comes at 1.4 m and has an associated ^{14}C date of 830 ± 50 BP, or AD 1165–1260 when calibrated (at 1

s.d.). Burney et al. (2001; Burney and Kikuchi 2006) have also carried out extensive work in the Makauwahi limestone sinkhole, an extraordinary sediment trap yielding a rich record of biotic change on the island. Here the earliest indication of human presence is from the pelvis of a Polynesian-introduced rat (*Rattus exulans*), directly ^{14}C dated at 822 ± 60 BP, or AD 1160–1270 calibrated (at 1 s.d.).

Bones of *R. exulans* were also recovered from limestone sinkholes in the ʻEwa Plain on Oʻahu, where they are associated with the bones of extinct or extirpated avifauna, including large flightless ducks (*Thambetochen* sp.), and the shells of extinct endemic terrestrial gastropods (Athens et al. 1999, 2002; see also Christensen and Kirch 1986). Direct AMS ^{14}C dating on several of these rat bones also provides proxy evidence for initial Polynesian presence on Oʻahu, as these rats were commensal and introduced by humans. Figure 5 is a combined Oxcal probability plot of the two earliest dates from *R. exulans* bones from ʻEwa, with a highest probability calibrated age range of AD 970–1030 (at 1 s.d.), or AD 890–1040 (at 2 s.d.).

Some scholars are reluctant to use the kinds of proxy indicators of anthropogenic disturbance described above as evidence for human arrival on islands, and have rejected dates on charcoal in sediment cores or on rat bones (e.g., Wilmhurst et al. 2011). This seems to me to be an extreme application of "chronometric hygiene." In the case of Hawaiʻi, the dates from numerous sediment cores, combined with direct AMS ^{14}C dating of rat bones, has provided a consistent set of dates strongly indicative of human presence on Oʻahu by around AD 1000, with evidence for *widespread* anthropogenic disturbance by AD 1200. For Kauaʻi, initial human presence is indicated by at least AD 1200.

Re-Evaluating "Early" Hawaiian Sites

The final set of evidence to consider before returning to the question of when the Hawaiian Islands were first settled by Polynesians is the radiocarbon evidence from the handful of habitation sites which had been proposed as belonging to the earliest phases of the Hawaiian cultural sequence (Kirch 1985). For the South Point, Hawaiʻi Island sites there has been no recent attempt at re-dating, although the older sets of radiocarbon dates have been reassessed (Dye 1992). Combining the four most consistent ^{14}C dates on charcoal from Layer II at site H8 (Emory and Sinoto 1969:Table 1) yields calibrated age ranges of AD 1040–1090 and 1120–1280 (at 1 s.d.), which would be consistent with the general time frame suggested by the paleoenvironmental evidence just reviewed, and with the emerging chronologies for Eastern Polynesia. Nonetheless, it would be desirable to attempt to re-date the base of site H8 (and possibly also Layer III at H1) using AMS methods, if suitable samples can be located in the Bishop Museum collections.

A second site for which claims of relatively early settlement had been advanced is the Hālawa Dune Site (Mo-A1-3) on Molokaʻi

(Kirch and Kelly 1975). Kirch and McCoy (2007) submitted six samples from the original 1969–70 excavations for AMS ^{14}C dating. Based on the results of this re-dating combined with a re-analysis of the original suite of dates, Kirch and McCoy conclude that the Hālawa site dates no earlier than about AD 1300, with the main occupation phase dating to between AD 1400–1650 (2007:402).

This leaves only the Bellows Dune site (O18) at Waimānalo, Oʻahu, as having a possible claim of dating with the period of initial Polynesian settlement of the Hawaiian archipelago. In an attempt to establish the age of the deeper stratigraphic deposits at O18, Dye and Pantaleo (2010) dated seven samples obtained during the original 1967 excavations, selecting only short-lived materials. Based on the new results, and using a Bayesian statistical framework, they conclude that the O18 site was "established in AD 1040–1219" (2010:113). Dye and Pantaleo argue that this was "some 260–459 years after the current estimate of first settlement" of Hawaiʻi. That argument, however, is based on the acceptance of AD 800 as the date of Polynesian colonization of the islands, following Athens (1997). As I have pointed out above, the ʻUkoʻa core from which Athens derived the AD 800 date actually only shows anthropogenic influences occurring between approximately AD 800 and 1200. Dye and Pantaleo's new dates for O18, in my opinion, establish the site as the earliest documented habitation in the Hawaiian Islands. Their estimate of AD 1040–1219 is only marginally later than the earliest dates on *Rattus exulans* bones from the ʻEwa Plain (see Figure 5). This is not to say that the Bellows Dune site is the "ur-colonization" settlement for Hawaiʻi. But it does strongly hint that the O18 occupation dates to within the first century of Polynesian arrival in the archipelago.

