SHORTER COMMUNICATION

CHRONOLOGY IN KAUA‘I:
COLONISATION, LAND USE, DEMOGRAPHY

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The compilation and publication (Carson 2005a) of 272 radiocarbon dates from confirmed archaeological contexts in Kaua‘i Island of the Hawaiian Archipelago provide a substantive basis to address a number of chronological questions. In this article I will use this data compilation to address three topics: the timing of island colonisation, the chronology of land use, and some implications for palaeodemography. The timing of colonisation is of chief concern, given some unusually early dates of the first centuries A.D. in Kaua‘i (Kirch 1985:87) that stand in contrast to a growing body of evidence supporting later dates of colonisation in the archipelago, which are closer to A.D.1000 (Athens et al. 2002, Masse and Tuggle 1998, Spriggs and Anderson 1993, Tuggle and Spriggs 2001). The evident trend in radiocarbon dates regarding colonisation reflects chronological development in land use intensity over the past several centuries, which is arguably related to population size.

A synthesis on an island-wide scale is especially instructive, because most chronological models are based on scattered fragments of incomparable data. The island-wide chronology provides a baseline for comparison of specific sites, valleys, or districts. It also provides a robust basis to compare with syntheses from other islands as they continue to develop (e.g., Weisler 1989), which may eventually lead towards updated archipelago-wide or even larger chronologies.

ANALYTIC PROCEDURES

The raw data for this analysis are 272 radiocarbon dates for charcoal samples from definable archaeological contexts in Kaua‘i Island. All dates were calibrated at 2 Sigma (95.4% probability), using the OxCal programme (Bronk Ramsey 2001) and standard atmospheric data (Stuiver et al. 1998).

In accordance with the protocol for “chronometric hygiene” (Spriggs 1989, Spriggs and Anderson 1993), the most obviously unacceptable dates were excluded from the Kaua‘i radiocarbon database. The immediately rejected dates are those involving terrestrial gastropod shells, sea urchin spines, non-cultural organic sediments, dispersed charcoal of mixed association, poorly documented context, lack of $^{13}\text{C}/^{12}\text{C}$ ratio correction, potential laboratory errors in sample processing, and one marine shell specimen of unknown stratigraphic provenience. In addition to these factors, Dye (1994a, 1995, 2000) reviews a number of problems with radiocarbon sample material and histogram interpretation that create misleading results in Hawaiian archaeology.
It is important to note that all samples successfully passing this protocol have been reported since 1980 from Beta Analytic, with the overwhelming majority since 1990. These results were unavailable during the first efforts at establishing archipelago-wide radiocarbon chronologies (Cordy 1974, Kirch 1974, 1985:298-308). A considerable portion of the data was unavailable to important revisions and critiques of the Hawaiian chronological sequence (Kirch 1990, Spriggs and Anderson 1993). Likewise, the present database will need to be updated and reviewed in accordance with future work.

Although not excluded from the database, a few dates may be considered dubious when revealed as clearly anomalous in comparison to others from the region. Specifically, dates not overlapping with others at the 2 Sigma range may be disregarded when other samples from the same contexts fail to replicate the same results. These early dates were retained in the database in recognition that future research may address them more thoroughly than has been possible so far. For instance, sample Beta-1240 from the Halele‘a District is calibrated A.D.590 to 970 (Schilt 1980), but this 2 Sigma range does not overlap with other dates from the same context at the

Figure 1. Traditional districts of Kaua‘i, noting geographic distribution of archaeological radiocarbon dates.
site (Athens 1983). Another example is sample Beta-29594 from the Kona District that is calibrated A.D.150 to 800 (Walker et al. 1992) and clearly anomalous when compared to others in the general vicinity. In both of these cases, the wide error range in the 2 Sigma calibration points to inherent imprecision and likely unreliability. These and other anomalies are retained in the database, but they appear questionable at best when compared to other results.

When compiling the radiocarbon data, I recognised three major problems, each of which could be rectified by more attentive work and proper funding. First, the sample context was not always what it was reported to be. Upon further examination of available documentation, samples purportedly from surface architectural features were found actually to be from underlying deposits pre-dating the features of interest. Dye (2004:127-29) has noted a similar problem in many projects throughout Hawai‘i. Second, taxonomic identification was performed for less than 20 of the 272 charcoal samples, so the possibility of in-built older age in long-lived specimens cannot be assessed (Dye 2000). Third, numerous excavation projects involved no radiocarbon dating whatsoever, even when charcoal samples were collected from known stratigraphic contexts.

THE KAUA‘I RADIOCARBON DATABASE

The results are reported by traditional districts (moku‘āina) of Kaua‘i, including Kona, Puna, Ko‘olau, Halele‘a and Nā Pali (Fig. 1). Despite an imbalance in the number of dates from each district, much the same overall trend can be noted in the ratio of dates per time interval. I have already published a complete list of the 272 dates (Carson 2005a) and only present a brief overview here (Fig. 2).

Kona District

The Kona District produced 134 (49.3%) of the 272 radiocarbon dates, from a total of 22 separate project areas. Very few dates (N=10 or 7.5%) calibrate before A.D.1300 to 1400. One of these has a wide potential calibration range of A.D.150 to 800, and it is unsupported by other dates from the same site or any other in the district. The other nine earliest dates include a few with ranges potentially slightly before A.D.1000, but their potential ranges also extend much later than A.D.1000. Most of the dates (N=81 or 60%) post-date A.D.1400.

Puna District

The Puna District generated 49 (18%) of the 272 radiocarbon dates, from 12 separate projects. Only three dates (6%) calibrate approximately A.D.1000 to 1400. Another three (6%) are within the range of c.A.D.1250 to 1650. All 43 others (88%) post-date A.D.1300 and are mostly later than A.D.1400.

Ko‘olau District

The Ko‘olau District provided 16 (5.9%) of the 272 radiocarbon dates, obtained from nine investigations. Despite the small number of samples, the results are
comparable with those from more intensively sampled districts. Just one of the 16 dates (6%) calibrates A.D.1030 to 1260. Another one (6%) calibrates A.D.1250 to 1530. All 14 others (88%) post-date A.D.1300 and are mostly after A.D.1400.

**Halele’a District**

The Halele’a District yielded 66 (24.3%) of the 272 radiocarbon dates, from a total of 25 study areas. Some of these dates were obtained for multiple layers in stratified sites. One date (2%) is calibrated A.D.590 to 970, and it is a statistical outlier even in relation to other dates from the same site. Four (6%) of the district’s dates calibrate c.A.D.1000 to 1400. Most of the dates (N=50 or 75%) are later than A.D.1300 and most are after A.D. 1400.

**Nā Pali District**

The Nā Pali District offered a meagre seven (2.5%) of the total 272 radiocarbon dates in the present analysis, and come from just three study areas. Six (85.7%) are later than A.D.1400. A single date (14.3%) calibrates A.D.1290 to 1450. Claims of occupation as early as A.D.1000 to 1200 at the well preserved, stratified coastal site of Nu‘alolo Kai (Site 50-30-01-196) have been overturned (Soehren and Kikuchi n.d.), but renewed excavations (Hunt 2005) indicate an earliest occupation of this site around A.D.1290 to 1450 (see also Graves et al. 2005). Five charcoal-based radiocarbon samples from the original 1958 to 1964 excavations (Soehren and Kikuchi n.d.) were excluded from the radiocarbon database because of two technical problems: (i) they did not undergo $^{13}\text{C}/^{12}\text{C}$ ratio correction, so their conventional dates are not known, and (ii) three of these five samples were processed by the Gakushuin Laboratory, known to have produced anomalously old dates. Moreover, the earliest of the five dates was out of stratigraphic order. A re-excavation in 1990 provided more secure dates without the original technical problems (Hunt 2005).

**THE TIMING OF COLONISATION**

For the assessment of an initial date of colonisation this study does not distinguish the type of activity represented by different radiocarbon dates. Rather, all dates are regarded equally as indication of human activity in the most general sense. To address activity-specific research questions, a smaller sample size of radiocarbon dates is available.

The Kaua‘i radiocarbon database confirms that humans were active at multiple locations in the island within the date-range of A.D.1000 to 1300. Four dates are calibrated with wide ranges potentially a few centuries earlier than A.D. 1000, but also potentially a few centuries later. Only two of the 272 dates have calibrated ranges entirely pre-dating A.D.1000, and they have not been replicated by additional investigations in the same areas.

The archaeological data are consistent with palaeoenvironmental investigations into the first anthropogenic impacts in the Kaua‘i environment. An influx of charcoal (probably from forest-clearing), the appearance of the Polynesian-introduced rat
(Rattus exulans), the initial loss of native flora and fauna (presumably by human agency) and other environmental evidence indicate A.D.1000 to 1250 as the earliest period of human-induced environmental change in multiple locations around Kaua‘i (Burney 2002, Burney et al. 2001, Burney and Burney 2003).