When Was Hawaiʻi First Settled?

In this paper I have endeavored to trace the efforts--over more than a century and a half--of various scholars to determine the approximate time when Polynesian explorers first made their remarkable voyage from central Eastern Polynesia, across the doldrums and into the North Pacific, to discover Hawaiʻi. Fornander and Hiroa were limited to Polynesian oral traditions calibrated to chiefly genealogies, but thought that this event occurred sometime in the mid-first millennium AD Emory applied linguistic analysis to arrive at a date of AD 1150. But with the advent of stratigraphic archaeology and radiocarbon dating, it appeared for a time that the date of initial settlement would be pushed back considerably, possibly to the beginning of the first millennium AD. Then a long process of scientific investigation and self-correction set in. The initial uncritical enthusiasm for radiocarbon dating was replaced by a more sober realization that radiocarbon dating was complicated, and that the early methods need improvement. Archaeologists began to pay attention to issues of sample type and selection. In the half-century that has passed since Emory

and Sinoto obtained their first ^{14}C dates from Kuli‘ou‘ou, South Point, and other Hawaiian sites, we have made huge strides forward in the hard work of establishing solid cultural chronologies throughout Polynesia.

To the question of “when was Hawai‘i first settled by Polynesians” I would answer with the following three points:

1. Although the debate over the chronology for Polynesian expansion into Eastern Polynesia still continues (e.g., Wilmhurst et al. 2011; Mulrooney et al. 2011), there is no question that some form of “short chronology” has prevailed. With the exception of the Society Islands (for which our database for early settlement remains inadequate), none of the main archipelagoes and islands of central Eastern Polynesia are likely to have been colonized by Polynesians before AD 900–1000. Since this is the immediate homeland region from which the voyagers to Hawai‘i are presumed to have come, a lower bound on the settlement date for Hawai‘i also has to be AD 900–1000.
2. The “proxy” paleoenvironmental evidence for human presence in Hawai‘i, which for now comes almost exclusively from O‘ahu and Kaua‘i Islands, leaves no doubt that human activities were creating significant disturbances on both of these islands by AD 1200. This then sets an upper bound on Polynesian settlement at this time. Moreover, the earliest dates on human introduced *Rattus exulans* bones on O‘ahu are consistent with Polynesian arrival around AD 1000.
3. Re-dating of the O18 site at Bellows, Waimānalo, O‘ahu puts the occupation of that small hamlet at between AD 1040–1219. Obviously, this range falls closely between the lower and upper bounds indicated by the Eastern Polynesian chronologies and the paleoenvironmental evidence.

In my view, it is now reasonable to argue that the first arrival of Polynesians in Hawai‘i is unlikely to have occurred much before AD 1000, although the event could conceivably have been sometime in the 10th century. There is also no question that at least O‘ahu and Kaua‘i islands were already well settled, with local populations established in several localities, by AD 1200. Beyond this I fear it would be dangerous to tread. But the research will continue, and with future improvements in methods accompanied by the inevitable serendipity that archaeologists know they must depend on, we may yet narrow down the time frame of Polynesian discovery of this most amazing archipelago.

Notes

1. This article is based upon the Keynote Address delivered to the Society for Hawaiian Archaeology at the 2010 Annual Meeting at Wailua, Kaua‘i.

2. The main excavation at O18 took place during the summer of 1967, as a University of Hawai‘i field school. Although still a Punahou student at the time, I participated in the excavation at Pearson’s invitation, and later helped to analyze the collections.

3. Although published by the University of Hawai‘i Press in 1985, the manuscript was based on lectures given by Kirch at the University of Hawai‘i in the early 1980s.

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