The radiocarbon data may be compared to Wichman’s (2003:117-31) review of Kaua‘i chiefly genealogies, based mainly on information recorded by Fornander (1969:92-95, 181-91, 248, 291-98). About the time of Moikeha c.A.D.1280, chiefs traced their ancestry to Nana-‘ulu c.A.D.830 (Wichman 2003:124-25). According to oral traditions, Nana-‘ulu sailed from a homeland somewhere south of the Hawaiian Islands, but Kaua‘i was reportedly already inhabited when he arrived there. Genealogies and events before this time are obscure, but Wichman (2003:120-21) proposes that colonisation in Kaua‘i occurred about A.D.500 to 600, and was associated with the Kū‘alu and Lohi families.

At face value, the oral traditions may be interpreted to suggest that Kaua‘i populations were established by A.D.830, with some form of smaller scale occupation as early as A.D.500 to 600. However, the proposed dates need to be evaluated cautiously, given inherent problems with genealogical reckoning, such as uncertain number of years per generation, possible reinvention or restructuring of genealogies to suit political ends, potential memory of lineages before colonisation of the Hawaiian Islands, and other factors. Dates earlier than A.D.800 would be outside the range of what is expected from archaeological and palaeoenvironmental evidence, but slightly later dates would correlate with the radiocarbon chronology.

Kaua‘i has been regarded as having some of the earliest archaeological sites in the Hawaiian Islands (Kirch 1985:87), yet the current review indicates that colonisation did not occur any earlier than elsewhere in the archipelago. The results agree with the conclusion by Athens et al. (2002) that substantial human impacts were evident by A.D.1000 in O‘ahu Island, with less intense activity perhaps as early as A.D.700 to 800 (see also Masse and Tuggle 1998, Tuggle and Spriggs 2001). This pattern may be applicable for the archipelago as a whole, but data from others islands are yet to be synthesised in order to make that claim.

**LAND USE CHRONOLOGY**

The frequency of radiocarbon dates over time (see Fig. 2) portrays the overall trend in the intensity of land use for Kaua‘i Island. Without specifying what kind of activity is associated with each dated context, the dates are pooled as generic evidence of land use. This generalised land use refers to archaeological deposits of residences, short-term campsites, cultivation areas, religious structures and other activity spaces.

The overall trend shown in Figure 2 progresses at an even exponential rate, interrupted by a marked frequency increase after A.D.1400. After the approximately 200-year interval of c.A.D.1400 to 1600 a relative decline in dated activities returns to the overall trend established in earlier centuries. For radiocarbon dates in this later period, calibrations almost entirely date after A.D.1600.

The peak activity period c.A.D.1400 to 1600 must be understood as an exceptional interruption in an otherwise even intensification of land use. The overall frequency
of dates progressively increases in each successive time interval, with the exception of a spiked increase in the c.A.D. 1400 to 1600 interval. During this period, the scope of human activities demanded the creation of more numerous (and perhaps larger and longer-lasting) use-areas than at any other time period. This change could suggest a population increase, or could reflect a change in the scale or scope of what the population was doing at that time.

Figure 2. Overall trend in calibrated Kaua‘i radiocarbon dates. Individual dates are presented elsewhere (Carson 2005a). Calibrations are for complete 2 Sigma (95.4% probability) ranges, using OxCal (Bronk Ramsey 2001) and standard atmospheric data (Stuiver et al. 1998).
With regard to the range of activities occurring during the apparent land use explosion c.A.D.1400 to 1600, the existing data are unsatisfactory. More than half of these dates refer to subsurface cultural layers of unknown functional association, which investigators mistakenly associated with overlying surface stonework ruins that actually post-date the subsurface layers. This error is embarrassingly common throughout the archipelago (Dye 2004:127-29). Nonetheless, the dated layers yielded charcoal, some artefacts, occasional faunal remains and a number of artificial pit features.

Carson (2005b) has established that a sample of dates from the Halele’a District mark the construction and initial use of irrigated taro terraces c.A.D.1400 to 1600 (see also Athens 1983) that apparently coincide with the overall period of high-intensity land use (Fig. 3). The cultivation fields continued to be used in later periods, and abandonment dates may be estimated by the presence of materials of post-contact origin on or near the surface of most sites. In most cases, though, available radiocarbon dates tend to refer to the time of initial construction rather than the time of remodelling or abandonment.

Artificial fishponds present another opportunity to date the beginning of large-scale production systems in Kaua’i. Palaeoenvironmental investigations of ‘Alekoko Fishpond in the Puna District indicate the onset of artificially enclosed conditions close to A.D.1400 (Burney 2002:21-23, Burney and Burney 2003:215-18, Carson 2005c:69-70). More research is needed at a greater number of fishponds before the overall chronological pattern can be determined, but the limited results so far appear to be compatible with the c.A.D.1400 to 1600 range for large production systems in general.

The creation of large-scale production systems and associated support areas certainly could be responsible for the peak of land use c.A.D.1400 to 1600. This form of land use was unprecedented before about A.D.1400, and it involved the transformation of large areas into permanent infrastructure. For constructions intended for long-term use (as in the case of field systems, community event structures, monumental complexes, etc.), the basic infrastructure would not need to be replicated at later time intervals. A period of large-scale building therefore would be over-represented in the archaeological record, and this may be the case for the c.A.D.1400 to 1600 period in Kaua’i.

Hence I propose, tentatively at least, a model arguing for a change in land use about A.D.1400 that involved a widespread construction surge, and that at least part of this activity included large sites or complexes intended for long-term use in multiple places. Archaeological features of this proposed “construction boom” are over-represented in the archaeological record, so that a random survey is more likely to encounter features of this time period than of any other. This model is only proposed here, and more research is needed to address its validity.

Most unfortunately, many of the previously dated cultural occupation layers cannot be associated clearly with specific types of activities other than a generic category of anthropogenic land use. The layers contain artefacts, food remains and charcoal characteristic of general occupation debris, but they cannot be associated with specific use-contexts, such as residential sites, community event areas, religious precincts, workshops, etc., owing to poor documentation at the time of excavation. Only limited evidence is available to assess the date ranges of known activity types, comparable to that for the Halele’a agricultural fields noted above.
Nearly all of the Kaua‘i radiocarbon dates are from coastal areas, so that the relationship between coastal and upland locales cannot be analysed meaningfully. Consistent with the overall pattern, the inland dates are mostly post-A.D.1400, but a few are in the range of A.D.1200 to 1400. The earliest inland dates are slightly later than the earliest coastal dates, but more primary data will be needed to address the coastal-inland relationship.

No significant difference is evident between windward and leeward areas. Although wet windward valleys offered favourable conditions for traditional Polynesian settlement and land use (Cordy 1974, Kirch 1974), other zones supported equally early activities and much the same overall temporal trend, though the exact scope of past activities is unclear in many cases.

**IMPLICATIONS FOR PALAEODEMOGRAPHY**

The date of A.D.1000 can now be viewed as the practical starting point for human population growth in Kaua‘i. Existing palaeodemographic models have struggled with the previous ambiguity of this date, and some have used a date several centuries too early (Nordyke 1989; Schmitt 1968, 1971; Stannard 1989). Irrespective of whether the colonisation process involved phases of discovery, low-impact settlement and later establishment (Graves and Addison 1994), the empirical evidence of earliest human activities in Kaua‘i points to A.D.1000.

The overall trend of increasing numbers of radiocarbon dates (see Fig. 2) is probably a reasonable reflection of the rate of population growth, operating under the premise that the number of dated sites per time interval is a function of the population size at that time (Dye 1994b, Dye and Komori 1992). Calculating actual numbers of people, however, cannot be done purely on the basis of the radiocarbon dates. Some other information is needed, for instance, an estimate of the number and size of residential sites per time period might be useful (Clark 1988). But this information is at present lacking, especially for the earliest sites.

An exception to the overall trend, as discussed above, is associated with the “building boom” of about A.D.1400 to 1600, when people created more numerous, larger and longer-lasting sites in Kaua‘i. This should not necessarily be interpreted as a population explosion. Likewise, a relative decline in radiocarbon date frequency after A.D.1600 does not necessarily indicate an actual population decline. Rather, the evidence may reflect the long-lasting nature of the sites constructed in the A.D.1400 to 1600 interval. From this perspective, the apparent post-A.D.1600 decline refers to the number of new site constructions. This model is based on limited evidence presently available, and more again should be tested.

For the whole Hawaiian archipelago, Dye (1994b) noted almost precisely the same overall trend as well as the apparent peak of activity around A.D.1400 to 1600 (see also Dye and Komori 1992). The earlier archipelago-wide analysis of 599 dates from multiple islands (Dye 1994b, Dye and Komori 1992) included less than 100 of the 272 entries in the Kaua‘i radiocarbon database (Carson 2005a). Nonetheless, the consistency of results is encouraging, and to some extent it suggests the long-term value of the currently available data. The data from both analyses are considered robust and reliable, although interpretations of the data may change.

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Some aspects of the present work will be out-dated when substantially more data become available, but the major trends and patterns are established for Kaua‘i Island. The Kona, Puna and Halele‘a Districts are well sampled, and future data may refine but probably will not contradict the currently reported patterns. The Ko‘olau District dates are small in number but with a fair distribution, and additional data will most likely alter this distribution to some degree. The Nä Pali District dates are at present too few to establish a meaningful district-level trend, and additional data certainly would be significant.

Human activity is unambiguous after A.D.1000. A slight possibility of dates as early as A.D.800 may be retained for a colonising period with minimal physical impact. If colonisation occurred before this time, then it resulted in virtually no physical trace in the archaeological and palaeoenvironmental records. The negative evidence before A.D. 1000 is compelling, given the sensitivity of these island ecosystems to foreign agents, including humans, their introduced plants and animals, and other direct and indirect effects of their presence (Athens 1997, Athens et al. 2002).

The evident colonisation date for Kaua‘i accords with recent models based on data from O‘ahu Island (Athens et al. 2002, Masse and Tuggle 1998, Tuggle and Spriggs 2001). Before the availability of these syntheses, other researchers had suggested a longer chronology for Hawaiian settlement, extending as early as the first centuries B.C. (Graves and Addison 1994, Hunt and Holsen 1991). Colonisation closer to A.D.1000 appears to be the general pattern for the archipelago, and it may be consistent with the timing of colonisation elsewhere in the periphery of East Polynesia (Hunt and Lipo 2006, Peartree and Di Piazza 2003, Spriggs and Anderson 1993).

The Kaua‘i radiocarbon database reveals inflation in dates at c.A.D.1400 to 1600, coinciding with the development of agricultural systems in the Halele‘a District (Carson 2005b). The same timing also relates to the creation of at least one dated fishpond in Kaua‘i (Burney 2002:21-23, Burney and Burney 2003:215-18; see also Carson 2005c). The period c.A.D.1400 to 1600 is consistent with dates for intensified economic production from other parts of the archipelago, not only for subsistence but also for other resource needs (Athens and Kaschko 1989; Athens et al. 1991; Carson and Mintmier 2006a, 2006b; Cordy 2004; Godby and Carson 2004:81; Hommon 1976, 1986; Kirch 1985:284-308; McCoy 2005). If indeed activities in this period created more numerous, larger and longer-lasting sites than in any other time period, then sites of the period c.A.D.1400 to 1600 are likely to be over-represented in the archaeological record. This apparently archipelago-wide trend could be associated with the strengthening and expansive growth of regional polities (Kirch 1990), but substantive research has yet to establish a logical relationship between such intangible social variables and archaeological data.

The shortened chronology for Kaua‘i (beginning about A.D.1000) bears important implications for nearly all chronological research topics, because it constrains the time range within which various events and processes could have occurred. Population growth models need to be revised to start about A.D.1000. On the basis of the radiocarbon-dating results, current understandings of internal cultural developments dependent on population size and density need to be revised, e.g., the formation of diverse groups and sub-groups, the expansion of communities and territories, a more complex development of social and political orders, and the potential stress on an island’s economic carrying capacity.
To the extent that so-called “island laboratories” represent microcosms of the world (Kirch 1997, MacLeod and Rehbock 1994), the present work and further research may have wider significance. The Kaua‘i radiocarbon database, land use chronology and implications for palaeodemography provide a solid basis to pursue countless other topics regarding human/environment relations. Specific cases studies may suggest solutions for human/environment relational problems confronting the modern world (Diamond 2005). Kirch (2004:23) has written that such work “may be the most important contribution any of us will make to the future of this planet”.

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REFERENCES


Ngā Mōteatea: The Songs
PART THREE

A. T. NGATA
AND PEI TE HURINUI JONES

Over a period of forty years Sir Apirana Ngata, distinguished leader and scholar, collected and recorded hundreds of songs and chants from the iwi of Aotearoa, which became the four volumes of Ngā Mōteatea, with translations and annotations by Ngata and Pei Te Hurinui Jones. This is the third volume of a new edition of this national treasure, the largest and most comprehensive collection of Maori waiata and a unique contribution to New Zealand poetry. It is a rich resource for continuing research and scholarship in many fields, offers prime texts in the teaching of Maori language, literature and tribal history and serves as inspiration for contemporary composition and performance.

This completely redesigned and reset edition, published in association with the Polynesian Society and with assistance from Creative New Zealand, preserves the integrity of Ngata and Pei’s texts and their commentary. Long vowels in Maori have been macronised and changes have been made to conform to current usage with correction of errors in grammar, spelling and punctuation. Typography has been modernised. This edition also includes an audio CD of waiata drawn from the Archive of Maori and Pacific Music at the University of Auckland.